

# **ROMOD: A DYNAMIC CGE MODEL FOR ROMANIA**

## **A TOOL FOR POLICY ANALYSIS**



**RoMod: A Dynamic CGE Model for Romania**

**A Tool for Policy Analysis**

*RoMod: Een dynamisch CGE model voor Roemenië*

*een instrument voor beleidsanalyse*

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# Chapter 1

## Introduction

### 1.1. Economic context

The beginning of the 1990s witnessed the collapse of communist regimes in the Central and Eastern European countries (CEEC) and the Soviet Union, followed by the dissolution of the Soviet Union in 1991. Campos and Coricelli (2002, p.794) show that presumably, the transition of these countries towards market oriented economies “will join the Great Depression as one of the most important economic events of the last century”.

At first, the ex-communist countries seemed fairly well prepared for the transition process: they had reached a certain degree of industrialization, had an educated labor force, and a minimal population growth rate. They were facing a technologic lag, but that seemed to be a surmountable problem, given the expected aid and inflow of know-how from the developed Western European countries (Campos and Coricelli, 2002). Fourteen years later, however, the results of the transition appear to be mixed. Although most of the Central and Eastern European countries have been recognized as functioning market economies, they still have to overcome major structural economic problems. The transition process took much longer than expected and gave rise to high social costs. Furthermore, the former Soviet Union countries have still a long way to go before becoming functioning market economies.

The transition process generated considerable interest among economists and policymakers. For the economists it provided a unique laboratory to study economic policies, structural changes and the development of capitalism from its initial stages, by evaluating the impact of free markets, institutions, and democracy on the economy. For the policymakers it raised the awareness that the transition process should be better understood in order to cope with the restructuring of these economies. Neither economists nor policymakers were well equipped for the long transition process that started in the beginning of the 1990s. The economists did not grasp the scope and the complexity of the phenomenon that took place in the former

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Eastern block. The policymakers had no experience in dealing with such a vast institutional change and in designing appropriate structural adjustment programs. As a result, several strategies ranging from the “shock therapy” to the more gradualist approaches have been proposed and carried out in attempts to restructure the transition economies. Great efforts have been made to introduce incentives for entrepreneurship and to develop small and medium size enterprises and to restructure and privatize the state-owned enterprises. Most adjustment programs merely emphasized liberalization and privatization and overlooked the importance of building market-supporting institutions (Kolodko, 2001).

Another major economic event in the late 1990s has been the formal invitation by the European Commission to start accession negotiations with ten Central and Eastern European countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Eight of them joined the EU in May 2004, while Romania and Bulgaria are expected to join in January 2007.

The EU membership has raised additional challenges for both economists and policymakers. One of the most important tasks is to estimate the socio-economic costs and benefits for the new member states and the EU-15. For Romania and Bulgaria, the effects of the regulatory adjustment in the process of preparation for the EU accession should be further evaluated. Thus, the past few years witnessed an increased need for developing economic tools that could assist policymakers in the decision making process.

The focus of this study is on Romania, a middle-income Eastern European country which started the transition towards a market oriented economy in the beginning of 1990. Romania has been formally invited to start the negotiations for EU accession in 1999. Thus, during the past few years policymakers have faced the challenge of complying with the EU requirements, which include the meeting of the 1993 Copenhagen European Council criteria and the adoption of the “*Acquis Communautaire*”.

Romania has been recognized as a functioning market economy in 2004 (European Commission, 2004) but further efforts are needed in restructuring the economy while maintaining the macroeconomic stability. Although progress has been made in price liberalization and privatization, the delays in enterprise restructuring, the low financial intermediation and the weaknesses in corporate governance have held back the development of the private sector (see table 1.1) and left Romania behind all the other EU accession countries. Furthermore, the completion of the EU accession requires institution building and the reform of the judicial systems and public administration, while additional investments in infrastructure and environment are needed (EBRD, 2003). A reasonable level of alignment with the EU *acquis* has been achieved in most of the areas, with all chapters being closed in the accession negotiation process by the end of 2004.

**Table 1.1. Transition indicators of EU accession countries, 2003**

	Small scale privatization	Price liberalization	Trade and foreign exchange system	Large scale privatization	Governance and enterprise restructuring	Competition policy	Banking reform and interest rate liberalization	Securities markets and non-bank financial institutions	Infrastructure reform
Bulgaria	4-	3	4+	4-	3-	2+	3+	2+	3-
Czech Republic	4+	3	4+	4	3+	3	4-	3	3
Estonia	4+	3	4+	4	3+	3-	4-	3+	3+
Hungary	4+	3+	4+	4	3+	3	4	4-	4-
Latvia	4+	3	4+	3+	3	3-	4-	3	3
Lithuania	4+	3	4+	4-	3	3	3	3	3-
Poland	4+	3+	4+	3+	3+	3	3+	4-	4-
<b>Romania</b>	<b>4-</b>	<b>3+</b>	<b>4</b>	<b>3+</b>	<b>2</b>	<b>2+</b>	<b>3-</b>	<b>2</b>	<b>3</b>
Slovak Republic	4+	3	4+	4	3	3	3+	3-	2+
Slovenia	4+	3+	4+	3	3	3-	3+	3-	3+

*Note: The index ranges from 1, indicating little or no progress, to 4+ pointing to standards similar to advanced economies.*

*Source: EBRD Transition Report 2003.*

One of the specific problems encountered by the Romanian policymakers during the pre-accession period has been the lack of economic tools to assist them in the implementation and monitoring of fiscal-budgetary measures. While a range of regulatory adjustments are still needed in order to comply with the requirements of the EU *acquis* on taxation, their socio-economic effects are hardly known due to the lack of an evaluative instrument.

## 1.2. Research questions and methodology

This study aims to provide a general framework for evaluating a wide range of fiscal-budgetary policy measures in Romania during and beyond the pre-accession period. It adds to the relative small number of models developed for Romania and specifically addresses the impact of fiscal-budgetary policy measures at a detailed sectoral level. This is of special relevance as various policy measures can have widely different effects. For example, the impact of a rise in excise duties on mineral oils on the output of agricultural sector, oil sector, manufacture of transport equipment, construction or real estate activities can vary in terms of sign and magnitude. As a result, the sectoral effects on employment would be different as well. While these differences are difficult to ascertain, their consequences on the society cannot be ignored by the policymakers.

The general framework developed in this study has three main aims:

- To provide a better understanding of the structural relationships between the different economic agents in Romania;
- To develop a quantitative instrument to assist the Romanian policymakers in evaluating the effects of different fiscal-budgetary policy measures;
- To evaluate the socio-economic effects of some measures aiming at harmonizing taxes with the EU requirements and restructuring public expenditures.

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Analyzing the *structural relationships between various economic agents* should include a clear and consistent representation of the specific links among the households, the firms, the government and the external sector. Such a scheme should describe the performance of each agent (institutional sector) in terms of its contribution to the value added, the disposable income, and savings, etc. Furthermore, detailed data on production should provide an understanding of the characteristics of each sector, while detailed data on intermediate and final consumption should allow an assessment of consumption patterns of each production sector or economic agent (institutional sector). Equally important, would be a detailed representation of the tax structure by commodity, e.g. for the value-added tax, excise duties and import tariffs, and by production sector, e.g. for social security contributions and taxes on production. And the treatment of the current account should give insight into the structure of imports and exports.

The Social Accounting Matrix (SAM), which integrates the “social” with the “economic” dimension, is a suitable instrument to analyze such structural relationships (Lafeber and Tuyl, 1993). Thus, a Social Accounting Matrix has been built for Romania for 2000, the latest year for which the relevant data are available. The Romanian SAM gathers data from various sources (National Institute of Statistics, Ministry of Finance, Ministry of Economy and Commerce, IMF, OECD), and provides a consistent framework which encompasses the relationships between the households, the firms, the government and the external sector. It also incorporates 35 types of production sectors and 35 types of commodities, capturing the links between the sectors (through intermediate consumption) and comprising disaggregated data on production and employment. The detailed commodity disaggregation provides a deeper insight in the consumption patterns of the households and the government. Furthermore, the detailed tax structure enables an assessment of the main tax payers at the sectoral level and allows the calculation of effective tax rates by sector, e.g. social security contributions rates and taxes on production, or by commodity, e.g. value-added taxes and excise duties. For the current account, it describes the major exporting production sectors and the structure of imports by commodity.

*An instrument which could help policymakers* to evaluate the effects of different fiscal-budgetary policy measures should take account of the behavior of all the major players in the economy: the households, the firms, the government and the external sector. It should of course also encompass a detailed tax structure, differentiated according to the various sources of public revenue. The contribution to the government budget in terms of revenues and expenditures should be explicitly included. Furthermore, the framework should be able to provide an evaluation of the gains or losses encountered by the households as a result of the policy measures undertaken by the government as well as the effects in terms of output, employment, capital, energy consumption and prices at a very detailed sectoral level. And, since a static analysis of effects of fiscal-budgetary measures could be misleading, a time dimension should be added by allowing for savings and investment reactions.

A computable general equilibrium (CGE) for the Romanian economy, called RoMod, has been developed to address the specific requirements in evaluating the

effects of fiscal-budgetary policy measures described in the foregoing paragraph. CGE models are useful tools in such analysis because they encompass the links among the production structure at a detailed sectoral level, the pattern of demand, the income of different institutional sectors (economic agents) and the balance of payments (Thissen, 2000). RoMod builds on the detailed structure of the Romanian SAM mentioned above and has a recursive dynamic structure to capture the effects of the policy measures over time. RoMod allows an evaluation of fiscal-budgetary policy measures on a much wider scale than the very few models developed so far for the Romanian economy, with its very detailed tax structure. Furthermore, it provides comprehensive results in terms of sectoral output, employment, capital, energy use, private and public consumption by commodity, exports and imports and their price structure.

The process of preparation for the EU accession requires the harmonization of the legislation on indirect taxes (value-added tax and excise duties) with the EU standards, as stipulated by chapter 10 on taxation. Further, the restructuring of public expenditure is needed in order to comply with the European Commission's recommendations. Thus, the *Romanian policymakers should be able to evaluate the socio-economic effects of some of these fiscal-budgetary measures.*

RoMod is used to analyze the effects of tax harmonization in accordance with the EU requirements and the restructuring of the public expenditures within five main scenarios. Very detailed sectoral and budgetary results are presented for each of them. Furthermore, as a test of the estimates of the socio-economic effects, the robustness of results to the uncertainty in the model's parameters is assessed. The reliability of these parameters and their impact on the model's output represents in fact one of the most debated issues in the CGE literature. Therefore, uncertainty and sensitivity analysis is conducted to deal with this issue. The methods proposed to assess the stochastic features of the model's results (uncertainty analysis) and to decompose the model's output variance according to the contributing parameters (sensitivity analysis) represent a novelty in the CGE modeling field, although they have been widely applied in the fields of environmental modeling and chemical engineering. Thus, the current study allows a well-founded evaluation of the possible effects of some of the fiscal-budgetary measures undertaken by the Romanian government or envisaged in the 2003 Pre-accession program (Romanian Government, 2004). The only two models that have been used so far by the Romanian government in preparing the Pre-accession programs (Dobrescu macro-model and the Romanian version of RMSM-X developed at the World Bank) fail to provide detailed sectoral results.

### 1.3. Outline of the study

The study is structured as follows. Chapter 2 provides an historical perspective on the recent economic developments in Romania. It also includes a brief overview of some theoretical and empirical issues regarding growth in transition to underline the important role played by institution building and governance in view of the forthcoming EU integration and in developing the mechanisms of a market oriented

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economy. Then, the process of preparation for the EU accession and some recent fiscal and budgetary developments are discussed.

Chapter 3 begins by developing the conceptual framework of the computable general equilibrium analysis, providing a brief history of its development and a definition. A classification, according to various criteria, is meant to give an introduction to the large variety of CGE models. Subsequently, the empirical CGE models for Eastern European economies are surveyed, to put into perspective and to classify the CGE model for the Romanian economy presented in chapter 4.

Chapter 4 presents the theoretical foundations of the computable general equilibrium model for the Romanian economy. RoMod focuses on the real side of the economy. It is characterized by neoclassical structuralist features and captures the behavior of four economic agents: the firms, the households, the government and the external sector in a recursive dynamic setting.

Chapter 5 explains the construction of the Romanian SAM for 2000. It starts with a discussion of the theoretical foundations of a social accounting matrix. Then, the construction of the Romanian SAM is explained in detail, along with an analysis of the structural relationships among different economic agents (institutional sectors), the pattern of demand and the tax structure. Some assumptions and limitations are emphasized, given the lack of data. The SAM further serves as a database for the model developed in chapter 4.

Chapter 6 presents the calibration of the CGE model for the Romanian economy. First, some theoretical aspects regarding the calibration procedure are discussed. The calibration approach is compared with the econometric approach, pointing out the advantages and disadvantages of using the calibration procedure. Then, the calibration of the parameters of RoMod is presented. The benchmark equilibrium data set used for calibration is the SAM for 2000 presented in chapter 5.

Chapter 7 starts by explaining the baseline scenario chosen for RoMod. Then, the detailed socio-economic effects of five main policy scenarios are presented, aiming at tax harmonization with the EU requirements and public expenditures restructuring (Romanian Government, 2004). The chapter also illustrates the robustness of the results for the five policy scenarios to the choice of the model's parameters. First, a screening method (the Morris method) is proposed to identify those parameters from a large list that drive most of the variation in the model's output. The Morris method provides a qualitative indication, by ranking the parameters according to their influence on the model's results, at a low computational cost. A variance-based method (the Sobol' variance decomposition method) is subsequently used for uncertainty and sensitivity analysis. Due to the high computational cost involved by the Sobol' method, only the influential parameters, selected according to Morris method, are examined. Finally, chapter 8 presents some final conclusions and some directions for future research.

## Chapter 2

### Fiscal restructuring and macroeconomic performance in Romania

#### 2.1. Introduction

In its early stages, the transition of the Eastern European countries from centrally planned to market economies resulted in a massive output fall, regardless of the type of stabilization plan implemented. As an outcome, a large debate on its causes has started in the literature. While in its initial phase some authors were emphasizing the fall in consumer demand, trying to explain the decline in output in a Keynesian fashion (Blanchard, Dornbusch, Krugman, Layard and Summers, 1991; Berg and Sachs, 1992), some others advocated a “transformational” recession, determined by the breaking down of the command and control mechanisms of the central planning system and their replacement by a decentralized decision making system and free market practices<sup>1</sup> (Kornai, 1994). Ever since, the theoretical literature on transition economies, has taken two major directions: one trying to explain the initial collapse in output, the other focusing on medium-term issues. Meanwhile, the empirical literature has focused on the effects of initial conditions, macroeconomic adjustment and liberalization on growth. Recently, the role of the institutions as a major prerequisite for growth came into focus in both the theoretical and applied fields (Campos and Coricelli, 2002).

During the past few years, the Eastern European countries, including Romania, have been facing a new challenge, the accession to the European Union. As Hagemann (2004) points out, the final target of accession is the adjustment of the institutional and regulatory framework and the convergence of the candidate countries in per capita incomes with the EU standards. Thus, some new directions have been articulated in the empirical literature on transition economies. While some authors

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<sup>1</sup> Campos and Coricelli (2002) further emphasize that the functioning of the free market mechanisms could not be sustained without the presence of market-oriented institutions.

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attempt to estimate the costs and the speed of convergence to the EU average (Barbone and Zalduendo, 1997; Fischer, Sahay and Vegh, 1998; Kejak, Seiter and Vavra, 2004), some others analyze the socio-economic effects of the regulatory adjustment and integration (Brown, Deardorff, Djankov and Stern, 1995; Banse and Tangermann, 1996; Lejour, Mooij and Nahuis, 2001; etc.). This study belongs to the latter field of research, aiming to evaluate the possible effects of tax harmonization and public expenditures restructuring in Romania, in the process of preparation for the EU accession. However, some theoretical and empirical issues related to growth in transition are briefly discussed in this chapter, to emphasize the important role played by the institutions in view of the future EU integration. The rest of the chapter is meant to give an historical perspective for the reader who is not familiar with Romania's recent economic developments.

The chapter is organized as follows. First, some theoretical issues regarding the growth in transition are discussed in section 2.2, according to the relevant literature. In section 2.3, an analysis of Romania's recent economic developments is given, with special emphasis on the preparation for the EU accession and the budgetary and fiscal policies during the 1990s, followed by some concluding remarks in section 2.4.

### **2.2. Growth in transition - some theoretical and empirical issues**

The first ten years of transition of the Eastern European countries are summarized by Campos and Coricelli (2002) through seven stylized facts: the fall in output, the shrinking of the capital stock, the labor movement<sup>2</sup>, the trade reorientation towards the EU, the change in the structure of the economy<sup>3</sup>, the rapid collapse in institutional structure and the high social costs.

The theoretical research on transition economies has developed along two directions: one focusing on the initial fall in output, the other dealing with the medium-term issues. Two major contributions attempt to explain the initial fall in output: Calvo and Coricelli (1992) and Blanchard and Kremer (1997). Calvo and Coricelli (1992) adopt the "credit crunch" approach, related to the tight financial policies undertaken during the price liberalization period. They show that overall the credit contraction can generate a liquidity constraint at the firm level and a temporary decline in output. Blanchard and Kremer (1997) emphasize the disorganization as being the main explanation for the output fall. The breakdown in the precisely specified economic relations between the firms under central planning would prompt an output collapse.

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<sup>2</sup> The labor movement refers to: the change from the state to the private sector, the change from employment to unemployment or inactivity status, and the change in occupation (Campos and Coricelli, 2002).

<sup>3</sup> In the Eastern European countries the share of services in GDP increased, accompanied by a decline in the share of industrial sectors (Campos and Coricelli, 2002).

## Fiscal restructuring and macroeconomic performance

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With regard to the medium-term issues, the change in the structure of the economy and the reallocation of resources from the state to the private sector are the main pillars of the research in the field (Chadha, Coricelli and Krajnyak, 1993; Aghion and Blanchard, 1994; Castenheira and Roland, 2000; Chadha and Coricelli, 1995). While, Aghion and Blanchard (1994) analyze the optimal speed of transition emphasizing the importance of job creation through an efficiency wage model, the other authors aim to integrate the new investment process in physical (Castenheira and Roland, 2000; Chadha and Coricelli, 1995) and human capital (Chadha, Coricelli and Krajnyak, 1993). These papers show that tight macroeconomic policies and price liberalization do not necessarily encourage growth.

Campos and Coricelli (2002) further point out that the quality of institutions which support the functioning of a market economy is a major prerequisite for growth. However, an evaluation of the role of institutions in the growth process is not an easy task. Even more difficult is to design institutions leading to sustainable growth. Although some steps have been taken in this direction, pertinent studies are still scarce (Rodrik, 2000; Romer, 2000; Frensch, 2004). Rodrik (2000) shows that the process of institution building should not over-stress the best practice “blueprints” imported from the more advanced economies, but it should account for “local knowledge”. He points out that large-scale institution building should be based on local needs and capabilities<sup>4</sup>. Although the Eastern European economies exhibit a large diversity of institutional arrangements, there has been a general tendency to adopt “blueprints” of efficient institutions (Campos and Coricelli, 2002). Thus, Campos and Coricelli (2002) argue that the EU integration might have beneficial effects on the Eastern European countries. Nevertheless, they emphasize that the role of institutions should be analyzed in a much broader framework, accounting for the relationship between the state and the market.

At the same time, the empirical analysis of cross-country variation in growth has focused on the initial conditions and economic policies (De Melo, Denizer and Gelb, 1996; Fischer, Sahay and Vegh, 1996a; Fischer, Sahay and Vegh, 1996b; Denizer, 1997; De Melo, Denizer, Gelb and Tenev, 2001). Most of these studies use the liberalization index developed by De Melo, Denizer and Gelb (1996), which is given as the weighted average of liberalization in three areas: internal markets<sup>5</sup>, external markets<sup>6</sup> and private sector entry<sup>7</sup>. De Melo, Denizer and Gelb (1996) derive an annual liberalization index for 28 transition countries<sup>8</sup>, for the period 1989-1994, as well as a cumulative liberalization index. The cumulative liberalization index reflects the duration and the depth of reforms and is calculated as the sum of a

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<sup>4</sup> The “local knowledge” should be achieved in their view through experimentation, a process which takes a long time. However, the experience of more advanced economies should not be disregarded.

<sup>5</sup> Internal markets liberalization accounts for the price liberalization and the abolition of state monopolies.

<sup>6</sup> The external markets liberalization refers to the foreign trade regime liberalization.

<sup>7</sup> Private sector entry liberalization accounts for the privatization of the state-owned enterprises and financial sector’s reform.

<sup>8</sup> It comprises 26 countries in Central and Eastern Europe and the Former Soviet Union (including Mongolia which is considered the “16<sup>th</sup> Republic” of the Former Soviet Union group) plus China and Vietnam.

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country's annual liberalization indexes from 1989 onwards<sup>9</sup>. De Melo, Denizer and Gelb (1996) show that cumulative liberalization has positive effects on output changes in Central and Eastern European countries and the Former Soviet Union group, by running a multiple regression for average growth over the period 1989-1994. The explanatory variables in their regression are the cumulative liberalization index, the income per capita in 1989 and a war dummy variable

Fischer, Sahay and Vegh (1996a) use observations for 1992-1994 corresponding to 20 transition countries, and show that growth is negatively and significantly associated with inflation and positively associated with liberalization index, fiscal surpluses and official external assistance as a percentage of GDP. They further point out that the growth prospects of the transition economies are determined by two sets of factors: one arising from the transformation and transition process, the other one related to the basic neo-classical determinants of growth. Thus, Fischer, Sahay and Vegh (1996a) consider growth as being determined by the weighted average of the equation explained above and the Levine and Renelt (1992) equation. For countries more advanced in the transition process the authors predict that the Levine-Renelt equation would become more relevant. Fischer, Sahay and Vegh (1996b) further extend the number of countries to 25 for the same period (1992-1994) and find that growth is positively associated with the cumulative liberalization index, the fiscal surpluses and the fixed exchange rate regime, and negatively with initial income. However, Campos and Coricelli (2002) point at two possible problems related to the use of the cumulative liberalization index in these studies. First, the index measurement builds in a large doze of arbitrariness. Second, it is still unclear if the effects of liberalization on output performance are due to the cumulative liberalization or the change in the liberalization indexes.

Denizer (1997) extends the cross-country regression analysis of De Melo, Denizer and Gelb (1996) to account for the initial conditions. The initial conditions are proxied by a dummy variable which reflects the institutional factors<sup>10</sup>, and the distance from external markets (in this case the distance from Vienna). Two other dependent variables are included: the share of the industry in the GDP to account for overindustrialization, and a dummy variable which accounts for regional tensions. Denizer (1997) finds that the consumer price index and the institutional factors are positively related to growth, while the distance from external markets, the share of the industry in the GDP and the regional tensions are negatively correlated with growth. Denizer's study suggests that the initial conditions matter in the transition process and they may have strong implications on long run growth prospects.

De Melo, Denizer, Gelb and Tenev (2001) take an integrated approach to evaluate the effects of the initial conditions, policy change and reforms, using panel data with time shifting<sup>11</sup>. They identify 11 variables which characterize the initial conditions in

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<sup>9</sup> The reason for using the cumulative liberalization index is the authors' belief that structural and institutional adjustment takes time even when the policy reforms are enforced fast.

<sup>10</sup> The dummy variable takes a value of one for countries with a sovereign regime and which displayed a market oriented economy before becoming socialist countries.

<sup>11</sup> De Melo, Denizer, Gelb and Tenev (2001) use the panel data with time shifting to build a sample that is consistent with the beginning of transition in each of the 28 countries under study.

## Fiscal restructuring and macroeconomic performance

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transitions economies<sup>12</sup>. The authors use the method of principal components to reduce their dimensionality and to deal with multicollinearity. Most of the variation across the 11 conditions is captured by the first two principal components: the first one measuring the unfamiliarity with market processes and macroeconomic imbalances, and the other one accounting for the level of socialist development and the associated structural distortions. De Melo, Denizer, Gelb and Tenev (2001) specify a system of equations where the economic liberalization (given as the annual liberalization index described above) depends on the initial conditions, regional tensions and political change. They find that the initial conditions are important for both the speed of liberalization and performance. Nevertheless, policy change is still the most important factor determining the growth differences across the 28 countries in the sample.

Recently, the role of institutions in explaining growth in transition came into focus in the empirical field. However, results are still sparse (Havrylyshyn and Van Rooden, 2000; Raiser, Haerpfer, Nowotny and Wallace, 2001). Havrylyshyn and Van Rooden (2000)<sup>13</sup> extend their previous study (Havrylyshyn, Izvorski and Van Rooden, 1998) to account for 9 indices of institutional development coming from five different sources: the overall “Index of Economic Freedom” and the average of the indices for property rights and government regulations, published by the Heritage Foundation and the Wall Street Journal; the measure on democratic freedom, the measure on economic freedom, the average of the indices for the rule of law and governance and public administration, and the average of the indices for the political and civil rights, published by the Freedom House in the “Nations in Transit” and in the annual Survey of Freedom data; the EBRD’s legal reform index, published by the EBRD; an institutional factor based on the survey conducted in 1998 by the World Bank on the institutional environment for its World Development Report; and the country risk ratings published by “Euromoney”. In order to reduce the subjectivity of the individual variables and to deal with multicollinearity, the authors adopt the principal components method, also used by De Melo, Denizer, Gelb and Tenev (2001) for the initial conditions. The first principal component of the dataset representing 8 out of the 9 institutional indices (excluding the institutional factor based on the World Bank survey), as well as the first principal components of the datasets comprising only indices representing the legal framework or political liberties explains about 90 percent of the overall variability in the individual indices. Havrylyshyn and Van Rooden (2000) show that indicators of institutional development add to the explanation of growth. Nevertheless, although significant, their explanatory value is small compared to the economic policies and the initial conditions. Campos and Coricalli (2002) point out some problems related to Havrylyshyn and Van Rooden (2000) study: the high subjectivity of the

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<sup>12</sup> The first three variables account for initial levels of development: annual per-capita income levels, urbanization and industrial distortion; the next three are indicators of resources and growth: proximity to the market economies, availability of exportable natural resources and reported prior economic growth rates, there are three variables accounting for economic distortions: repressed inflation, trade dependence on other communist countries and black market exchange rate premium; finally, two variables reflect the initial institutional development: one differentiating among new national states, the other one capturing the lack of familiarity of non-Baltic Former Soviet Union with market institutions.

<sup>13</sup> Their study accounts for 25 countries for the period 1991-1998.

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institutional indicators, and the instant effect of institutional development on growth. The development of institutions is expected to take time and their impact on growth is expected to be delayed.

Raiser, Haerpfer, Nowotny and Wallace (2001) use data from the World Values Survey for 1990 and 1995 and document the degree of civic participation and trust in the transition countries. They find that social capital has an impact on growth, through the degree of civic participation and trust in the public institutions. However, the impact of social capital is rather weak. Reforms have also a statistically significant and positive effect on growth. Raiser, Haerpfer, Nowotny and Wallace (2001) could not find convincing evidence of the interaction between the civic participation or the trust in public institutions and the reforms indicators.

Some other studies also include the political liberalization as an explanatory variable for economic liberalization (De Melo, Denizer, Gelb and Tenev, 2001; Fidrmuc, 2003) or average reforms (Falcetti, Raiser and Sanfey, 2002). However, these studies focus on the impact of the initial conditions and reforms on growth and do not analyze in depth the role of the institutional factors.

Campos and Coricelli (2002) emphasize that while there is a growing awareness of the importance of institutions in the transition economies, the channels through which they affect growth and the time dimension between institutional development and growth are not clear. They suggest that the relationship between growth and institutional development would be much more interesting to assess than the level of institutional development alone. Nevertheless, the short series of data for the transition countries do not allow such an empirical analysis. The solution they propose is to focus on the relationship between the initial levels of institutional development and economic performance.

As already explained, the accession to the European Union could have important beneficial effects on the Eastern European countries through the adoption of the EU “blueprint” and the individual’s beliefs that the EU institutions are the right institutions. Thus, this field of research seems to be even more promising from the EU integration perspective. However, in the present study we chose to focus on evaluating the effects of the policy reforms undertaken by the Romanian government, aiming at harmonization with the EU requirements. There are two main reasons for doing so. First, there is a need for an economic tool which could provide estimates for such policy measures. Second, the research in both theoretical and empirical fields failed to provide so far a clear mechanism through which the institutional development affects economic performance in transition economies. Thus, the incorporation of the governance quality in the Romanian model is left for future research.

### **2.3. Economic developments in Romania after 1989**

The starting point for the transition to a free-market economy in Romania has been more difficult than in other countries in Eastern Europe. The reason is the excessive development of heavy industry before 1989, which has led to the depletion of energy

## **Fiscal restructuring and macroeconomic performance**

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resources and has increased the costly dependence on imports of raw materials and energy. Furthermore, the state-owned enterprises were inefficient and involved in considerable quasi-fiscal activities (IMF, 2004a). The quick reduction of the foreign debt during the 1980s, which represents 20-30 percent of GDP according to the OECD estimates (11 billion USD), has been mainly based on the cut of imports of investment goods (OECD, 1998). The consequence has been an increasing technological lag. The transition shock has been particularly large also because none of the economic reforms, which characterized the Eastern European countries in the 1980s, have been undertaken in Romania (OECD, 1998).

Three important periods can be distinguished in the restructuring of the Romanian economy, mostly corresponding to the political cycles: 1990-1996, 1997-2000 and 2001-2004. Each of these periods is briefly discussed in the following sections. A short assessment of the preparation for the EU accession is provided in section 2.3.4, followed by some budgetary and fiscal developments during and after the 1990s in section 2.3.5.

### **2.3.1. The state of the economy during 1990-1996**

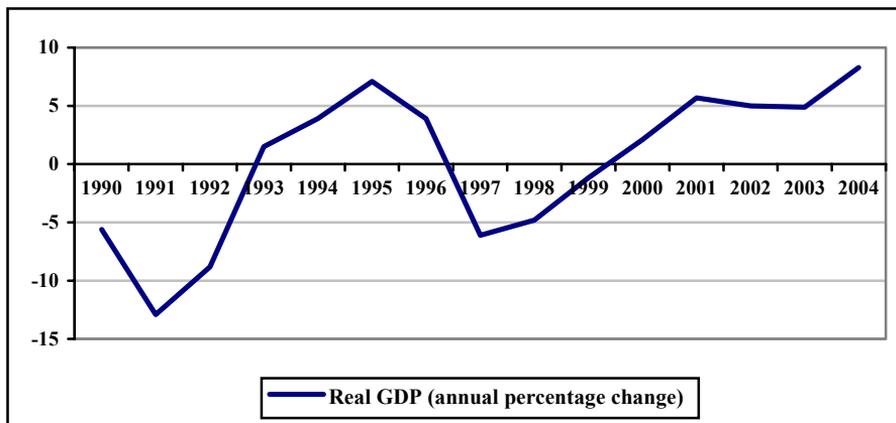
In the early 1990s a “gradualist approach” to structural reforms has been adopted in order to minimize the social costs associated with the transition to the free-market economy. This strategy, as anticipated by the 1993 OECD Assessment of the Romanian Economy, has failed to produce sustainable gains in either economic or social conditions. The first years of transition have been characterized by a sharp decrease in output, accompanied by high inflation rates. Nevertheless, it is doubtful that the “gradual approach” to structural reforms is to be blamed for the poor economic performance in the first years of transition. In fact, the initial collapse of output is one of the stylized facts identified by Campos and Coricelli (2002) for the first years of transition in all the Eastern European countries, regardless of the type of the structural reforms adopted. Some authors (Kornai, 1994; Budina and Van Wijnbergen, 1997) point out that the deep economic recession in the beginning of 1990s has been more an effect of the breaking down of the command and control mechanisms of the central planning system, than an effect of the economic policies adopted, as already mentioned.

The success in reducing inflation under the stabilization policy of 1994 and the resumption of growth in 1993 (see figure 2.1) have not been sustained as a consequence of the largely unstructured economy. This weakness showed up in the sharp increase of the consolidated government budget deficit (see figure 2.2), even in the context of continuing GDP growth. The deficit reached 3.9 percent of GDP in 1996, compared to the recorded surpluses throughout the 1980s.

Large quasi-fiscal deficits have further been accumulated in the effort to bring the fiscal deficit under control and to support the production sectors facing hardships. The quasi-fiscal operations have taken the form of subsidies through preferential credit from the National Bank of Romania and the commercial banks to the agriculture and energy-intensive sectors, increases in payments arrears by state owned companies, and foreign exchange sales of the National Bank of Romania to the energy sector at an appreciated exchange rate (IMF, 2000). Compared to many

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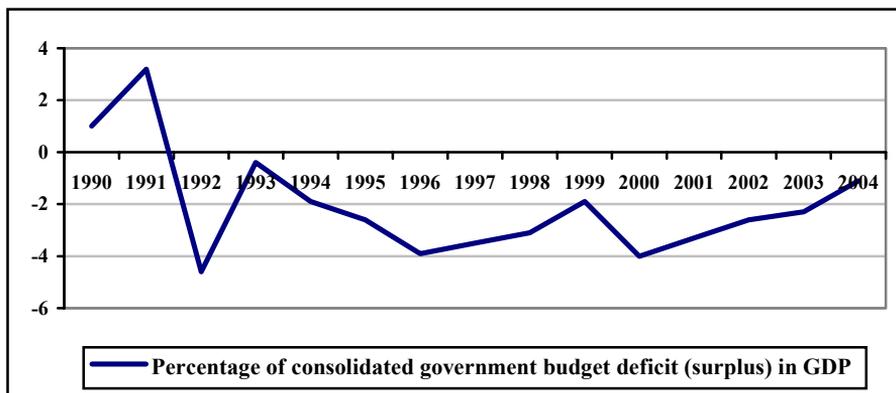
other transitional economies, the accumulation of fiscal and quasi-fiscal deficits has contributed to the early recovery in output, but it has further caused severe inflationary and balance of payments pressures (IMF, 2001).



Source: National Bank of Romania, Annual Report 2004.

**Figure 2.1. Real GDP growth, 1990-2004**

In the first decade of the 1990s, the inherited technological lag has caused an excessive use of Romania's low external debt levels for borrowing in the international capital market. The external debt has risen from 0.9 percent of GDP in 1990 to 23 percent of GDP in 1996.



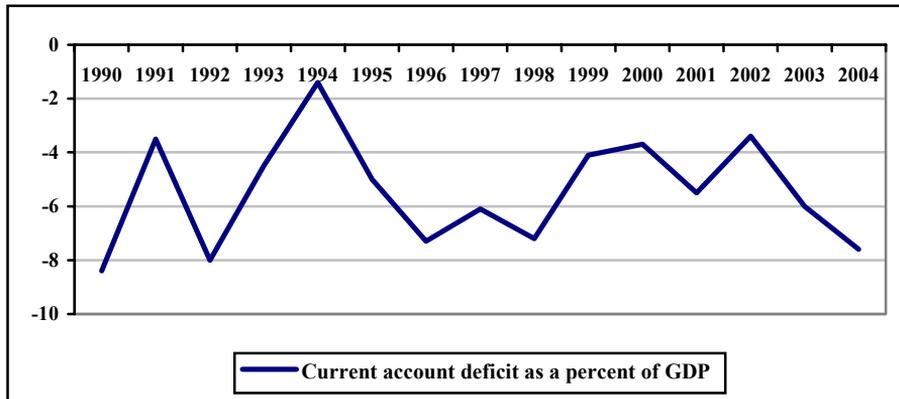
Source: National Bank of Romania, Annual Reports 1998-2004.

**Figure 2.2. Percentage of consolidated government budget balance in GDP**

The export performance achieved in 1994 could not be sustained because of the unstructured heavy industry relying on imports of raw materials and energy. As a consequence, the current account deficit drastically deteriorated, reaching 7.3 percent of GDP in 1996 (see figure 2.3). The confidence in the national currency has

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been falling, leading to a sharp depreciation of the official exchange rate by the end of the year.



Source: National Bank of Romania, Annual Report 2004.

**Figure 2.3. Current account deficit as a percentage of GDP**

### 2.3.2. Economic developments during 1997-2000

In 1997, the new government committed itself to a “shock therapy” program of both macroeconomic and institutional reforms. The program emphasized on accelerating the privation process and had as main priorities:

- The liberalization of prices for basic products and of the exchange rate;
- The developing of financial markets for a better allocation of resources.

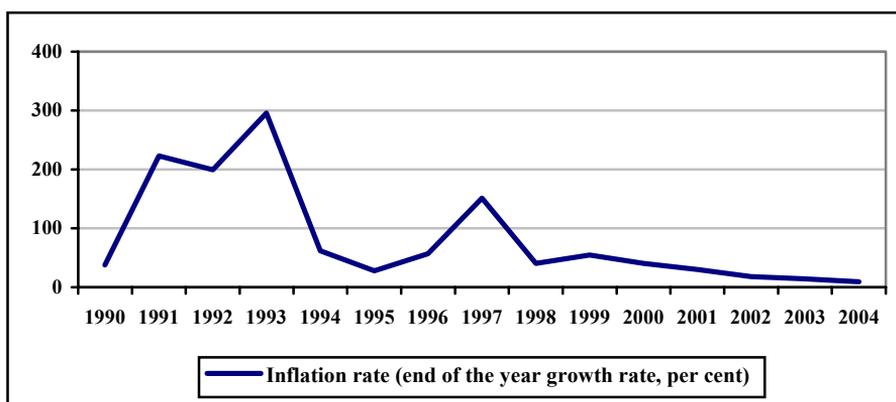
To limit the negative consequences of the price liberalization and to keep the inflation at a level that would not induce market distortions, a macrostabilization program was enacted. The stabilization plan of 1997 failed because of the structural inefficiency of the Romanian economy and the quality of the macroeconomic policies applied. Furthermore, the lack of macroeconomic stability, the chaos in the area of tax policy and the predominance of weak governance resulted in a slower development of private sector compared to other Eastern European economies (IMF, 2004a). As Rodrik (2000) points out the development of right institutions which support the development of market oriented practices takes time. Thus, the adoption of the “shock therapy” program might not have been sustained by the level of institutional development. The economy was drawn into a second deep transitional recession. The real GDP decreased by over 12 percent during three consecutive years accompanied by high inflation rates. The 2002 OECD Economic Assessment appreciated that although the macrostabilization plan of 1997 failed, it created some irreversible conditions that made room for improved monetary and fiscal policies starting with 2001 (OECD, 2002).

The main achievement of the year 1997 was a reduction in the fiscal deficit (see figure 2.2, section 2.3.1). This performance is all the more impressive when taking

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account of the transfer of an important part of the quasi-fiscal operations costs from the National Bank of Romania to the budget.

Furthermore, financial markets became operationally effective in 1997. The money market became an effective transmission channel for monetary policy, the interest rate reflecting the real cost of resources. The impressive development of the T-bills market during the same year was determined by the increased supply of T-bills on the primary market and by the market driven interest rates. The foreign exchange market became also effective due to the liberalization of the exchange rate and the unlimited access of the banks to the foreign exchange market (National Bank of Romania, 1998). However, tighter monetary and fiscal policies caused a contraction of GDP in 1997 (see figure 2.1, section 2.3.1). Furthermore, as a consequence of price liberalization and the absence of a way of monitoring the transmission of increased prices between uncorrelated economic sectors, the inflation rate reached 151.4 percent at the end of the year (see figure 2.4).



Source: National Bank of Romania, Annual Report 2004.

**Figure 2.4. The evolution of the inflation rate during 1990-2004**

In 1998 the internal disequilibrium was accentuated by the unfavorable external conditions and by the pressure induced by the servicing of the external debt. The main achievement of the year was the significant decrease of the inflation rate (see figure 2.4). However, the costs of reducing inflation were high, mainly due to the inconsistency in the formulation and application of the mix of micro and macroeconomic policies. Another achievement of 1998 was the acceptance of the conditions for the current account convertibility (National Bank of Romania, 1999).

The consolidated government budget deficit decreased in 1998 (see figure 2.2, section 2.3.1.), but the financing of the deficit caused severe pressure on the financial system. Due to the Russian crisis, the access to the external market was limited forcing the government to finance the whole deficit from internal resources. As a result, the crowding out effect negatively influenced the recovery of the economy. The increase of the interest rates on the money market further raised the cost of financing the fiscal deficit. The current account deficit reached 7.2 percent of

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GDP in 1998 accompanied by a decrease in output and the depreciation of the national currency. As a consequence, the reserve foreign assets fell more than expected, giving a negative signal to the external markets regarding the foreign debt service in 1999 (National Bank of Romania, 1999).

In 1999 the economy came under more pressure as the foreign debt service reached almost 30 percent of the medium and long-term public debt. Some efforts were made to raise funds on the foreign private capital markets, but the unfavorable external conditions and the expectations of a possible default regarding the service of the foreign debt made difficult the access to funding at reasonable costs. The high segmentation of the internal financial markets and the difficult access to external financing contributed to the persistence of the high interest rates. The fiscal deficit (see figure 2.2, section 2.3.1.) was almost solely financed from domestic sources, increasing demand on the money market and further putting pressure on the interest rates. Romania successfully managed to service the peak of medium and long-term foreign debt service in amount of USD 2.8 billion, of which USD 2.2 billion related to public and publicly guaranteed debt (National Bank of Romania, 2000).

The 1999 economic program emphasized the purging of the banking system and restoring the international competitiveness to narrow the unsustainable current account deficit. The lax bank lending standards and the directed lending to non-performing state-owned enterprises in industry and agriculture had resulted in a rapid accumulation of non-performing loans. The banking system crises were resolved in 1999, by closing the biggest state-owned bank Bancorex and transferring the non-performing loans to a recovery agency. Furthermore, directed lending was terminated (IMF, 2004a). Although GDP declined (see figure 2.1, section 2.3.1.) and inflation resurged (see figure 2.4), the basis had been set for a smooth functioning of the banking system and for Romania's return to the international capital market starting with year 2000.

After three consecutive years of decline in output real GDP grew by 2.1 percent in 2000, due to the exceptionally favorable international economic environment and some corrective measures approved by the government (National Bank of Romania, 2001). The resumption of growth was mainly driven by export demand and investments that offset a continuous fall in private consumption. However, the inflation rate turned out to be 40.7 percent by the end of the year. The main causes were the unfavorable weather conditions, which induced an increase in agricultural prices, and the lack of financial discipline, which characterized the first 10 years of transition. Furthermore, the bankruptcy of an important investment fund (FNI), in the first half of 2000 further affected some banks and put additional pressure on the inflation rate. The bankruptcy of FNI also caused a decrease in bank deposits, an increase in cash money and a drop in trust in the national currency (National Bank of Romania, 2001).

### **2.3.3. Recent economic developments, 2001-2004**

After the general elections at the end of 2000, the new government committed itself to accelerating the economic reforms and aiming to NATO accession and EU integration (OECD, 2002). The main priorities of the reform program were:

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- An inflation rate of 22-25 percent in 2001, progressively reduced to single digits by 2004;
- An average growth rate of 4.5-6 percent between 2001-2004;
- A consolidated budget deficit of 3.7 percent of GDP in 2001, subsequently revised to 3.5 percent;
- A current account deficit of 6 percent of GDP in 2001;
- An exemption of VAT and custom duties for imports of technology;
- A reduction of the VAT rate on energy and subsistence goods to 9 percent, to reduce the social costs;
- Attracting foreign direct investments up to USD 1.8 billion annually.

Most of the program objectives were achieved during 2001. The real GDP growth rate reached 5.7 percent in 2001 (see figure 2.1, section 2.3.1) driven by the favorable developments in agriculture and industry. Furthermore, value added in the services sector had the highest contribution to GDP formation, 46.4 percent, making the GDP structure more comparable with that of developed countries. However, the 2002 OECD Assessment noted that a continuation of high growth not yet fully supported by economic restructuring could lead to growing external imbalances (OECD, 2002).

The consolidated budget deficit fell to 3.3 percent of GDP (see figure 2.2, section 2.3.1), below the target of 3.5 percent due to: the cut in budget expenditures by 0.7 percentage points of GDP in line with the lower-than-projected budget revenues, and the success in reducing the public debt interest costs by the Treasury.

The relatively low world oil price, the cautious exchange rate policy and the good agricultural year contributed to keeping the current account deficit within sustainable limits in the first nine month of 2001. However, the 11 September terrorist attacks on the United States created an unfavorable external environment and increased the current account deficit, which reached 5.5 percent of GDP at the end of the year (see figure 2.3, section 2.3.1). The wider current account deficit was covered by the foreign capital inflows negotiated with the IMF allowing an increase of the official foreign exchange reserves.

The inflation rate reached 30.3 percent at the end of the year, higher than the target of 25 percent, due to the higher-than expected adjustments in prices of some services and public utilities and the arrears and the insufficient adjustment in the real economy (National Bank of Romania, 2002).

Considerable progress was made during 2001 in the restructuring of the banking sector. One of the main loss-making banks was privatized<sup>14</sup> and another large bank (Banca Comerciala Romana), which accounted for one-third of banking sector assets, started the preparations for privatization.

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<sup>14</sup> Banca Agricola was privatized, with Raiffeisen Zentralbank Österreich AG becoming the majority shareholder.

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The privatization of the small-size enterprises was nearly completed but the restructuring of large enterprises and public utilities lagged, resulting in wage pressures, distortions in allocation of resources in favor of public enterprises and continuing payment arrears (OECD, 2002).

In 2002 the economic growth slightly slowed down to 5 percent due to the unfavorable international economic environment. Exports were replaced by investment<sup>15</sup> as the engine of growth. The current account deficit remained high, 3.4 percent of GDP, due to the increase in imports for intermediate consumption, the increase in the world oil price and the elimination of custom duties for imports of most industrial products from the EU. The inflation rate dropped to 17.8 percent at the end of the year compared to the initial target of 22 percent, despite upward adjustments in the price of energy. Furthermore, the management of the budget process improved and consolidated budget deficit was reduced to 2.6 percent of GDP compared to the initially planned level of 3 percent. The deficit target overshoot derived mainly from the lower than expected inflation rate, although government revenues dropped 2.1 percent of GDP. The unemployment rate decreased to 8.1 percent in 2002, compared to 8.8 at the end of 2001 (National Bank of Romania, 2003). Nevertheless, the business environment and investment incentives became less favorable in 2002 compared to 2001 because the VAT and custom duties exemptions for imports of technology were cancelled.

The 2002 OECD Assessment emphasized the need for policy coherence. The suggested macroeconomic and structural policies were structured in five blocks: liberalization, stabilization, financial sector reform and mechanisms of exit and entry of enterprises. The assessment showed that uneven progress in different areas represents a source of instability. Furthermore, it pleaded for less involvement of the state in economic activity and market-based adjustments (OECD, 2002).

The strong real GDP growth (see figure 2.1, section 2.3.1) continued in 2003, accompanied by a gradual lowering of inflation, and a decline in unemployment (7.2 percent) and the consolidated budget deficit. The main engine of growth in 2003 has been the expansion of domestic demand as a result of a higher flow of credit to the private sector, equivalent to 6.75 percent of GDP<sup>16</sup> (IMF, 2004a), and a rise in the minimum wage rate, equivalent to 7.2 percent in real terms (National Bank of Romania, 2004). Given the limited domestic capacity to satisfy domestic demand and the decreasing inflation, imports had to rise to equilibrate the internal market. Thus, the current account deficit went up to 6 percent of GDP in 2003 from 3.4 percent in 2002, pointing out the need for further microeconomic restructuring and a prudent macroeconomic policy (National Bank of Romania, 2004). The inflation rate reached 14.1 percent at the end of 2003, very close to the initial objective of 14 percent. The development of the consolidated budget deficit further supported the disinflation process. The deficit fell to 2.3 percent of GDP compared to the initial objective of 2.65 percent. However, it should be stressed that 60 percent of the

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<sup>15</sup> Gross fixed capital formation represented 21.3 percent of GDP in 2002.

<sup>16</sup> The flow of credit to the private sector in 2002 represented only about 4 percent of GDP.

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consolidated budget deficit has been accumulated in the last month of the year as a result of seasonal inflation pressures (National Bank of Romania, 2004).

In 2003 National Bank of Romania adopted the euro as the reference currency, given the high share of commercial transactions denominated in this currency and the requirements related to the EU integration. Further progress has been made in the restructuring of the banking system, as negotiations for selling 25 percent of the shares of another important state-owned bank (Banca Comerciala Romana) were finalized.

To accelerate the privatization process the authorities adopted a program of voluntary employment reduction in 2003<sup>17</sup>, including generous payments for laid-off workers. Still, the privatization in the energy sector was delayed due to the reluctance of the authorities to give up their influence in this sector. Although the macroeconomic environment and tax legislation has improved, IMF assessment shows that the business environment has remained mixed in 2003 (IMF, 2004a). The reason is the lack of sufficient progress in improving governance, eliminating corruption, and improving transparency and enforcement of laws by the judicial system.

The positive economic developments continued in 2004 with sustained real GDP growth, a steady slowing down of inflation, and an improving consolidated budget deficit. Further, steps have been undertaken in the privatization of the country's largest oil company (Petrom) and two other electricity distribution companies. According to the IMF governance has improved in 2004, as a result of the approval by parliament of laws aiming at strengthening the power and independence of the judicial system (IMF, 2004b).

### 2.3.4. The accession to the European Union

In December 1999 at the Helsinki summit, Romania had been formally invited to start the negotiations for EU membership. The preparation for accession included the meeting of the 1993 Copenhagen European Council criteria and the adoption of the "*Acquis Communautaire*". The European Commission jointly with Romania has set January 2007 as the indicative date for accession.

A series of Regular Reports on Romania's progress towards meeting the criteria for membership have been drafted by the European Commission starting with 1998, to evaluate the compliance with the 1993 Copenhagen European Council criteria and the progress towards the adoption of the "*Acquis Communautaire*". The latest one, the 2004 Regular Report (European Commission, 2004) concludes:

- *The political criteria continue to be fulfilled*, even though further efforts need to be done in a number of areas. The Commission emphasizes the need for improving the management of court cases and the quality of judgments, an effective implementation of the anti-corruption legislation, the strengthening of

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<sup>17</sup> The privatization process of the large state-owned enterprises has been initially slowed down by the requirements that investors should make sizeable investments and guarantee to preserve employment.

## Fiscal restructuring and macroeconomic performance

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the local and regional governance such to ensure proper implementation of the *acquis* at these levels, and the increase efforts to guarantee media independence.

- *The criterion of being a functioning market economy is complied with*, although further progress can be made in deepening structural reforms and preserving macroeconomic stability. The report points out that a cautious policy-mix should insure the sustainability of the external position and the reduction of inflation, while further reducing the broader public sector deficit. The Commission identifies some areas that need improvement in the future: the enforcement of financial discipline, adjustments in energy prices, the financial performance of state-owned enterprises, the government expenditure reform and tax compliance, the privatization process, the functioning of the public administration and judicial system. In the mining, energy and transport sectors the restructuring and privatization should be jointly carried out.
- *A “fair level” of alignment with the acquis has been achieved in most of the areas*. Romania is expected to complete the legislative transposition before the indicative date for accession if the current pace of progress is preserved. Furthermore, all the chapters have been closed in the accession negotiation process by the end of 2004.

In the following, we briefly discuss two of the chapters that have a relative higher relevance for the present study: taxation (chapter 10) and Economic and Monetary Union (chapter 11).

The EU *acquis* in chapter 10 mainly covers indirect taxation, in particular the value-added tax (VAT) and excise duties regimes. With regard to direct taxation, only corporate taxation is covered, aiming at removing barriers for cross-border activities between firms. Romania has made significant progress in the approximation to the EU *acquis* in the area of indirect taxation through the adoption of a single Fiscal Code, which entered into force as of January 1, 2004<sup>18</sup>.

With regard to the VAT, the Code eliminates the VAT exemptions on a number of commodities and services contrary to EU legislation and introduces a reduced rate of VAT of 9 percent for them in accordance with the Annex H of the Sixth Council Directive (77/388/EEC). The reduced rate of VAT of 9 percent further replaces the statutory rate of 19 percent for other commodities and services, as allowed under the *acquis* (Annex H of the Sixth Council Directive). Exemptions are implemented for: imports made by international organizations, supply of commodities that are subject to diplomatic and consular relations, and goods placed under duty-suspension arrangements. Romania has been granted two transitional arrangements: to apply a registration and exemption turnover threshold of 35,000 euro to small and medium enterprises, and to continue applying the VAT exemption with right of deduction for international passenger transport. The elimination of VAT exemptions is also envisaged for programs produced and transmitted by radio and TV channels (including cable TV companies) other than national ones, and for the sales of films and program licences, subscriptions to international news agencies and other rights

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<sup>18</sup> Law no.571/23 December 2003 regarding the Fiscal Code.

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of distribution for radio and TV activities (Romanian Government, 2004). Yet, the Commission emphasizes that special efforts should be further made concerning the alignment to the *acquis* with regard to exempted activities, taxable persons and special schemes (European Commission, 2004).

Concerning the excise duties, the Fiscal Code introduces the definition of the tax warehouses and the duty-suspension movement regime. Furthermore, the structure of the duty on wines, fermented beverages and intermediated products, and the duty on beer produced by small independent breweries have been aligned to the *acquis*. A derogation to apply a reduced excise duty has been granted for fruit growers' distillation for personal consumption (not lower than 50 percent of the standard rate for a limit of 50 liters of fruit spirit of 40 percent volume per year per household). Furthermore, Romania will continue to apply a lower duty rate than the EU minimum requirements on cigarettes until December 31, 2009. The 2004 Regular Report points out that further efforts are needed to align the excise duty rates applied to the harmonized product categories with the EU legislation, especially for mineral oils (European Commission, 2004).

In the field of direct taxation, Romania still has to complete the transposition of the Parent-Subsidiary directive and to transpose the directives on Interest and Royalty payments and Savings. Furthermore, new tax measures have to be adopted to comply with the principles of the Code of Conduct for business taxation (European Commission, 2004).

The Economic and Monetary Union (EMU) membership is now part of the EU *acquis* (chapter 11 – Economic and Monetary Union). The legislation on the EMU, which has to be implemented before the date of accession, includes specific requirements related to central bank independence in the member states, the prohibition of direct financing by central bank of the public sector and the prohibition of the privileged access by the public sector to financial institutions. Most of the legislation in these fields has already been adopted by the Romanian authorities. However, the Commission underlines that special effort should be made in its enforcement. Some clarifications are still needed regarding the possibility of judicial review for the governor of the National Bank of Romania and the prohibition to the privileged access and monetary financing.

Upon accession, new members cannot obtain an opt-out or exemption from full EMU membership<sup>19</sup>. As a consequence, Romania will be automatically bound upon entry in the EU, by the rules of the Stability and Growth Pact<sup>20</sup> and the Broad Economic Policy Guidelines. The new EU members will have derogation from proceeding to full EMU membership, until the criteria of the Treaty of Maastricht are met. However, the Commission underlines that by that time, the member states

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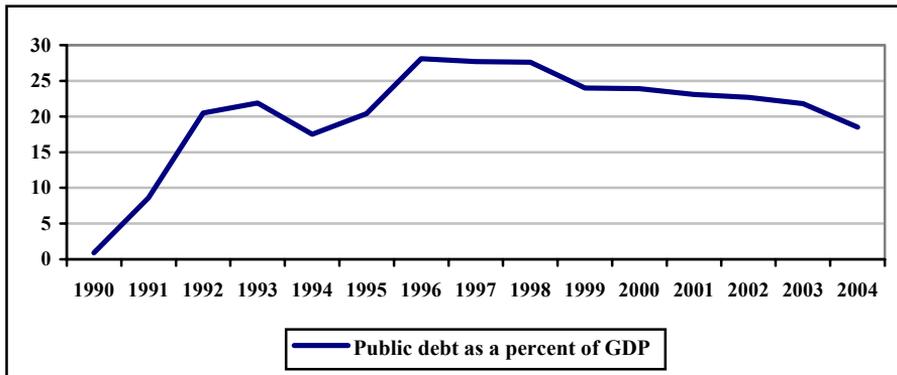
<sup>19</sup> The full EMU membership represents the third stage of the EMU membership, without any derogation, which also implies the participation in the euro zone.

<sup>20</sup> The Stability and Growth Pact objective of sound budgetary positions, close to balance or in surplus, will allow dealing with normal cyclical fluctuations while keeping the conventional government deficit within the reference value of 3 percent of GDP.

## Fiscal restructuring and macroeconomic performance

with derogation should treat their exchange rate as a “matter of common concern” (European Commission, 2004).

Romania is just meeting two out of four of the Maastricht criteria and is still experiencing instability of its nominal and real exchange rates. The inflation rate is far above the EU average and even the highest compared to the new member states. The interest rate is expected to remain high until the inflation rate converges to EU levels. The consolidated budget deficit is below 3 percent of GDP, but this has been achieved during a period of high economic growth. The public debt to GDP ratio (see figure 2.5) is the only convergence criterion that Romania meets consistently.



Source: Ministry of Finance and National Bank of Romania.

**Figure 2.5. Public debt as a percent of GDP, 1990-2004**

The accession to the EU has several fiscal implications, requiring additional expenditure in fields like agriculture, environment and infrastructure. Therefore three pre-accession instruments have been financed by the European Community to assist the pre-accession preparations:

- The PHARE program, which provides support for institution building, investment in support of the regulatory infrastructure to comply with the *acquis*, and investment in economic and social cohesion. PHARE program is further meant to develop the institutions and mechanisms that will sustain the implementation of the Structural Funds after the accession;
- SAPARD, which provides support for agriculture and rural development;
- ISPA, which supports infrastructure projects in transport and environment areas.

The financial assistance for 2004 amounts to about 825 million euro (about 1.4 percent of Romania’s GDP): 405.3 million from the PHARE program, 158.7 million from SAPARD and between 289 and 343 million from ISPA. Although the absorption rate of funds in terms of commitments is high (97 percent for the PHARE program and about 80 percent for the SAPARD) their implementation is often delayed, leading to extensions of deadlines for projects completion. Furthermore, while large grants from the EU are expected until 2006, averaging 800 million euro per year, the IMF estimates that Romania will face an additional financing gap of about 1 percent of GDP per year (IMF, 2001).

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The strong commitment of the government towards EU integration and an appropriate policy-mix resulted in an improved macroeconomic performance and further progress towards accession. However, the Commission emphasizes the need for further structural reforms and maintaining macroeconomic stability. Special attention should be given to improving the judicial and administrative capacity in Romania, so as to be ready for the membership by January 2007 (European Commission, 2004).

### 2.3.5. Budgetary and fiscal developments during and after the 1990s

The consolidated government budget in Romania includes the state budget, the social security fund and the local government administrations budget. Several other smaller funds have been included in the consolidated budget, which cover additional areas of social support (including unemployment compensation of farmers' pensions) and some more specialized functions<sup>21</sup> (such as energy projects and road construction) or which gather the revenues from privatization (State Ownership Fund-SOF).

The budget management system has been weak during the 1990s both at the level of preparation and execution. The budget has been based on macroeconomic forecasts and assumptions. However, their usefulness seemed to be limited. The underground economy and the instability of fiscal legislation have made it difficult to establish a significant relation between the fiscal base and revenue collections. Difficulties encountered in tax administration and tax collection have made the forecasts even more unreliable. Expenditures have not been easy to predict either. Most of the times they have been a result of negotiations based on the previous year's budget rather than the present value of the previous period expenditures (OECD, 1998). As a consequence, Romania's fiscal position has remained precarious during the 1990s, despite the important progress towards more efficient and sustainable public finances (IMF, 2001).

The inconsistent reforms in the first six years of transition, coupled with large increases in fiscal and quasi-fiscal deficits caused macroeconomic imbalances, which emerged in late 1996. The rise in the fiscal deficit had been the result of declining rather than growing expenditure, in the context of decreasing government revenues. Because of the relatively low public debt, the fiscal trends of 1996 did not immediately seem a reason for alarm. The consolidated government budget represented however only a partial view of the overall picture. It did not capture completely the deterioration (OECD, 1998) that actually occurred in 1996:

- First, the projected deficit of 2.2 percent of GDP turned into an actual 3.9 percent of GDP. The budget was rectified three times during the year, in August, November and December, with significant changes in the projections of the corporate tax revenues. For instance, in August 1996 the projected corporate tax revenues were revised downwards with about 1.2 percent of GDP. Therefore, the deficit arose primarily in the state budget. The state budget deficit

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<sup>21</sup> The funds with specialized functions have been included in the state budget starting with 2003.

## Fiscal restructuring and macroeconomic performance

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of 4.9 percent of GDP was partly offset by a surplus of 1 percent of GDP in the unemployment fund.

- Second, some of the public expenditures due in 1996 were carried forward to 1997. These expenditures included the subsidy payments to farmers and the thirteenth monthly salary for public sector employees. Therefore, measured on accrual basis the consolidated budget deficit of 1996 turned out to be 5.8 percent of GDP.
- Furthermore, a large quasi-fiscal deficit was accumulated during 1996 due to the support provided to the economy. The National Bank of Romania's refinancing increased by 3.4 percent of GDP during 1996. The main part of the increase consisted of various forms of structural credits and other targeted credits. About half of these credits represented targeted lending to the agricultural sector, through refinanced loans provided by Banca Agricola<sup>22</sup>. The rest was used to support the industry, especially the energy-intensive sectors, to provide support for two state-owned banks in difficulty, and to support the purchases of government debt by the domestic banks. Various trading restrictions were used to support the exchange rate in 1996. As a result, an implicit tax on exports and subsidy on imports was created. The policy was mainly directed at lowering the price of energy imports. An indication of the size of the quasi-fiscal support could be given by the growing divergence between the official exchange rate, most probably overvalued, and the foreign exchange offices' rate<sup>23</sup>. The premium in the foreign exchange offices' rate averaged 12 percent over 1996. Finally, the increase of payments arrears to the budget (including the social security fund) contributed to shortfalls in government revenue.

The substantial fiscal adjustment undertaken starting with 1997 consisted of increases in revenues and cuts in primary expenditures. The tax revenue collection has rebounded, while the initial expenditure cuts have concentrated on wages, pensions and capital. The main accomplishment of 1997 has been the elimination of all forms of quasi-fiscal spending. The support for agriculture, industry and other economic activities has been fully brought in the budget (IMF, 2001). The fiscal adjustment undertaken in 1999, which resulted in a decrease of the budget deficit up to 1.9 percent of GDP, was achieved in the context of a serious recession (National Bank of Romania, 2000).

More progress has been made starting with 2001 when the control over budgetary expenditures has been regained by reducing the number of extra-budgetary funds from 18 to 9. Furthermore, the 2002 budget Law has been passed on time for the first time since the beginning of the transition. The fiscal deficit increase of 2000, corresponding to a pre-election period, was also reversed afterward, and the quasi-fiscal deficits for 2000-2001 were estimated to be only about 1 percent of GDP. The principal remaining quasi-fiscal element consisted of losses in publicly owned enterprises, which are funded through the accumulation of arrears or loans under state guarantee. Another source of quasi-fiscal deficits could be the energy price

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<sup>22</sup> Banca Agricola was a state-owned commercial bank whose initial purpose was to provide support for the agricultural sector. As already mentioned, it was privatized in 2001.

<sup>23</sup> The foreign exchange offices' rate may be considered a more market-oriented rate.

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subsidization. While the direct subsidies are included in the budget, the difference between the world price and the domestic price of energy could also be considered a form of subsidy and included in the expenditures (OECD, 2002). Further progress has been achieved in 2002 and 2003 when the consolidated budget deficit fell to an estimated 2.6 percent of GDP and 2.3 percent of GDP respectively, in the context of a resumption of growth. Moreover, the established target of 2.9 percent of GDP for 2004 is likely to be overshoot even though 2004 is an electoral year (IMF, 2004b).

### Revenue policies

The continuous downward trend in the revenue collections during the 1990s was reversed in 1999 and slight efficiency gains were achieved in tax policy. The importance of income and wage taxation has been reduced, decreasing the distortions and the incentives for rent-seeking activities and non-wage labor costs. Instead, more importance has been given to indirect taxes, which are easier to administer and lead to fewer distortions (IMF, 2001). Furthermore, the very frequent change in tax legislation<sup>24</sup> throughout the 1990s resulted in a poor business environment. Progress was made in 2004 through the adoption of the Fiscal Code<sup>25</sup>, which encompasses most of the legislation in the taxation field.

The wage-based taxation was characterized by diverging developments in the personal income taxation and social security contributions. In 1992, the personal income schedule had 13 brackets and marginal rates ranging from 6 to 45 percent. The top marginal rate was further increased to 60 percent in 1993 accompanied by an increase in the number and classes of exempted taxpayers. Given the harmful effects of such high marginal tax rates the authorities decided to reduce the top rate to 45 percent as of 1997. The number of brackets and the spread between the top and bottom rates were also reduced. In 2000 the previous categorical system was replaced by a global income tax covering all sources of personal income. The policy aimed at broadening the base while further reducing the marginal rates, and lowering the tax burden on low-wage earners (IMF, 2001). The highest marginal rate was set at 40 percent and kept unchanged throughout 2004. Starting with January 2004 the legislation on the personal income tax has been included in the Fiscal Code. Furthermore, starting with January 2005, a flat income tax of 16 percent has been implemented.

The statutory social security contributions rate reached 35 percent of gross wages in 1997, after initial increases in 1990 and 1991. It was further increased during 1998-1999, reflecting both the deterioration in the financing of the pension fund and the establishment of the National Health Insurance House modeled on the German system. Unfortunately, these increases resulted in lower compliance and adverse effects on employment and inflation. Another attempt to reverse the unsustainable level and composition of the social security contributions was undertaken in 2000, when the authorities took steps to increase the tax base by making civil contracts subject to social security contributions. However, this measure gave incentive to

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<sup>24</sup> During the 1990s most of the tax legislation has been managed through government ordinances.

<sup>25</sup> Law no.571/23 December 2003 regarding the Fiscal Code.

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further tax evasion. A new law<sup>26</sup> regarding the public pension system and other social security benefits entered into force on April 1, 2001. The law differentiates the social security contribution rates according to three types of work conditions: normal, particular and special work conditions. Particular work conditions include those conditions which can temporarily or permanently affect the work capacity due to a high risk exposure. They are established through government decision<sup>27</sup>. The special work conditions include: mining establishments, for employees working underground more than 50 percent of the normal working time per month; activities involving manipulation of nuclear materials; the civil air force, for air crews; and some of the artistic activities involving high risks in affecting the work capacity. The social security contributions rates are fixed yearly. Table 2.1 presents the social security contributions rates between 2000 and 2004.

**Table 2.1. Social security contribution rates (%)**

Social security contribution rates (%)	2000	2003	2004
Normal work conditions	35	34	31.5
Particular work conditions	40	39	36.5
Special work conditions	45	44	41.5

Source: Ministry of Finance.

In 2003 the government decided to start reducing the social contribution rates as their high level prompted tax evasion. Further cuts of at least 1 percentage point per year were envisaged for 2005-2007 in the 2003 Pre-accession program (Romanian Government, 2004). The targets were subsequently raised to more ambitious levels in the 2004 Pre-accession program, amounting to a reduction of 10 percentage points during 2006-2008, of which 8 percentage points are earmarked to reduce the contributions by employers (Romanian Government, 2005).

The corporate income tax was introduced in 1990. Efforts were made starting with 1992 to reduce the number of rates which amounted to 68 in 1991 (from 0 to 77 percent). The two rates applying after 1992 (30 and 45 percent) were further reduced to a uniform rate of 38 percent starting with 1996. However, there were two problems associated with the regulations enforced in 1996. First, the statutory rate was the second highest (after Slovakia) among the Eastern European countries, giving rise to tax evasion. Second, the frequent and *ad hoc* tax holidays and investment incentives, which were based on short-term assessment of the relative importance of the investment promotion with respect to the tax revenue collection, eroded the credibility of the tax regime and proved to be damaging for the business environment. Thus, the reform undertaken in 2000 abolished all sorts of tax holidays and further lowered the statutory rate to 25 percent, while introducing an investment tax allowance of 10 percent (IMF, 2001). However, a reduced tax rate of 6 percent was then implemented for taxable profits from export revenues. In reaction to the

<sup>26</sup> Law no.19/27 March 2000 regarding the public pension system and other social insurance benefits.

<sup>27</sup> The work conditions are established by the HG no.261/22 February 2001 regarding the criteria and the methodology for categorizing the particular work conditions.

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European Commission's objections<sup>28</sup>, the tax rate applied to export-related profits was increased to 12.5 percent in 2003 and to 25 percent in 2004 (Romanian Government, 2004). Starting with 2004, the regulations regarding the corporate income tax became part of the Fiscal Code. In January 2005 the corporate tax rate has been set to 16 percent. Although an enormous progress has been achieved compared to the beginning of 1990s in the field of corporate income tax, further steps are needed in order to complete the harmonization with the EU *acquis*<sup>29</sup>.

Substantial progress was made in introducing a modern system of indirect taxes. The value-added tax (VAT) replaced the turnover tax in 1993. With a statutory rate of 18 percent, the international experience would have suggested that revenue collections should be around 9 percent of GDP. However, the VAT revenue collections reached only 4.6 percent of GDP in 1997. The poor performance was caused by the large number of exemptions and multiple rates and the difficulties of tax administrators to adjust to the difference in the nature of the VAT from the previous turnover tax (IMF, 2001). Therefore, the comprehensive VAT reform undertaken in 2000 embodied a single positive rate of 19 percent, a zero rate for exports and international passenger transport, and a wider tax base. The reform was expected to increase the VAT collections up to at least a level of 9 percent of GDP over the next few years. However, VAT revenues were still as low as 6.3 percent of GDP in 2001, due to the large share of the informal sector and a number of tax exemptions. Further progress was made in 2002 in harmonizing the VAT legislation with the EU *acquis* by introducing the definition of taxable person, eliminating the concept of zero VAT rate and replacing it with the "exemption with the right of deduction", and eliminating some tax exemptions. In 2003 the regulations regarding the VAT refunding were improved, and some exemptions granted for activities undertaken by the NATO member states in Romania (Romanian Government, 2004). The VAT revenues reached 7.2 percent of GDP, still below their expected level. In 2004 the VAT regulations were included in the Fiscal Code. As already discussed in section 2.3.4, to comply with the *acquis*, exemptions were replaced in 2004 by a reduced rate of 9 percent, in accordance with the Sixth Council Directive (77/388/EEC).

The excise duties were introduced in 1993, as part of the process of replacing the turnover tax. They mainly concern mineral oils, tobacco and beverages, but are also levied on some luxury goods and passenger cars. Their administration proved very difficult from the very beginning. Thus, some attempts to tackle the underlying problems have resulted in changing some specific rates to *ad valorem* taxes and further specifying the *ad valorem* taxes in euro terms to prevent the need for frequent inflation adjustments (IMF, 2001). Furthermore, the excise revenues proved to be relatively low, with 2.6 percent of GDP in 2000 and up to 3.2 percent in 2003, due to the large share of the informal sector (IMF, 2004c). Moreover, the frequent changes created other problems. For example, during 2002-2004 the excise duty

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<sup>28</sup> The reduced tax rate was thought to operate as an implicit export-specific subsidy, creating competition distortions with respect to the EU member states.

<sup>29</sup> See section 2.3.4 for further discussions.

## Fiscal restructuring and macroeconomic performance

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levels were modified six times<sup>30</sup>. Nevertheless, progress was made regarding the harmonization with the EU *acquis*<sup>31</sup>, especially by the newly adopted Fiscal Code<sup>32</sup>.

Trade liberalization and the tariffication of the quantitative restrictions generated a quick increase of tax revenues from trade in the early stages of transition. A level of 1.5 percent of GDP has been maintained through 1999. However, the rising pressure on the current account resulted in the decision to introduce a general import surcharge of 6 percent in 1998, which was then reduced to 4 percent in 1999 and 2 percent in 2000, and was eliminated in 2001 (IMF, 2001). The tariffs revenues fell continuously after 2000, from 1.1 percent in 2000 to 0.7 percent in 2003, as a result of the elimination of tariff rates for EU trading partners in preparation for EU integration. Romania's currently applied tariffs average 18.6 percent for all products, compared to the EU level of 6.3 percent. Romania agreed at the Ljubljana Ministerial Meeting that tariff alignment would not take place before the enlargement unless there is a demonstrable economic interest<sup>33</sup>.

### Expenditure policies

By 1996 fiscal and quasi-fiscal expenditures had become largely unsustainable. The rapid accumulation of debt, from 0.9 percent of GDP in 1990 to 28.1 percent of GDP in 1996 gave rise to financing problems. Therefore, the fiscal adjustment of 1997 concentrated on the reduction of primary expenditures, further accommodating the high interest costs. The major problem areas identified by IMF were the government wage bill, the social security system, the transfers and subsidies expenditures, and interest costs (IMF, 2001).

The government wage bill reached a relatively high level in 1996, representing about 20 percent of the total government expenditures. Contrary to expectations, the transition to the free-market economy was accompanied by an increase in government employment to reduce the social costs of transition. Government employment had increased by 10 percent during 1990-1996. Furthermore, the early attempts at reducing the wage rate proved unsuccessful. A drastic cut in wage expenditure was undertaken in 1997, resulting from a reduction in wages and employment. However, the reduction did not last and the wage bill increased again. Government employment was reduced by only 4 percent by the end of 1999, while the average monthly government wage rose up to a level of 110 USD by mid-2000, driven by the wage increases in the education, defense and compulsory social security sectors (IMF, 2001). The government wage bill remained high in 2001, at a level of 5 percent of GDP, followed by a declining trend throughout 2002-2003 (4.9 percent of GDP in 2002 and 4.8 percent of GDP in 2003). However, further reductions are needed to improve fiscal sustainability (IMF, 2004d).

The social security system also faced major problems in Romania. The pension system appeared to be unsustainable from the beginning of 1990s. The financial

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<sup>30</sup> The evolution of excise duties on mineral oils is further provided in chapter 7, table 7.5.

<sup>31</sup> See section 2.3.4 for a discussion on the harmonization of the excises duties with the EU *acquis*.

<sup>32</sup> The legislation regarding the excise duties is now part of the Fiscal Code.

<sup>33</sup> Information available at: <http://mkacedb.eu.int/cgi-bin/stb/mkstb.pl>

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health of the pay-as-you-go (PAYG) defined-benefit (DB) system was compromised by the extension of pension benefits to non-contributing employees, mainly farmers and employees in agricultural enterprises. Further, the contributions were too low to cover the implied replacement rate. In the following years the pension system deteriorated even further. The growing number of pensioners was accompanied by a continuing decline in the number of contributors. The dependency ratio of the number of contributors per pensioner became lower than one, while the statutory rates became excessively large. Furthermore, even though the pensions reached an historic low, the deficit of the pension system continued to increase (IMF, 2001). In 2000, a reform of the pension system was initiated. The self-employed became subject to social security contributions and the pensions were indexed to the CPI. Also the retirement age increased to 62 for men and 57 for women and was supposed to be further increased by another three years over a 13-year period. However, a more comprehensive reform is further needed (OECD, 2002). The high current levels of the contribution rates invite tax evasion. Therefore, the reduction in the statutory contribution rates, as envisaged by the Romanian government in the Pre-accession program, is essential. The Pre-accession program identifies further measures to improve the long-term sustainability of the pension system: to enforce viable replacement rates and rules for pensions' indexation, to maintain the real value of the social benefits, to increase the voluntary compliance and social security contributions collection (Romanian Government, 2004). The private sector should be further involved in providing social security services.

The subsidy and transfer expenditures increased sharply in the beginning of 1990s. Due to the increasing difficulties of financing these expenditures within the government budget, a large share was moved off-budget in 1993. This resulted in large quasi-fiscal deficits by the late 1996. Beginning with 1997 subsidies and transfers were reduced and brought fully into the budget. Further, the full price liberalization resulted in a drastic decrease of price subsidies. The only implicit subsidy is the one on energy prices (OECD, 2002). In 2000 direct subsidies to enterprises represented around 1.3 percent of GDP (National Institute of Statistics, 2003). Roughly half of these subsidies were supporting public passenger transport, of which 85 percent for railways public transport. Given the commitments assumed in the process of preparation for the EU accession (to improve financial performance of state-owned enterprises and to reduce state aid), the government's medium-term expenditure plans envisage a cut in subsidies. In turn, the capital expenditures on infrastructure, especially on motorway construction, are expected to rise (IMF, 2004c).

The rapid buildup of public debt in the first years of transition generated an increase of interest payments, amounting to 5.3 percent of GDP in 1999. Two main mechanisms contributed to the accumulation of public debt:

- The government recapitalized the state-owned banks, which until 1996 provided quasi-fiscal subsidies to the heavy industry and agriculture and which had accumulated a large nonperforming portfolio.

## Fiscal restructuring and macroeconomic performance

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- Loan guarantees were extended through 1996 to finance current operating and subsidy expenditures for state enterprises and agriculture. Their frequent default further burdened the budget.

Furthermore, the price liberalization induced positive real interest rates and increased the cost of raising domestic finance. According to IMF estimates (IMF, 2001), assuming positive single-digit real interest rates and also maintaining an average primary budget surplus of about 2.3 percent of GDP would bring down the interest expenditure to about 2 percent of GDP in 2004. Indeed, interest payments in 2003 fell to a level of 2.1 percent of GDP (IMF, 2004d).

An important challenge for the years to come will be to cope with the additional costs of the EU integration process, estimated to be about 4 percent of GDP for the period 2001-2004 (OECD, 2002). They could induce a financial gap of 1 percent of GDP per year during 2005-2006 according to IMF estimates (IMF, 2001). Furthermore, the Pre-accession program identifies some budgetary risks that should be tackled in the medium run: the rise in the budget deficit coupled with an increase in the quasi-fiscal deficits and the lag in the structural reforms, the arrears to the government budget, the pension system, and the default rate for the publicly guaranteed external debt (Romanian Government, 2004).

### 2.4. Conclusions

This chapter reviews some theoretical and empirical aspects related to growth in transition, followed by a discussion of economic developments in Romania, with special emphasis on the preparation for the EU accession and some budgetary and fiscal policies. It concludes that a high quality of governance is a prerequisite in deepening the market-oriented economic structures in all transition countries, including Romania. In the same line, the improvement in the judicial and administrative capacity is one of the points advocated by the Brussels European Council for Romania. Although Romania has been recognized as a functioning market economy by the European Commission, further steps should be taken with respect to structural reforms, while maintaining macroeconomic stability. Further efforts are also expected in continuing the alignment with the EU *acquis*, even though a “fair level” has been already achieved in the most of areas.

A significant progress has been made in budgetary and fiscal terms compared to the beginning of the 1990s. Nevertheless, in the following years the authorities will have to deal with the costs related to the process of preparation for the EU accession: both budgetary and social costs. Some of the socio-economic costs related to the harmonization with the EU *acquis* and the public expenditure restructuring in line with the EU requirements are evaluated in chapter 7.



## **Chapter 3**

### **Brief overview of empirical CGE models**

#### **3.1. Introduction**

Since the early 1960s computable general equilibrium (CGE) models have been used to analyze an enormous variety of issues ranging from the effects of agricultural and trade policies to tax policies, environmental policies, regional policies, etc. Although most of the empirical CGE models are still single-country, single-period models, efforts have been made in developing multi-regional and multi-period (dynamic) frameworks to analyze the outcomes of different economic policies.

A comprehensive survey of CGE models is practically impossible due to the rapid expansion of the research in this field. The few survey papers already published consider different subgroups of CGE models, such as those used for analyzing tax and trade policies (Bandara, 1991; Pereira and Shoven, 1988; De Melo, 1988; Shoven and Whalley, 1984), environmental policies (Beaumais and Schubert, 1996), agricultural and trade policies (Van Tongeren, Van Meijl and Surry, 2001), energy policies (Bhattacharyya, 1996; Bergman, 1988) and regional policies (Partridge and Rickman, 1998).

The aim of this chapter is to survey the empirical CGE models for Eastern European economies, in order to put into perspective the model of the Romanian economy developed in this study. Romania is a transition country, which explains why the present survey focuses on the CGE models for Eastern European economies and their transition to a market oriented economy. Furthermore, Romania's preparation for the EU accession provides grounds for comparison with the new EU member states. The chapter starts by developing the conceptual framework of the computable general equilibrium analysis, providing a brief history of its development and a definition. The classification, according to various criteria, allows at providing more insights in the field of CGE models. Subsequently, the brief overview of computable general equilibrium models for Eastern Europe will show that the disaggregated model presented in this study is the first of its type to be built for the Romanian

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economy and, more generally, that there are only few CGE models which deal with questions regarding transition economies.

### 3.2. Definition and brief history

Combining and narrowing the definitions of Dixon and Parmenter (1996) and Dervis, De Melo and Robinson (1982), Thissen (2000, p. 50) defines a CGE model “as the fundamental macro-economic general equilibrium links among income of various groups, the pattern of demand, the balance of payments and a multisector production structure. Moreover, the model incorporates a set of behavioral equations describing the economic behavior of the agents identified in the model and the technological and institutional constraints with which they are faced. The model is in general equilibrium, because a set of prices and quantities exists, such that all excess demands for commodities and services, in nominal as well as in real quantities, are zero.” Thus, the main features of this type of models are summarized by their own name: *Computable*, because they produce numerical results; *General*, because they include explicit specification of the behavior of several economic actors; and *Equilibrium*, because they employ market equilibrium assumptions (Dixon and Parmenter, 1996). The CGE models can be alternatively found in the literature as Applied General Equilibrium (AGE) models or SAM (Social Accounting Matrix) based general equilibrium models.

The first CGE model, according to this definition, is attributed to Johansen (1960). He developed a numerical, multi-sectoral (20 sectors model) general equilibrium model for the description of growth in the Norwegian economy. Johansen derived a linear approximation of the model by taking the logarithmic derivatives of the nonlinear CGE model, and further solved it by simple matrix inversion. However, the 1960s were not an active period in CGE modeling. More attention has been paid to the development of economy-wide econometric models based on time-series data and less focused on the economic theory. Meanwhile, the leading general-equilibrium economists were preoccupied with developing the theoretical framework for the general equilibrium models. Scarf (1967 and 1969) made the most direct link between theoretical work and the empirical CGE modeling, by designing a fixed-point algorithm for computing solutions to numerically specified models, without a prior linear approximation (Dixon and Parmenter, 1996). His students, John Shoven and John Whalley adopted the algorithm and became later, in the early 1970s, the leading contributors in the field, by constructing several CGE models for developed countries.

In the 1970s, the major shocks to the world economy, including the sharp change in the energy prices, increased the interest in the CGE modeling. The approach used in the econometric models at that time, of looking at the data without relying on sound theoretical specifications, failed to provide useful simulations of the effects of shocks. Besides, the improvement of the data basis required for CGE modeling and of the computer programs increased the ability of CGE models to handle details. CGE modeling became an established field of applied economics (Dixon and Parmenter, 1996). Furthermore, in the late 1970s Adelman and Robinson (1978)

provided the first CGE model for a developing country (Korea) which started a long list of applications. To solve the model they considered it as being a set of non-linear equations and derive the solution directly, using numerical techniques (Robinson, 1989). Nowadays, a number a software packages (e.g. GAMS, GEMPACK, TROLL, MATLAB) are available for solving complex mathematical programming models.

Over the last 30 years a large number of CGE models have been developed. Their results are concerned, among other things, with: employment, income distribution, social welfare and environment, industries, education and training. A substantial number of CGE models were constructed for the developing countries. Whereas the CGE models built in the seventies were basically static, the research in the eighties has evolved to dynamic aspects. For applied economists, the CGE field offered the challenge to incorporate into the models the ideas emerging from macroeconomics, like rational expectations and the differences between the effects of anticipated and unanticipated shocks. The applied general equilibrium analysis became an important instrument for policy analysis, attractive not only for economic researchers but also for national and international policy makers.

### 3.3. Classification of the CGE models

Given the rapid expansion of the literature on CGE analysis in the past 30 years as well as the large diversity of CGE models, it is impossible to present an exhaustive list of classification criteria. Our analysis will focus just on few aspects regarding the theoretical background, the incorporation of dynamics and the technique used to determine the parameters.

#### 3.3.1. Developed countries models versus developing countries models

Along the lines of Chenery (1975) and Robinson (1991), a first breakdown of CGE models can be related to their historical application:

- in the developed and;
- in the developing countries (see figure 3.1).

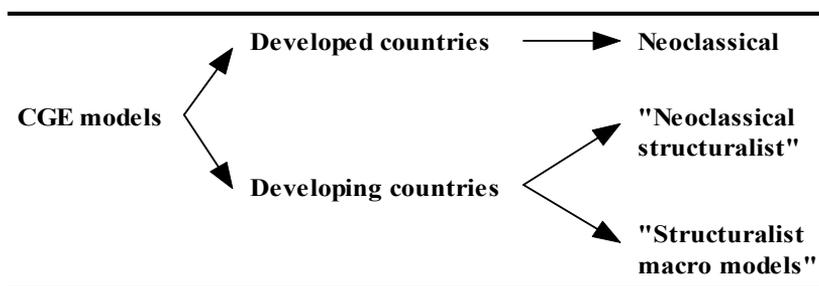


Figure 3.1. Classification of CGE models according to their initial application

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In the past, the CGE models designed for the developed countries were mainly neoclassical. They were based on the hypothesis of optimizing agents and full labor employment and capacity utilization. They evolved from the general equilibrium framework of Walras and the work on the numerical solution of a Walrasian system, by Scarf (1967). They were mainly used to answer the efficiency questions in neoclassical welfare analysis (Robinson, 1991; Taylor, 1990a).

In contrast, the models built for the developing countries have focused on structural issues, as a consequence of the need to examine the structural cause of underdevelopment. One direction in their development was initiated at the World Bank, by the study of structural adjustment in the medium run. Starting from the work of Dervis, De Melo and Robinson (1982), these “neoclassical structuralist”<sup>34</sup> CGE models have been based on the neoclassical real trade theory, but also incorporating a number of adjustment rigidities, such as price ceilings and import rationing. Robinson (1989) argues that these imperfections may have either an institutional source or they are dependent on the policy choices. “Neoclassical structuralist” models do not include macro variables like interest rates or inflation, having strong roots in Walrasian general equilibrium and real trade theory (Robinson, 1991). A second direction of the “structuralist” macro models, in particular articulated by Taylor, have its roots in the theory of Marx, Kalecki, Kaldor and Keynes (Taylor, 1990a). In their view the economy’s behavior is fundamentally based on its structural characteristics. Structural factors like the distribution of income, the degree of specialization in foreign trade, control over the means of production by distinct types of actors, the geographical and sectoral distribution of population, and its skills level are at the foundations of this type of models (Taylor, 1990a). “Structuralist” macro models often assume that macroeconomic causality runs from the demand side under passive money supply conditions. Robinson (1989) points out that this approach further seeks to integrate macro models with multisectoral models, and thus to bring together Keynes with Walras.

The first attempt at integrating the macro models with neoclassical, trade-focused CGE models was made by Bourguignon, Branson and De Melo (1989). Their “maquette” model is considered to be the ancestor of the “financial” CGE models, which share many of the structuralist features of the models developed by Taylor. Furthermore, the “structuralist” macro models built since the late 1990s evolved as well, relying on a sector-dependent combination of price and quantity adjustments (Vos, 1998). Thus, the two schools of thoughts (neoclassical and structuralist) appear to move closer together (Robinson, 1991). Moreover, the CGE models for the developed countries incorporate nowadays some structuralist features.

### 3.3.2. Macro closures

The formal introduction of the concept of closure rule can be traced back to Sen (1963). Sen (1963) showed that the necessary ex-post equality between savings and investment cannot be fulfilled when all the following conditions are satisfied: the factors are paid at their marginal productivity, household consumption is a function

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<sup>34</sup> The term “neoclassical structuralist” goes back to Chenery (1975).

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of real income, real investment is fixed, and the factors are fully employed. The equilibrium is achieved only by relaxing one of these constraints. The choice of the constraint to be dropped represents in fact the choice of the closure rule. In mathematical terms, the model should consist of an equal number of independent equations and endogenous variables. The closure rule reflects the choice of the model builder of which variables are exogenous and which variables are endogenous, so as to achieve ex-post equality.

The selection of the closure rule is not only concerned with the technical solution of the problem described above but is also a reflection of choice of theory. It specifies which functions need to be described explicitly and which variable are allowed to adapt to ensure that savings and investments equate. For example, the neoclassical theory would imply that labor is paid to marginal factor productivity and specify a functional form for the real wage rate. The neo-Keynesian theory on the other hand would imply a fixed nominal wage rate and an endogenous price level determination. Thus, the choice of the closure rule affects the policy simulations results obtained with a CGE model.

Although the early work on macro “closure” focused on the savings-investment balance, Adelman and Robinson (1989) pointed out that there are three macro balances in any SAM-based model:

- The government balance;
- The external balance and;
- The saving-investment balance.

and each of them can be a potential source of ex-ante disequilibria, which must be reconciled ex-post.

Cattaneo, Hinojosa-Ojeda and Robinson (1999) discuss these closures with a CGE model for Costa Rica. The government saving macro balance can be assured in two alternative ways. First, the aggregate real government spending is fixed exogenously with revenues depending on the tax instruments such that government savings adapt endogenously. Another possibility, adopted in the trade liberalization scenarios by Cattaneo, Hinojosa-Ojeda and Robinson (1999), is a revenue-neutral government closure, where government savings are fixed, while either the corporate tax rate or the sales tax rate is endogenous. Löfgren, Harris and Robinson (2002) further refine the revenue-neutral government closure, with taxes either adjusting endogenously by the same number of percentage points or by being multiplied by a flexible scalar. For the external balance, Cattaneo, Hinojosa-Ojeda and Robinson (1999) implement two alternatives closure rules. First, foreign savings are fixed exogenously and the real exchange rate is allowed to vary. In the trade liberalization experiments Cattaneo, Hinojosa-Ojeda and Robinson (1999) also assume an alternative closure where the exchange rate is kept fixed and foreign savings are determined endogenously. This closure assumes that the economy is financing an increase in the trade deficit by attracting capital inflows or external aid. In the third type of macro balance, the saving-investment balance itself is the object of a closure rule. Savings-investment closures focus on some combination of adjustment mechanisms of investment, output and savings ratio. In the following, we will discuss in some more detail the

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saving-investment macro “closures”, given the extensive attention they received in the literature: Taylor and Lysy (1979), Bell (1979), Rattso (1982), Dewatripont and Michel (1987), Adelman and Robinson (1988), Robinson (1989), Bandara (1991), Thissen (2000), Kraev (2003).

The choice of the savings-investment closure rules can be illustrated using the following one-period model for a closed economy (Sen, 1963):

$$\text{Supply of goods:} \quad X = f(K, L) \quad (3.1)$$

$$\text{Labor demand:} \quad \frac{\partial f(K, L)}{\partial L} = w \quad (3.2)$$

$$\text{Income distribution identity:} \quad X = \pi + w \cdot L \quad (3.3)$$

$$\text{Saving-investment identity:} \quad I = s_p \cdot \pi + s_w \cdot w \cdot L \quad (3.4)$$

$$\text{Exogenous investment:} \quad I = \bar{I} \quad (3.5)$$

where  $X$  is output,  $K$  capital,  $L$  labor,  $I$  investment,  $w$  real wage rate,  $\pi$  total capital income,  $s_p$  and  $s_w$  propensities to save out of total capital income and out of wages, respectively.

The model assumes the production of only one good ( $X$ ), constant returns to scale, different propensities to save for capitalists and workers and ignores the depreciation of the capital stock. The investment behavior is given (equation 3.5), and is determined, for instance, by the “animal spirits” of the entrepreneur, or by their expected rate of growth. The labor and capital supply are both fixed in the short run:

$$\text{Labor supply:} \quad L = \bar{L} \quad (3.6)$$

$$\text{Capital supply:} \quad K = \bar{K} \quad (3.7)$$

As originally formulated by Sen, the question is whether a system can satisfy the equations (3.1)-(3.5) and at the same time account for full employment, i.e.,  $L = \bar{L}$ , and  $K = \bar{K}$ . The system is in fact overdetermined, with five equations and four variables:  $X$ ,  $w$ ,  $\pi$  and  $I$ . The solution is either to relax one of the constraints or to introduce some other variables in the system.

**The neoclassical closure** attributes a vital role to the savings. Investment is endogenous and is brought to equality with savings at a level that guarantees full employment through a mechanism that is not incorporated explicitly in the system (for example the interest rate). However, in the standard Solow (1956) model, the mechanism is neither discussed, nor an independent investment equation is introduced.

**The Johansen closure** attributes a decisive role to the investments. Sen (1963) points out that what this model implies is that a pattern of taxes and subsidies always brings the level of planned savings towards the autonomously fixed level of

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investment. This brings up the role of government and can also be achieved by introducing endogenous government spending or taxes in the system.

*The macro adjustment via real balance changes* implies that the adjustment mechanism can occur when exogenous money supply is introduced into the model, through the price level. In this case the saving rates are functions of “real balances” ( $\bar{M}/P$ ), where  $\bar{M}$  is the exogenous money supply and the price level ( $P$ ) is endogenous. An initial price increase will reduce national wealth. The economic agents, confronted with the change of the real value of their assets will save more to compensate, cutting consumption.

*The loanable funds/Fisherian closure* assumes that an additional variable, the interest rate, mediates the adjustment mechanism that brings investment and savings into equilibrium. The saving rates rise as a function of interest, while investment demand declines as a function of the interest rate. However, Taylor (1990a) emphasized an important problem regarding this adjustment mechanism, the strength of the interest rate effects in the developing countries. According to empirical findings, the overall savings do not seem to respond to interest movements in the developing countries, although the composition of the portfolio changes. Furthermore, low elasticities can limit the adjustment based on the variation of the interest rate. This is the reason that this type of closure is usually not used in applied CGE models.

*The neo-Keynesian/Kaldorian closure* assumes that labor is not paid according to its marginal productivity. The neo-Keynesian system is based on the simple formulation given by Kaldor (1956) and Pasinetti (1962), where an income-distribution mechanism achieves the savings-investment balance. The nominal wage rate is fixed, while the price level is endogenous and brings about the equilibrium between investment and savings by an increase in the income of high savers.

*The Keynesian closure* allows for unemployment. The equilibrium is achieved through adjustments in unemployment, which is an endogenous variable. The savings at full employment level could be different from investment, so that a variation in the level of employment could bring savings and investment into equilibrium. An increase in the aggregate output is always associated with a decline in real wages under this closure.

*Kaleckian/structuralist closure* is discussed by Taylor (1990b) and it is often used as closure in structuralist CGE models. It is based on Kalecki’s (1971) model of output adjustment in a closed economy. As in the Keynesian closure, the labor market does not clear. The share of wages in output is fixed and there are constant returns to labor. Furthermore, it usually assumes a maximum productive capacity, above which the system switches to forced savings.

In most of their models Dervis, De Melo and Robinson (1982) took the neoclassical view. Total investment is determined by savings behavior and is thus also a function of the distribution of income among different institutions or income categories (assuming that their savings rates differ). While Dervis, De Melo and Robinson

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(1982) argued for a “neutral” closing of the model, Taylor and Lysy (1979) stressed the political and economic considerations involved in choosing the closing rule.

### 3.3.3. Incorporation of dynamics in the CGE models

Traditional applied general equilibrium models have paid relatively little attention to the intertemporal aspects of decision-making and adjustment dynamics. The introduction of the time dimension in the CGE models has occurred, among other reasons, due to the increasing concern of policymakers about the intertemporal distortions induced by government interventions, including tax policies. Nevertheless, the incorporation of dynamics in the CGE models has proceeded only gradually. In the first stage, the transition path after an exogenous shock was represented as a sequence of static equilibria under the assumption of myopic expectations. In a later stage the modeling of dynamics was improved by considering intertemporal optimization and forward-looking behavior.

The treatment of intertemporal issues in CGE models has given rise to three different approaches: the static equilibrium approach, the recursive sequence equilibrium approach and the fully dynamic approach. A classification of dynamic CGE models is given by Dixon and Parmenter (1996), while a survey of dynamic CGE models for tax policy evaluation has been presented by Pereira and Shoven (1988).

*The static equilibrium approach* in the CGE models consider only one period. The model generates savings, investment, and demand for capital goods, where investment represents only a demand category and capital goods are not installed during the period. Most traditional CGE models, including Shoven and Whalley model (1972) and Dervis, De Melo and Robinson model (1982) are static. A more recent version of a static CGE model has been presented by Robinson, Yunez-Naude, Hinojosa-Ojeda, Lewis and Devarajan (1999). Van Tongeren, Van Meijl and Surry (2001) point out that sometimes static CGE models are used to evaluate policy effects at some future point in time. This is done by calibrating the model on an artificial dataset which is usually assumed to represent the steady-state growth path for that economy. In this case the capital stock (even though the capital goods are not installed during that period) is calibrated such that it is consistent with the steady-state assumption.

*The recursive sequence equilibrium approach* assumes that the model is solved for a sequence of static equilibria. The equilibria are connected through capital accumulation, while other variables are updated exogenously (e.g. population). They do not incorporate intertemporal aspects of decision making. Dixon and Parmenter (1996) distinguish two categories of recursive CGE models according to the type of expectations from which the behavior of economic agents is derived: myopic (static) expectations and adaptive expectations. In recursive CGE with myopic expectations the savings rates are exogenous and investment is given by total savings within the period. In the second case, investment in year  $t$  depends on the expected rate of return in year  $t+1$ . However, under the adaptive expectations assumption economic agents consider only the past for their optimization problem. Therefore, the expected rate of return in year  $t+1$  is determined by the rate of return and the cost of capital in year  $t$ . The first attempt to introduce dynamic elements into a CGE model was made

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by Ballard, Fullerton, Shoven and Whalley (1985). They extend the Shoven and Whalley model (1972) and implement it for the U.S. economy. Consumers have myopic expectations regarding future prices, especially regarding the future rate of return to capital. The production side is completely static. An example of recursive dynamics with adaptive expectations is provided by Dixon and Rimmer (2002) in the Monash model for the Australian economy.

**The fully dynamic approach** assumes that consumers' and producers' behavior is derived from both intra- and intertemporal optimization. All these models incorporate some form of life-cycle behavior. The household maximizes an additive separable time-invariant intertemporal utility function, while the producer's optimal behavior is determined by the maximization of the market value of the firm or by the maximization of the present discounted value of net cash flows. The market value of the firm is usually represented as the present discounted value of the future stream of dividends. These models are based upon the perfect foresight hypothesis and describe the transition path to the new equilibrium point. Intertemporal dynamic CGE models generally require a great computational effort because all the equations defined over the whole time horizon are solved at once. Therefore, they usually comprise only few production sectors.

The first efforts to introduce dynamic features into the modeling of economic behavior of consumers can be traced back to Ballard (1983) and Auerbach and Kotlikoff (1983). A special type in this class of models is the overlapping generations CGE model of Auerbach and Kotlikoff (1987), which is based on a 55-period life cycle model. Generations can be further linked in such a way that each generation can affect the utility of future generations through bequeathed wealth (Knudsen et al., 1998). On the producer side, the first attempts to implement dynamic features are those of Bovenberg (1985) and Summers (1985). Dynamic production and investment behavior are induced by the existence of capital adjustment costs and linked to Tobin's  $q$  theory. Adjustment costs are introduced to capture the installation costs of capital and the incomplete mobility of capital across industries. Dynamic features have also been included in modeling government behavior, the foreign sector and financial markets.

### 3.3.4. Techniques used to determine the parameters

An alternative classification of the CGE models can be derived according to the way that the parameters of the model are determined. Two main approaches to estimate the model parameters can be distinguished:

- Calibration;
- Econometric estimation.

**Calibration approach**, also called the "synthetic approach", exploits the equilibrium assumptions, the theoretical restrictions and the assumptions regarding the functional forms of the CGE model to evaluate the parameter values. It takes the initial estimates of the elasticities from outside sources and adjusts the other parameters in the given functional forms to the initial equilibrium dataset. As a consequence, the generated set of parameters is consistent with both the benchmark data and the

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model's theory. The initial equilibrium dataset commonly used in CGE models is a Social Accounting Matrix (SAM). In most cases, the parameters of CGE models are determined following this technique. Thissen (2000) proposed a refinement of the existing calibration approach, based on an estimation of the parameters using data for several years. The parameters are determined by minimizing an adjusted Root Mean Square percentage error for the endogenous variables and for several years.

*Econometric estimation of parameters* is applied using the simultaneous equations estimation methods that take into account the overall structure of the model. However, this approach is considered infeasible for large CGE models due to the degrees of freedom problems and the overwhelming requirements in terms of sophistication, data and time. Therefore, one has to resort to the single-equation estimation methods, using time series or cross-section data. The few existing econometrically specified CGE models are based on the work of Jorgenson (1984) and McKittrick (1998).

Recently, some authors (Kehoe, Polo and Sancho 1995; Dixon and Rimmer, 2002) have used a simple “validation” procedure as an alternative to the econometric estimation of parameters. They run a model backward over an historical period and compare the model results for some variables with the historical data. Consequently, the estimates for some important parameters are revised and the model is recalibrated in a kind of informal Bayesian estimation procedure. Even though the procedure uses limited historical data, making its use feasible compared to the econometric approach, it does not provide any statistical basis for evaluating the robustness of the estimated parameters. Arndt, Robinson and Tarp (2002) propose a maximum entropy approach to estimate the CGE models' parameters based on the “information theory” and the work of Shannon (1948)<sup>35</sup>. The method employs all the available historical data and can provide tests for estimated parameter values. Furthermore, it can be used in absence of numerous data and the full model tracks the historical data.

### 3.4. CGE models for Eastern Europe

#### 3.4.1. Brief history

In the past, CGE models have been considered by many not to be appropriate for the former centrally planned economies on both practical and ideological grounds. For example, in CGE models, consumers typically maximize their utility and producers maximize their profits and the demand for and the supply of products are cleared in markets at flexible equilibrium prices. This makes the CGE models particularly suitable for modeling a market-driven economy. In contrast, input-output models have long been used in many of the centrally planned economies to solve the “material balance” problem in quantitative planning. These fixed-price models proved to be more suitable to a system where the major policy instrument was direct quantitative control, and the price system was not given an important role.

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<sup>35</sup> Shannon (1948) defined a function to measure the uncertainty (entropy) of a collection of events.

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Nevertheless, as pointed out by Kis, Robinson and Tyson (1990), two factors enlarged the usefulness of CGE models for centrally planned economies:

- The major reforms undertaken in the late 1960s in some socialist countries, which were meant to improve the economic performance by instituting a new economic system with increased reliance on market mechanisms and price incentives. The leaders in these reforms were Hungary and former Yugoslavia;
- The development of the “structuralist” and the “neoclassical structuralist” CGE models, which incorporate a variety of “structuralist” features and recognize the existence of rigidities and imperfections in actual economies. Thus, when suitably adapted, a CGE model could be used for policy analysis in the post-reform socialist economies.

The two most important CGE models developed for the Eastern Europe in the 1980s were built under the auspices of the World Bank. Their main purpose was to analyze issues regarding structural adjustment in the medium run and especially, the impact of changes in foreign capital inflows and international trade on the structure and performance of the economy. The CGE model for Yugoslavia was developed at the World Bank, while the model for the Hungarian economy was built at the National Planning Office of Hungary and used to support analysis within the World Bank. The Hungarian economy model is based on earlier work of Zalai, who built the first CGE model for Hungary (HUMUS) in 1983. In the attempt to adapt the CGE framework so as to incorporate the important institutional features of socialist economies, both models evolved a long way from their neoclassical antecedents. An example could be the Yugoslav model, where the assumption of profit maximization of sectors is replaced by a complex set of relationships, which capture the operation of self-managed firms. The effect is that enterprises are less responsive to price signals and the workers income is not equal to the marginal productivity of labor. Nevertheless, these models still reflect their neoclassical roots, as they do not capture macroeconomic interactions among price level, the exchange rate, interest rates and monetary aggregates. The macro interactions are captured essentially through a special closure where inflation is endogenous and nominal personal income exogenous in the Yugoslav model, while forced savings close the Hungarian model.

Braber, Cohen, Revesz and Zolkiewski (1993) take up again the discussion regarding the use of CGE models for former centrally planned economies, from the perspective of the transformation of planning oriented economies to market oriented economies. They consider the Social Accounting Matrix (SAM) as the interface between a central planning model and a free market model and develop two types of models: a fixed price SAM multiplier model and a flexible price CGE model. The SAM model, with fixed prices, is considered to be more suitable within the centrally planned economy framework, while the flexible price CGE model is considered the free market economy prototype model. The CGE model developed in this framework is different from the earlier attempts undertaken by the World Bank, in the sense that it is mainly neoclassical and tries to portray an idealized free market economy. Both models are applied to the Polish and Hungarian economy. For each of them, two benchmark years have been introduced, a pre-transition year (1987 for

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Poland and 1988 for Hungary) and a transition (1990) year. There are two policy scenarios for each model and each country: increasing government demand for services, aimed at shifting the production structure towards services, and increasing government transfers to the first decile household group, aimed at changing the income distribution in favor of the poorest households. For both policy simulations the exogenous shocks seem to lead to smoother adjustments in the centrally planned economy case. More surprisingly, the second policy simulation suggests that the impact of government transfers on households' income is larger in a flexible price economy than in a fixed price economy. However, Braber, Cohen, Revesz and Zolkiewski (1993) point out that the reliability of the CGE policy simulations results is questionable due to the fact that an economy in transition can hardly be considered to be in equilibrium in the benchmark period, and thus the calibrated parameters may be misspecified. Their exercise is meant to show the functioning of the economy under different policy regimes.

During the 1990s, modelers have more readily applied the CGE framework to the Eastern European countries as these moved towards market oriented economies. The next four sections present the results of an attempted grouping of the CGE models for transition economies according to the purpose they have been built for. The first two categories analyze common issues in CGE modeling like trade liberalization and environmental policies. The third category focuses on a more specific problem that Eastern European countries have been confronted with: the accession to the European Union. Finally, the fourth category comprises other models that attempt to give a "general" description of the Eastern European economies, analyzing several different types of policy questions ranging from industrial policy and privatization to pension policy reforms and other tax reforms. A summary of empirical CGE models for Eastern Europe is provided in table 3.1.

### **3.4.2. Trade liberalization models**

Many CGE models have been built to analyze the consequences of trade liberalization for a country's welfare. The main reason for analyzing this issue in connection with the situation in Eastern European countries is the liberalization of the trade regimes with OECD countries and the collapse of the former trade and payments system for East bloc transactions, the Comecon, in 1990. The external liberalization consisted of the removal of non-tariff barriers and, more important, of the abolition of the state monopoly in foreign trade.

Table 3.1. CGE models for Eastern European countries

Model	Purpose of the model	Countries)	Classification	Modeling time dimension	Base year for data
Braber, Cohen, Ravasz and Zolkiewski (1993)	The functioning of the economy under different policy regimes	Poland Hungary	Neoclassical	Comparative static	1987, 1990 1988, 1990
Zalai (1993)	Analyzes the effects of trade liberalization	Hungary	Neoclassical structuralist	Comparative static	1990
Roberts and Round (1999)	Analyzes the effects of trade liberalization	Poland	Neoclassical structuralist	Comparative static	1987
Tarhoaca (2000)	Evaluate the effects of external shocks on the economy	Romania	Neoclassical structuralist	Comparative static	1997
Van Leeuwen (1997)	Analyze different energy and environmental policies	Poland Czech Republic Lithuania	Neoclassical structuralist	Recursive dynamics Comparative static Comparative static	1990 1992 1994
Galinis and Van Leeuwen (2000), version of Van Leeuwen (1997)	Analyze the economic and environmental impact of limiting the growth of nuclear fuel-generated electricity	Lithuania	Neoclassical structuralist	Comparative static	1994
Kimila (2003)	Analyzes the effects of SO <sub>2</sub> emissions reduction	Poland	Neoclassical structuralist	Recursive dynamics	1995
Kimila and Sleszynski, (2003), version of Kimila (2003)	Evaluate the effects of a comprehensive ecological tax reform	Poland	Neoclassical structuralist	Recursive dynamics	1995
Brown, Deandorff, Djankov and Stern (1995)	Evaluate the effects of EU-CEEC integration	Global coverage (distinguish Poland, Hungary and former Czechoslovakia)	Neoclassical structuralist	Comparative static	1992
Banse and Tangermann (1996)	Analyze the agricultural implications of Hungary's accession to the European Union	Hungary	Neoclassical structuralist	Recursive dynamics	1990
Piazzolo (2000)	Evaluate the effects of Poland's integration into the EU	Poland	Neoclassical (Ramsey-type model)	Dynamic optimization	1996
Lejour, De Mooij and Nahuis (2001)	Analyze the implications of EU enlargement	Global coverage (distinguish Poland and Hungary)	Neoclassical	Recursive dynamics	1997
Vanags (2001)	Evaluate the economic impact of EU accession for Latvia	Latvia	Neoclassical structuralist	Comparative static	1997

Table 3.1. CGE models for Eastern European countries (continued)

Model	Purpose of the model	Country(ies)	Classification	Modeling time dimension	Base year for data
Bayar, Majcen and Mohora (2003)	Analyse the effects of trade liberalization and financial flows between Slovenia and EU budgets after the accession	Slovenia	Neoclassical structuralist	Recursive dynamics	1997
De Haan (1993)	Analyzes the effects of changes in the nominal wage rates, markup rates and the nominal exchange rate	Poland	Structuralist	Comparative static	1990
De Haan (1995), version of De Haan (1993)	Analyzes the effects of changes in the nominal wage rates, markup rates and the nominal exchange rate	Hungary	Structuralist	Comparative static	1990
Roberts (1994)	Used to check to what extent the inferences from the model are robust to the choice of the base year and the assumed elasticities	Poland	Neoclassical structuralist	Comparative static	1986-1990
Roberts and Zolbiewski (1996), version of Roberts (1994)	Analyzes the distributional consequences of a decline in output and of privatization	Poland	Neoclassical structuralist	Comparative static	1990
Chatak and Roberts (1997), version of Roberts (1994)	Analyzes the effects of adopting a temporary industrial policy for Eastern Europe on reducing the social cost of transition	Poland	Neoclassical structuralist	Comparative static	1990
Roberts (1999)	Analyzes the consequences of the privatization process	Poland	Neoclassical structuralist	Comparative static	1989
Lemsink (1999)	Analyzes the financial reforms in the Polish stabilization program	Poland	Structuralist	Comparative static	1995
Jemejanov (1999)	Analyzes specific issues regarding the labor market	Latvia	Structuralist	Comparative static	1994
Furke and Strulik (2003)	Analyzes the effects of the 2000 income tax act	Estonia	Neoclassical (Ramsey-type model)	Dynamic optimization	2000
Jensen and Lassila (2001)	Analyzes the effects of different pension policy measures	Lithuania	Neoclassical (overlapping generations model)	Dynamic optimization	2000

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Zalai (1993) analyzes the effects of trade liberalization in Hungary with a modified version of the HUMUS model<sup>36</sup>. The latter is a single-period, multisectoral (21 production sectors) model, formulated in the spirit of mathematical programming models of resource allocation, with the objective of maximizing one or more components of final demand, subject to overall resource constraints. The model is essentially built for a centrally planned economy but also incorporates some market elements, introduced in connection with the reforms started in the late 1980s. The original HUMUS model reflects the institutional structure of Hungary's trade by modeling two separate trade balances, one denominated in USD and taking into account all transactions in hard currencies, the other denominated in roubles and taking into account all Comecom transactions. The new version of the HUMUS model reflects the collapse of Comecom and the liberalization of imports from OECD countries during 1989 and 1990, by incorporating a consolidated balance of trade. Nevertheless, the model still distinguishes between two trading regions following the author's belief that the behavior of representative agents in Eastern and Western markets is expected to be different for a few more years. An interesting feature of the model is that it allows a traditional analysis, based on a sophisticated input-output type solution, as well as a full CGE approach, taking into account the potential effect of a longer run structural adjustment in the economy, by running different policy simulations. The comparison reveals how misleading the standard input-output approach can be. Moreover, Zalai (1993) points out that the CGE solutions seem to capture much better the underlying economic reality.

Another attempt to analyze the effects of trade liberalization by using a CGE approach is the one by Roberts and Round (1999), for the case of Poland. They reconsider the traditional specification of imports in CGE models and develop an alternative representation which is more consistent with the situation in transition economies. Their specification of imports reflects a regime shift such that the scope for substitution between domestic and imported goods may change substantially, and differentiates between types of institutional users. In order to capture the importance of the user dimension, an Armington specification for combining imports and domestic supply by user is introduced, while the commodity dimension is suppressed. Another novelty in the model's specification relates to the supplies of domestically produced intermediate and final goods, which are introduced through supply-driven input-output relations. The CGE model is used to examine the different responses of consumers and producers when limited substitution between domestically produced and imported goods is introduced. The direction of many of the effects is predictable. For example, the increase in imports generates a deflationary impact (a typical Keynesian response). Roberts and Round (1999) emphasize the benefit of both the use of CGE approach and the institutional user import specification in capturing sectoral responses, which are less obvious. The main difficulty regarding this approach consists of the availability of data. Generally, imports are classified either by the type of commodity or by the type of purchaser. Relatively few countries produce separate tables for imported and domestic products, distinguishing not only by the type of commodity but also by purchaser

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<sup>36</sup> For a better understanding of the Humus family models, see Zalai (1998).

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group. When the latter classification is not available, the approach becomes infeasible.

The only CGE model built for Romania (Tarhoaca, 2000) is used to evaluate the effects of external shocks on the economy. The main features of the model are neoclassical structuralist. The model, calibrated for 1997, uses an Armington specification for imports and exports and applies a neoclassical closure with investment adjusting to the level of savings. The policy simulations consider two types of shocks. The positive shock is simulated either as an inflow of foreign savings or as an increase in the international price of exports. The negative shock is simulated either as an outflow of foreign savings or as an increase in the international price of imports. The results of the policy simulations prove to be very sensitive to the choice of the substitution elasticities in the Armington specification, possibly because the real side of the economy is modeled in a very simple manner using highly aggregate variables.

### 3.4.3. Environmental policy models

The awareness of environmental problems in Eastern European countries has been growing rapidly for the last ten years. However, there are still barriers in implementing drastic policy measures, most of them connected to the fear of potentially negative consequences for the economy. Thus, few models have been built to analyze the impact of different environmental scenarios. These models can be classified in two categories: country specific models and world models. The world CGE environmental models usually treat the Eastern European countries in a rather rudimentary way, at an aggregate level (as one region). Thus, in this section we will only discuss the country specific models.

A prototype model for Poland, for energy and environmental policy analysis, has been developed with the support of the European Commission (Van Leeuwen, 1997). The study is particularly interesting as Poland is one of the main air polluters in Europe. The main features of the model are neoclassical structuralist. A recursive dynamic determination of capital accumulation is included, where the model is solved for a sequence of temporary equilibria by assuming myopic expectations. The environmental issues are emphasized by deriving emissions of  $\text{SO}_2$ ,  $\text{NO}_x$  and  $\text{CO}_2$  and by imposing a maximum level for each pollutant. Environmental policy goals are simulated, by lowering these levels. The model also incorporates tradable emission permits<sup>37</sup>. The same framework is used for evaluating different environmental policies for the Czech Republic and Lithuania (Van Leeuwen, 1997), but these models adopt a static approach. The Polish model incorporates 17 production sectors and the base year for the calibration is 1990. The base year for the Czech model is 1992 and it comprises 13 production sectors. The difference between this model and the Polish one regards the structure of domestic demand. For Lithuania the main difficulty in building the model is that the most recent official input-output table available relates to 1985. Due to the major change in the structure

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<sup>37</sup> By issuing tradable emission permits, the maximum amount of emissions is set by the government and distributed among the producers by means of these permits. Emission permits can be traded among producers in a free market where the price of permits is determined.

## Brief overview of empirical CGE models

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of the economy this table cannot be updated using the usual techniques. Therefore a new input-output table for 1994 has been prepared, based on the technical coefficients derived from the input-output table for the Netherlands. The model comprises 15 production sectors. The Lithuanian model is further used to analyze the economic and environmental impact of limiting the growth of nuclear fuel-generated electricity (Galiniš and Van Leeuwen, 2000).

Kiuiła (2003) analyzes the economy-wide effects of SO<sub>2</sub> emissions reduction in Poland, to fulfill the requirements of the Second Sulfur Protocol. The CGE model is neoclassical structuralist, also allowing for unemployment. It distinguishes 17 production sectors, while households are disaggregated into two income groups, “the rich” and “the poor”, to investigate the social consequences of an environmental policy. The model has a recursive dynamic structure with myopic expectations and it is solved for the year 2010, based on 1995 as the benchmark year for the calibration. The simulations suggest that future SO<sub>2</sub> emission reduction may have positive effects on Polish economic indicators. A modified version of the Kiuiła’s (2003) model is used to evaluate the effects of a comprehensive ecological tax reform for the Polish economy (Kiuiła and Sleszynski, 2003). The differences between the two models are given by the inclusion of CO<sub>2</sub> emissions, calculated according to the sources (from fuels and industrial processes) and the fact that the model is solved for 2005, while still keeping 1995 as the benchmark year for the calibration. The policy scenarios analyze the implementation of new tax rates on CO<sub>2</sub> and SO<sub>2</sub> emissions, while the tax revenues are recycled through different mechanisms, e.g. subsidizing the environmental protection facilities for the enterprises, subsidizing capital costs of the firms, etc. Their results also show positive economic effects of the environmental measures.

### 3.4.4. EU enlargement models

One of the most important challenges for the European Union as well as Eastern European countries is the enlargement of European Union to the East. The economic implications of the Eastern enlargement play an important role in the current debate. A number of CGE models were developed to analyze the effects of the enlargement from the European Union perspective. Some of them also evaluate the costs and benefits of integration for the Eastern European countries. Two categories of EU enlargement models can be distinguished: world models and country specific models. In this section we will only summarize the country specific models and the world models which specifically incorporate some of the Eastern European countries. Unfortunately, most of the world models comprise the effects on the Eastern European economies at an aggregate level.

Brown, Deardorff, Djankov and Stern (1995) evaluate the effects of EU-CEEC integration using a specially constructed version of the University of Michigan CGE world trade model. The model includes 8 countries/regions, where Hungary, Poland and former Czechoslovakia are individually modeled. The European Union is further divided into three groups: EU-North, EU-South and EU-EFTA (Austria, Finland and Sweden). For each region 29 production sectors are specifically modeled, where manufacturing and services sectors are characterized as being monopolistically

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competitive with free entry. The model is static and the base year for the calibration is 1992. Brown, Deardorff, Djankov and Stern (1995) analyze the EU-CEEC integration through: the formation of CEFTA, the implementation of the CEEC-EU free trade agreements, the elimination of tariffs and non-tariff barriers. Their results show that both EU and CEEC reap gains although the gains are larger for the Eastern European economies. The effects on the non-European regions are negligible.

Banse and Tangermann (1996) extend the CGE developed by Adelman and Robinson (1988) for Korea, and apply it to Hungary to analyze the agricultural implications of Hungary's accession to the European Union. The CGE model incorporates 9 production sectors and has a recursive dynamic structure. The base year for the calibration is 1990. Banse and Tangermann (1996) compare the results of the CGE model with those of ESIM (European Simulation Model). ESIM is a static partial equilibrium model used to analyze changes in the Common Agricultural Policy (CAP). ESIM is a world model, including 14 country blocks and 27 commodities. Both models show that the inclusion of Hungary's agriculture in the CAP may result in an increase in agricultural production and exports.

Piazolo (2000) develops a dynamic Ramsey-type open economy CGE model for Poland (PRINCE) to evaluate the effects of its integration into the EU. The model distinguishes one production sector and one type of commodity. PRINCE is calibrated on the Social Accounting Matrix for year 1996. EU integration membership is captured through tariff reduction, border cost reduction, reduction of technical barriers to trade and net EU-transfers from Brussels to Poland. The welfare gains show that Poland will benefit directly from EU membership.

Lejour, De Mooij and Nahuis (2001) adopt a CGE model for the world economy, called WorldScan, to explore the implications of EU enlargement in terms of three dimensions: the accession to the internal market, the equalization of external tariffs and the free movement of labor. The economic consequences of accession to the internal market are measured by estimating gravity equations on the industry level<sup>38</sup>. The model is calibrated on the basis of the GTAP database, version 5 (Purdue University, 2001) with 1997 as the base year. WorldScan distinguishes 12 regions: Germany, France, UK, the Netherlands, South EU (comprising Italy, Spain, Portugal and Greece) and the rest of the EU (comprising Austria, Belgium, Luxembourg, Ireland, Denmark, Sweden and Finland), Poland, Hungary, the CEEC5 (comprising Czech Republic, Slovak Republic, Slovenia, Bulgaria and Romania), the former Soviet Union (also comprising the Baltic states), the rest of the OECD and the rest of the world (ROW). For each region the model distinguishes 16 production sectors. WorldScan analyzes the consequence of integration for both the EU and Eastern European countries in a neoclassical framework. The policy simulations suggest that EU enlargement yields large gains for the Eastern European countries and a modest welfare improvement for the EU. The accession to the internal market generates the largest economic effects.

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<sup>38</sup> In gravity models the trade flow between two countries depends positively on their size and negatively on the distance between them. In economic terms, trade flows between two countries depend on the importer's demand and the exporters supply and on the cost of trade (Lejour, De Mooij and Nahuis, 2001).

## Brief overview of empirical CGE models

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Vanags (2001) uses a comparative static CGE approach to evaluate the economic impact of EU accession for Latvia. The features of the model are neoclassical structuralist. It incorporates 8 production sectors and the benchmark year for the calibration is 1997. External trade is differentiated according to four main partners: the EU, the CIS, the other Baltic states and the rest of the world. The EU accession is analyzed within two phases. Phase 1 represents the mutual removal of tariffs on manufacturing products. Phase 2 includes the integration of the Latvian agriculture into the CAP, the adoption of the EU common external tariffs and the elimination of the real trade costs on EU trade. Vanags' results (2001) show that the overall trade impact is positive. However, the biggest share of trade gains occurs in the first phase.

Bayar, Majcen and Mohora (2003) develop a neoclassical structuralist recursive dynamic CGE model for the Slovenian economy to analyze the effects of trade liberalization and of financial flows from the EU to Slovenia after the accession. The model is calibrated on the Slovenian SAM for 1997 built by the authors. The novelty of the model consists in the modeling of a special institution called the Fund. The aim of the Fund is to collect transfers from both (Slovenian and EU) budgets and redistribute them according to the stated uses: a part of the transfers goes to the EU budget; another part is transferred back to the Slovenian budget (cash flow lump-sums and budgetary compensations); and the rest is used for subsidies or investment<sup>39</sup>. The model distinguishes 15 production sectors and 15 types of goods, and labor demand and unemployment distinguish between skilled and unskilled workers. The recursive dynamic structure incorporates adaptive expectations.

In summary: EU enlargement models report probable gains for the accession countries. The world models analyzing EU enlargement suggest benefits also for the European Union. However, these positive effects are much smaller than for the Eastern European countries.

### 3.4.5. Other models

A small number of CGE models have been built with the aim of specifically reflecting the structure of present-day Eastern European economies. Even then, their number falls clearly short of the number of CGE models built for developing countries. The policy questions they address cover a wide range of issues, from distributional consequences of a decline in output to industrial policies and financial liberalization. The specification of the models also varies considerably within the gamut from the neoclassical to the structuralist approach. Most models analyze the Polish economy.

De Haan's (1993) approach of modeling the Polish economy is mainly structuralist, following the tradition of Taylor (1990a). He analyzes the effects of changes in the nominal wage rates, markup rates and the nominal exchange rate, on prices, the sectoral gross output, the income distribution, the balance of payments and the

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<sup>39</sup> The distribution of the subsidies or investments between the sectors is done in line with the Common Agricultural Policy and Rural Development, Structural actions, internal policies and the SPD. The national public co-financing is also taken into account.

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public budget. The economy is investment-driven, which implies that savings tend to adjust to the level of investment. The adjustment process is driven by changes in income rather than in interest rate. The model closure is Kaleckian, known also as structuralist closure. Under this closure the markets are cleared either through a price adjustment or a quantity adjustment. In some sectors demand adjusts to an inelastic (fixed supply), while in other sectors demand determines supply whereas prices are cost-determined by markups over production costs. De Haan (1995) uses the same approach for modeling the Hungarian economy. The distinction between the two models consists in the level of disaggregation of the production sectors and households. The production sphere identifies 10 sectors in the Hungarian model, compared to 5 in the Polish one. Furthermore, the households are grouped according to 5 income categories in the CGE model for Hungary, compared to 3 categories in the CGE model for Poland. The policy simulations and the conclusions are similar in both models.

Roberts (1994) develops a neoclassical structuralist CGE model for the Polish economy, based on the conviction that neither a neoclassical approach (Braber, Cohen, Revesz and Zolkiewski, 1993), nor an extremely structuralist approach (De Haan, 1993) is suitable for an economy in transition where many adjustments in response to changes in relative prices take place but where at the same time some rigidities still exist. A one-sector model is used to check to what extent the inferences from the model are robust to the choice of the base year and the assumed elasticities. A Keynesian closure is chosen in order to carry out sensitivity analysis using a multiplier type response to the change in an exogenous variable (the government expenditure). As a consequence, the volume of capital is fixed exogenously, while the level of employment adjusts, allowing for unemployment. Data for 1986-1990 are used for calibrating the model, in order to examine how sensitive the results are to the choice of the base year. The model proves to be quite robust to the choice of benchmark equilibrium year, given that the years under consideration represented a relatively stable period. Instead, the model seems to be more sensitive to the choice of trade substitution elasticities.

Roberts and Zolkiewski (1996) use a modified version of Roberts's (1994) model to analyze the distributional consequences of a decline in output and of privatization. As a novelty, the model identifies 15 production activities and 6 types of commodities. The household sector is disaggregated into 5 socioeconomic groups, distinguished by their source of income. The labor demand is differentiated according to gender and level of education in six types. The model preserves the neoclassical structuralist spirit. The benchmark year for calibration is 1990. Two simulation experiments are conducted with the model: first, a decline in exports of the food, light and electro-engineering sectors, as an example of a negative demand shock, and privatization, as a positive supply shock. The first experiment represents the first stage of transition, when the negative effects on macroeconomic performance tend to be more severe. The privatization scenario is simulated by an exogenous change in factor productivity and in the pattern of primary distribution of income, and reflects the second stage of transition when recovery begins.

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Ghatak and Roberts (1997) analyze the effects of adopting a temporary industrial policy for Eastern Europe with a view to reducing the social cost of transition, using a modified version of the Roberts's (1994) model. This CGE model is also applied to Poland and calibrated for 1990. This version includes 24 industrial sectors. The adopted industrial policy is based on unbalanced growth, increasing efficiency in key sectors which, according to the linkage analysis, influence the rest of the economy more than other sectors. Their results show an improved macroeconomic performance when industrial policy concentrates on a key sector.

Roberts (1999) evaluates the consequences of the privatization process in Poland in a CGE framework. The novelty of the model is that it traces the economy-wide effects of a given change generated by the privatization, rather than describing the privatization process in detail and considering the institutional mechanisms behind the various scenarios. Roberts (1999) distinguishes three production sectors: the public sector, the private sector and the sector in transition. The sector in transition emerges as a consequence of initial transfers of assets from the public sector to the newly privatized sector. Once this sector has been established, no other transfer of assets occurs within the analyzed period of time. The model also incorporates rigidities in the functioning of product and labor markets. Neoclassical structuralist features are considered to be more suitable for a transition economy. The model is static and the base year for calibration is 1989. The policy scenarios show that the decline in government revenue from privatized enterprises and the increase in imports of intermediate goods by the private sector (not compensated by an increase in exports), accompanying the privatization process in Poland, may have contributed to the recession and the increase in the budget deficit.

The first attempt to incorporate the financial sector in a model for the Polish economy is by Lensink (1999). His real-financial CGE model is used to analyze the most important financial reforms in the Polish stabilization program, by presenting the effects of interest rate deregulation and changes in reserve requirements. The model is structuralist in the spirit of Rosenweig and Taylor (1990) with a real balance change closure. However, the real side of the economy is modeled in a very simple way. A single Harrod-Domar production function represents the entire production side of the economy and real private consumption and gross real investment are based on econometric estimates, using quarterly data. The rest of the parameters of the model are calibrated, using 1995 as benchmark year.

Jemeljanov (1999) develops another real-financial CGE model with structuralist features, this time for the Latvian economy. The benchmark year used for calibration is 1994. The main purpose of the model is to analyze specific issues regarding the labor market. Two groups of government measures are distinguished, in relation with the labor market. The first group which includes an increase of the working-age population, and a rise in the personal income tax rate and employees' social contributions premiums, inevitably induces a certain amount of unemployment. The other group, which prevents unemployment, comprises the introduction of an investment subsidy, a reduction of the corporate income tax rate and a decrease in

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the employers' social contributions rate. A shortcoming of the model consists in its loanable funds closure through the interest rate<sup>40</sup>.

Funke and Strulik (2003) build a dynamic closed-economy Ramsey-type CGE model for Estonia to analyze the effects of the 2000 income tax act. The model incorporates the behavior of three economic agents: the households, the government and the firms (represented by one production sector) and covers a variety of taxes on retained earnings, dividends and consumption. The model is calibrated on the available data for Estonia for 2000. However, some estimates for Finland are used for non available data, e.g. the capital stock. Funke and Strulik (2003) evaluate the effects of the introduction of a flat tax rate for all distributions of net dividends on investment decisions, output and consumption.

The only overlapping generations CGE model is developed by Jensen and Lassila (2001) for the Lithuanian economy to analyze the effects of different pension policy measures. The open economy model is built in the spirit of Auerbach and Kotlikoff (1987). The pension sector is explicitly modeled. The model is calibrated on the data for 2000. Jensen and Lassila (2001) evaluate the effects of a reform package including: a rise in the retirement age, a decrease in the compulsory social security contributions by raising the VAT, an increase in the basic pension benefits financed on a PAYG basis, and a gradual conversion to a private, funded system. They conclude that the policy measures can result in an efficient pension system in the long-run.

### 3.5. Conclusions

Several CGE models have been built for the Eastern European economies during the last twenty years. These models evolved a long way from their input-output antecedents, after the transition of the Eastern European economies from centrally planned to market oriented economies. The CGE framework proved to be more suitable for modeling the new market driven Eastern European economies.

Most of CGE models constructed for the Eastern European economies are general purpose models and they attempt to address a wide range of policy questions, from distributional consequence of a decline in output to industrial policies and financial liberalization. The majority of them analyze the Polish economy using a modified version of the Roberts's model (1994). The other CGE models built for Eastern European economies analyze common issues in CGE modeling like trade liberalization and environmental policies or focus on more specific problems that the former socialist countries have been confronted: the accession to the European Union.

There is no agreement among modelers which type of model more adequately describes the Eastern European economies. Even for one country, e.g. Poland, the

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<sup>40</sup> Taylor (1990a) emphasized an important problem regarding this adjustment mechanism, the weakness of the interest rate effect in the developing countries. Low elasticities can prevent the adjustment based on the variation of the interest rate.

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features of the models vary from a purely neoclassical to an extreme structuralist approach. However, most of the models have neoclassical structuralist features. Also the model closure is a controversial issue, but this may be a consequence of the differences in focus and the time period under investigation. The determination of the parameters of the model raises another problem. Most parameters are based on calibration so their reliability depends directly on the initial estimates of the elasticities, taken from outside sources. The short data series for the Eastern European economies render a reliable econometric estimation of the elasticities impossible. In most cases the elasticity values are fixed according to the modeler's experience regarding the analyzed economy.

The majority of CGE models built for Eastern economies are static or incorporate recursive dynamic features. The only fully dynamic CGE models are built for Poland (Piazolo, 2000), Estonia (Funke and Strulik, 2003) and Lithuania (Jensen and Lassila, 2001). There are two main problems regarding the fully dynamic CGE models. First, they usually represent the economy at a high level of aggregation considering only, e.g. one productive sector, due to the computational effort that they require. Because of this reason, they are not always suitable for analyzing specific policy questions. Secondly, it is doubtful if they are able to describe the dynamic behavior of the economies in transition. But it should not be overlooked that the incorporation of financial markets raises another problem, viz. the lack of specific data for the Eastern European economies. Just two financial CGE models have been built so far for the Eastern European economies, one for the Polish economy by Lensink (1999), and another one for the Latvian economy by Jemeljanov (1999).

Inevitably, the CGE model for the Romanian economy, developed in Chapter 4 also suffers from some of the problems mentioned above. Nevertheless, the disaggregated description it provides of the Romanian economy, can improve the understanding of how the economy operates and offer a basis for the analysis of a variety of policies.



## **Chapter 4**

### **A CGE model for the Romanian economy**

#### **4.1. Introduction**

In this chapter a dynamic CGE model, which represents the main features of the Romanian economy, is developed. The model, called RoMod, is used to examine the effects of tax harmonization and public expenditures restructuring in the preparation for accession to the European Union. As already pointed out in chapter 3, the earlier attempt to model the Romanian economy by Tarhoaca (2000) focused on the effects of external shocks and failed to capture the sectoral structure of the production, the behavior of the households and the firms and also the specificities of the capital and labor markets. The present model follows the tradition of Dervis, De Melo and Robinson (1982) and focuses on the real side of the economy to fill up these gaps. The neoclassical structuralist features of RoMod are however debatable for a country in transition, like Romania. Earlier attempts to model the Eastern European economies varied from purely neoclassical to extremely structuralist approaches, as already discussed in chapter 3. Because of the absence of a long-term economic policy and the ongoing structural changes it is impossible at this moment to state which is the right approach to model these economies. The transition to a free market economy, where prices play an important role in clearing markets, and the efforts towards integration into the European Union have been the reasons for choosing the specified framework for modeling the Romanian economy.

Although the explicit modeling of the financial sector would have been very useful to capture the effects of the fiscal policy measures and the financing of the fiscal deficit, this could not be done due to the lack of data. The most popular approach to model the financial sector was developed by Rosenweig and Taylor (1990) and it was applied to Thailand. In their model, the asset demand of the household, firms and commercial banks is determined by maximizing a Constant Elasticity of Substitution (CES) utility function. Other CGE models, which explicitly incorporate the financial sector were developed by Yeldan (1997), Vos (1998) and Naastepad

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(2002). All of them use financial flows and stocks data. Unfortunately, flow of funds tables for the main institutional sectors (including the financial sector) and stocks of assets and liabilities (the balance sheets for households, firms, financial sector, government sector, external sector), key data in modeling the financial sector, are unavailable making the incorporation of the financial sector into the model practically impossible.

The model has a recursive dynamic structure which incorporates adaptive expectations. There are two reasons for not incorporating intertemporal dynamic features in RoMod. First, as already mentioned in chapter 3, within a dynamic framework the sectoral specification of production would require a great computational effort. Second, Romania is a country in transition, which by its nature continuously undergoes structural changes and which therefore provides an insufficiently stable starting point (basis) for an approach aiming at intertemporal optimization.

In line with the general practice in the CGE analysis, the model is constructed together with a Social Accounting Matrix (SAM) for Romania. The SAM represents the database for the model and provides the specific characteristics of the Romanian economy. It also gives insight into the empirical limitations of the model with respect to data availability. The construction of the Romanian SAM for 2000 is presented in chapter 5.

The description of the CGE model for the Romanian economy is provided in this chapter. To keep the presentation as clear as possible it concentrates on the core model. Derivations of parts of the model are presented in appendix 4.A. A list of model's equations is further given in appendix 4.B. The model is solved by using the general algebraic modeling system GAMS (Brooke et al., 1998). The following conventions are adopted for the presentation of the model. The variable names are given in capital letters, small letters denote the parameters calibrated from the database (SAM) and Greek symbols are used for the elasticity parameters. The subscript  $i$  stands for one of the production activities (35 production sectors) and also for one of the commodities (35 commodities). The subscript  $c$  stands for one of the production sectors, except coal, oil, and natural gas sectors (32 sectors) and also for one of the commodities except coal, oil, and natural gas (32 commodities). Further, the subscript  $el$  stands for the electricity sector (1 sector) and also for the electricity commodity (1 commodity). The subscript  $l$  stands for one of the coal, oil, and natural gas sectors (3 sectors) and also for one of the coal, oil, and natural gas commodities (3 commodities). The subscript  $nen$  stands for one of the production sectors, except coal, oil, natural gas and electricity sectors (31 sectors) and also for one of the commodities, except coal, oil, natural gas and electricity (31 commodities). The subscript  $ct$  stands for wholesale and retail trade sector (1 sector) and also for wholesale and retail trade commodity (1 commodity). The subscript  $ctpr$  stands for transport via railways sector (1 sector) and also for the railways transport services (1 commodity),  $ctpa$  stands for the land transport sector (1 sector) and the land transport services (1 commodity), and  $ctpw$  stands for water transport sector (1 sector) and water transport services (1 commodity). The subscript  $ng$  stands for one of the production sectors except public administration sector (34 sectors), and  $gov$

stands for the public administration sector (1 sector). Finally, the subscript  $t$  stands for the year  $t$ . For exposition purposes, in the summations the subscript  $i$  is replaced by  $j$ .

### 4.2. Model description

#### 4.2.1. General outline of the model

The core of the model is built in the tradition of Dervis, De Melo and Robinson (1982) and EcoMod (2002), but accounts for country-specific elements. The model incorporates the economic behavior of four institutional sectors: firms, households, the government sector and the external sector. All economic agents are assumed to adopt an optimizing behavior under relevant budget constraints. The goods-producing sectors, consisting of both public and private enterprises, are disaggregated into 35 production activities. The government sector consists of both central and local government bodies. It should be stressed that the government sector does not include market producer public enterprises, which are part of the firms sector. With regard to the external sector the economy is treated as a small open economy with no influence on (given) world market prices.

The use of the SAM and the underlying input-output (IO) table as the databases have some consequences for the outcome of the CGE model. The most important one refers to the choice of units of measurement (*e.g.*, producers demand for energy inputs is expressed in “energy costs” instead of quantities). The typical assumption for a CGE model, which is also adopted here, is that economy is initially at an equilibrium with quantities normalized so that prices are equal to one. An exception to this rule is made for the labor market, which allows deriving the producers’ demand for labor expressed in number of workers, and the capital market which allows deriving the capital stock demand by the producers. The underlying SAM also imposes some limitations in examining certain nuances. For example, only average tax rates can be used and income streams cannot be traced in great detail.

#### 4.2.2. The firms sector

As already mentioned, the firms sector (comprising the entire production activities) is divided into 35 production sectors<sup>41</sup>. Services had the highest contribution to GDP in 2000 with 48.2 percent, followed by manufacturing with 35.8 percent, agriculture with 11.01 percent and construction with 4.99 percent. Thus, Romania’s GDP structure is more or less comparable to that of developed countries. Among the services sectors the wholesale and retail trade sector had the largest contribution to GDP with 10.2 percent, while the manufacturing of processed food products among the manufacturing sectors held that position with 10.02 percent.

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<sup>41</sup> The disaggregation of the production sectors and their correspondence to NACE Rev.1 (Classification of Economic Activities in the European Community) is given in appendix 4.C.

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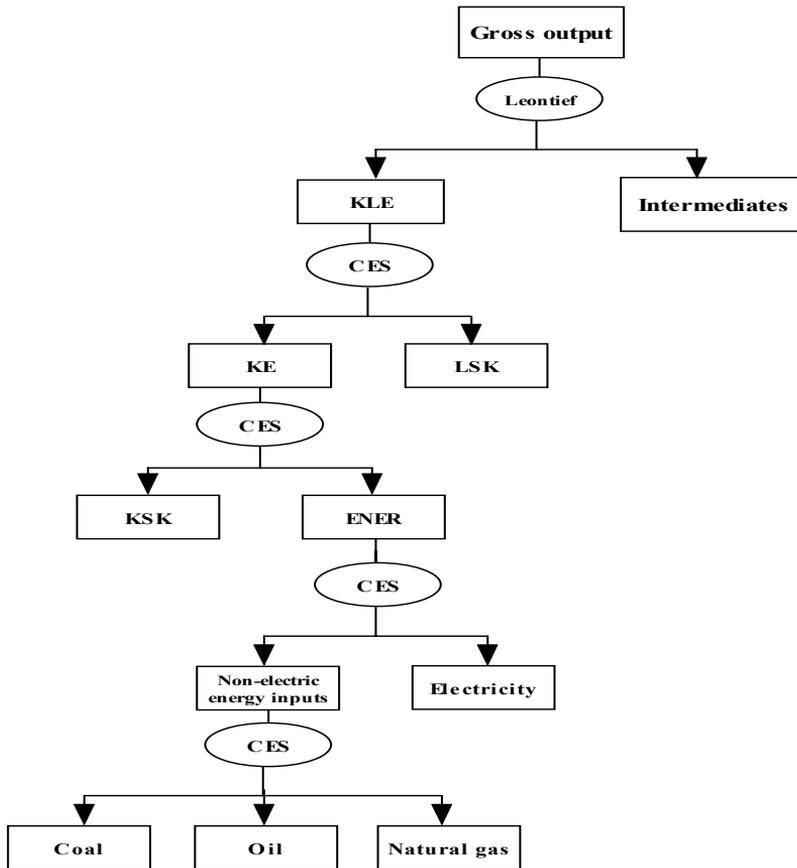
The firms sector includes both the public and the private enterprises. The weight of the public firms is still relatively large in Romania, given that the contribution of the private firms sector to GDP was 64.5 percent in 2000 (National Bank of Romania, 2001). Unfortunately, the necessary data to model the public and the private enterprises separately are not available. Apart from data limitations, the pace of privatization and the resulting decrease in importance of the public firms sector provide another reason for not modeling them separately. In 1995, the government took steps towards a more active privatization policy by launching the second Mass Privatization Program and the government elected at the end of 1996 further accelerated the pace of privatization, which was embedded in a wider program of structural reforms. In 2002 the private firms sector share in GDP had risen to a level of 69 percent (Romanian Government, 2004). Meanwhile, the restructuring of the public enterprises has increased their competitive awareness and has made them more comparable with the private companies. In this context, the assumption of competitive markets with flexible prices, adopted in the model, seems more appropriate than the use of mark-up pricing or administered prices.

The CGE model does not model the behavior of individual firms, but of groups of similar ones aggregated into sectors. The usual assumption for such a model is that producers maximize profits under perfect competition, i.e. minimize costs for each level of output. For example, for the firms operating internationally, the world market dictates the output price to a large extent, so, for an optimal outcome they have to produce as efficiently as possible. Some other firms are constrained in the costs level by domestic competitors. Thus, the optimizing producers minimize their production costs at every output level, given their production technology. Furthermore, production prices equal average cost, a condition that implies profit maximization for a constant returns to scale technology.

The gross output for each sector except the coal sector, oil sector and extraction of natural gas sector is represented by a nested production structure<sup>42</sup>. At the outer nest producers are assumed to choose intermediate inputs of non-energy goods and a capital-labor-energy ( $KLE_c$ ) bundle, according to a Leontief production function. At the second stage, producers choose the optimal level of labor input ( $LSK_c$ ) and capital-energy composite ( $KE_c$ ). The production substitution possibilities are reflected in this case by a constant elasticity of substitution (CES) function. The optimal level of capital ( $KSK_c$ ) and energy ( $ENER_c$ ) is determined at the third stage, according to a CES function. Further, at the fourth stage, producers allocate the energy bundle between electricity and non-electric energy commodities. The production substitution possibilities are reflected by a CES function at this level as well. The allocation between different non-electric energy commodities: coal, oil and natural gas, is given at the fifth stage by another CES function. The complex nested structure and the functional forms used in all the production sectors except the coal, oil and extraction of natural gas sectors are summarized in figure 4.1.

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<sup>42</sup> The nesting of the production structure follows Bayar, Dramais, Mohora and Opese (2004).



**Figure 4.1. The nested CES and Leontief production technology for all production sectors except coal, oil and natural gas sectors**

The capital-labor-energy bundle  $KLE_c$  is related to output  $XD_c$  through a Leontief production function, which assumes an optimal allocation of inputs<sup>43</sup>:

$$XD_c = (1/aP_c) \cdot KLE_c = (1-1/aP_c) \cdot IO_c \quad (4.1)$$

where  $IO_c$  reflects the intermediate inputs of non-energy goods used by sector  $c$ , and  $1/aP_c$  is the well-known fixed coefficient relating the  $KLE_c$  composite to output. Thus, domestic output valued at basic prices net of taxes but including direct

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<sup>43</sup> The Leontief production function implies that sectoral output must be produced with fixed (minimum) quantities of intermediate inputs and factor composite per unit of output, i.e. with fixed coefficients.

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subsidies on production,  $[PD_c \cdot (1 - tp_c + tsp_c)]$ , is given by the sum of the capital-labor-energy bundle ( $KLE_c$ ) for sector  $c$  valued at basic prices and non-energy intermediate commodities used by sector  $c$  valued at the price of the non-energy commodities ( $P_{nen}$ ), including the non-deductible VAT ( $vati_{nen,c}$ ) and excise taxes ( $tci_{nen,c}$ ) on intermediate consumption:

$$(1 - tp_c + tsp_c) \cdot PD_c \cdot XD_c = KLE_c \cdot PKLE_c + \sum_{nen} io_{nen,c} \cdot P_{nen} \cdot (1 + vati_{nen,c}) \cdot (1 + tci_{nen,c}) \cdot XD_c \quad (4.2)$$

where  $io_{nen,c}$  are the technical coefficients.

$KLE_c$  is a CES aggregation of capital-energy composite ( $KE_c$ ) and labor ( $LSK_c$ ):

$$KLE_c = (\gamma P11_c \cdot KE_c^{-\rho P1_c} + \gamma P12_c \cdot LSK_c^{-\rho P1_c})^{-1/\rho P1_c} \quad (4.3)$$

Minimizing the costs function:

$$Cost_c(KE_c, LSK_c) = PKE_c \cdot KE_c + PL \cdot wdif_c \cdot (1 + tsh_c) \cdot LSK_c \quad (4.4)$$

subject to (4.3) yields the demand equations for the capital-energy composite and labor:

$$KE_c = KLE_c \cdot (PKLE_c / PKE_c)^{\sigma P1_c} \cdot \gamma P11_c^{\sigma P1_c} \quad (4.5)$$

$$LSK_c = KLE_c \cdot [PKLE_c / ((1 + tsh_c) \cdot PL \cdot wdif_c)]^{\sigma P1_c} \cdot \gamma P12_c^{\sigma P1_c} \quad (4.6)$$

and the associated zero profit condition:

$$PKLE_c \cdot KLE_c = PKE_c \cdot KE_c + (1 + tsh_c) \cdot PL \cdot wdif_c \cdot LSK_c \quad (4.7)$$

where  $PL$  is the average wage rate and  $wdif_c$  is sector's  $c$  wage differential with respect to average wage,  $PKE_c$  is the sectoral price of the  $KE_c$  bundle,  $tsh_c$  is the social security contributions rate for sector  $c$ , and  $\gamma P11_c$  and  $\gamma P12_c$  are the distribution parameters. The elasticity of substitution between capital-energy composite and labor is given by  $\sigma P1_c$ , where  $\sigma P1_c = 1/(1 + \rho P1_c)$ .  $PKE_c$  is assumed to be equal to one which implies that  $KE_c$  expresses the demand for capital-energy costs in sector  $c$ . The capital-energy composite is perfectly mobile between sectors. The inter-sectoral wage differential is a parameter derived as the ratio between the sectoral wage rate and the average wage rate at the national level (Dervis, De Melo and Robinson, 1982). Holding the inter-sectoral wage differentials constant in counterfactual policy simulations introduce rigidities in the labor market.

In the following stage, the producer determines the optimal choice of capital and energy demand, where the capital-energy ( $KE_c$ ) bundle is a CES composite of capital ( $KSK_c$ ) and an energy composite ( $ENER_c$ ):

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$$KE_c = (\gamma P21_c \cdot KSK_c^{-\rho P2_c} + \gamma P22_c \cdot ENER_c^{-\rho P2_c})^{-1/\rho P2_c} \quad (4.8)$$

Minimizing the costs:

$$Cost_c(KSK_c, ENER_c) = RK_c \cdot KSK_c + PI \cdot d_c \cdot KSK_c + PEN_c \cdot ENER_c \quad (4.9)$$

subject to (4.8) yields the demand equations for the capital stock and the energy composite:

$$KSK_c = KE_c \cdot (PKE_c / (RK_c + d_c \cdot PI))^{\sigma P2_c} \cdot \gamma P21_c^{\sigma P2_c} \quad (4.10)$$

$$ENER_c = KE_c \cdot (PKE_c / PEN_c)^{\sigma P2_c} \cdot \gamma P22_c^{\sigma P2_c} \quad (4.11)$$

and the zero profit condition:

$$PKE_c \cdot KE_c = RK_c \cdot KSK_c + DEP_c \cdot PI + PEN_c \cdot ENER_c \quad (4.12)$$

where  $RK_c$  is the sectoral rental rate for capital services,  $PEN_c$  is the sectoral price of the energy bundle,  $\gamma P21_c$  and  $\gamma P22_c$  are the distribution parameters and  $\sigma P2_c$  is the elasticity of substitution between capital and energy, with  $\sigma P2_c = 1/(1 + \rho P2_c)$ . Depreciation per sector ( $DEP_c$ ) is valued at the price of the composite investment commodity ( $PI$ ), and  $d_c$  is the depreciation rate in sector  $c$ .

Furthermore, the energy demand bundle is a CES aggregation of electricity  $el$  used by sector  $c$  ( $ENINP_{el,c}$ ) and non-electric energy inputs ( $ENEROG_c$ ):

$$ENER_c = (\gamma P31_c \cdot \sum_{el} ENINP_{el,c}^{-\rho P3_c} + \gamma P32_c \cdot ENEROG_c^{-\rho P3_c})^{-1/\rho P3_c} \quad (4.13)$$

Again, by minimizing the costs:

$$Cost_c(ENINP_{el,c}, ENEROG_c) = PEOG_c \cdot ENEROG_c + \sum_{el} P_{el} \cdot (1 + vati_{el,c}) \cdot (1 + tci_{el,c}) \cdot ENINP_{el,c} \quad (4.14)$$

subject to (4.13) yields the demand equations for electricity and non-electric energy commodities:

$$ENEROG_c = ENER_c \cdot (PEN_c / PEOG_c)^{\sigma P3_c} \cdot \gamma P32_c^{\sigma P3_c} \quad (4.15)$$

$$ENINP_{el,c} = ENER_c \cdot [PEN_c / (P_{el} \cdot (1 + vati_{el,c}) \cdot (1 + tci_{el,c}))]^{\sigma P3_c} \cdot \gamma P31_c^{\sigma P3_c} \quad (4.16)$$

and the zero profit condition:

$$PEN_c \cdot ENER_c = \sum_{el} [ENINP_{el,c} \cdot P_{el} \cdot (1 + vati_{el,c}) \cdot (1 + tci_{el,c})] + PEOG_c \cdot ENEROG_c \quad (4.17)$$

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where  $P_{el}$  is the price of electricity,  $vati_{el,c}$  is the non-deductible value-added tax rate paid on intermediate consumption of electricity by sector  $c$ ,  $tci_{el,c}$  is the rate of other taxes on intermediate consumption of electricity paid by sector  $c$ ,  $\gamma P31_c$  and  $\gamma P32_c$  are the distribution parameters and  $\sigma P3_c$  is the elasticity of substitution between electricity and other non-electric commodities, with  $\sigma P3_c = 1/(1 + \rho P3_c)$ .

In the final stage, the non-electric energy bundle is a CES aggregation of coal, oil, and natural gas:

$$ENEROG_c = (\sum_l \gamma P4_{l,c} \cdot ENINP_{l,c}^{-\rho P4_c})^{-1/\rho P4_c} \quad (4.18)$$

Minimizing the costs:

$$Cost_{l,c}(ENINP_{l,c}) = \sum_l (1 + vati_{l,c}) \cdot (1 + tci_{l,c}) \cdot P_l \cdot ENINP_{l,c} \quad (4.19)$$

subject to (4.18), we get the demand equation for each type of non-electric energy input:

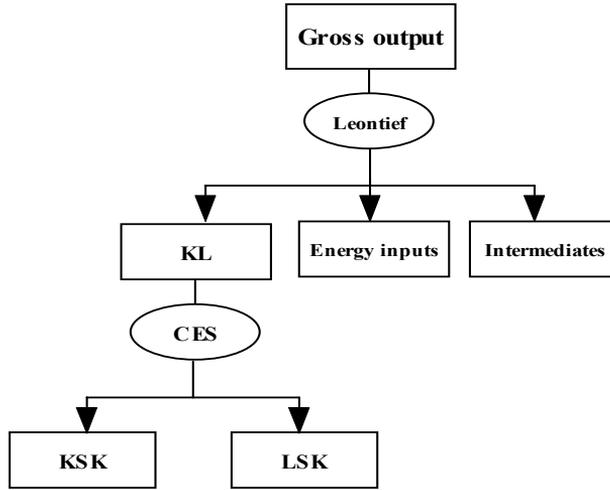
$$ENINP_{l,c} = ENEROG_c \cdot [PEOG_c / (P_l \cdot (1 + vati_{l,c}) \cdot (1 + tci_{l,c}))]^{\sigma P4_c} \cdot \gamma P4_{l,c}^{\sigma P4_c} \quad (4.20)$$

and zero profit condition:

$$PEOG_c \cdot ENEROG_c = \sum_l [ENINP_{l,c} \cdot P_l \cdot (1 + vati_{l,c}) \cdot (1 + tci_{l,c})] \quad (4.21)$$

where  $vati_{l,c}$  is the non-deductible VAT rate paid on intermediate consumption of coal, oil, and natural gas by sector  $c$ ,  $tci_{l,c}$  is the excise duty rate on intermediate consumption of coal, oil, and natural gas paid by sector  $c$ ,  $\gamma P4_{l,c}$  are the distribution parameters and  $\sigma P4_c$  is the elasticity of substitution between different non-electric energy inputs used by each production sector. The elasticity of substitution between different non-electric energy inputs is equal to  $\sigma P4_c = 1/(1 + \rho P4_c)$ .

The gross output for the coal sector, oil sector and the extraction of natural gas sector is also determined from a nested production structure. At the upper nest producers are assumed to choose intermediate inputs of non-energy goods, energy inputs and a capital-labor ( $KL_l$ ) bundle, according to a Leontief production function. The energy inputs are represented by coal, oil, natural gas and electricity. At the second stage, producers choose the optimal level of labor ( $LSK_l$ ) and capital ( $KSK_l$ ), according to a CES function. The nested structure and the functional forms used for coal sector, oil sector and natural gas sector are given in figure 4.2.



**Figure 4.2. A nested Leontief and CES production technology for the coal, oil, and natural gas sectors**

For the coal, oil and natural gas sectors, the capital-labor bundle ( $KL_l$ ) is related to output ( $XD_l$ ) through a Leontief production function, which assumes an optimal allocation of inputs:

$$XD_l = (1/aL1_l) \cdot KL_l \quad (4.22)$$

Furthermore, the energy inputs are also related to the output  $XD_l$  through the Leontief production function:

$$XD_l = (1/aL2_{en,l}) \cdot ENINP_{en,l} = [1 - 1/aL1_l - \sum_{en} (1/aL2_{en,l})] \cdot IO_l \quad (4.23)$$

Thus, the domestic output valued at basic prices net of taxes but including direct subsidies on production [ $PD_l \cdot (1 - tp_l + tsp_l)$ ], is given by the sum of the capital-labor bundle, valued at basic prices ( $PKL_l$ ), and intermediate consumption of energy and non-energy commodities valued at purchaser's prices, including non-deductible VAT and excise duties on intermediate consumption:

$$(1 - tp_l + tsp_l) \cdot PD_l \cdot XD_l = KL_l \cdot PKL_l + \sum_{en} [ENINP_{en,l} \cdot P_{en} \cdot (1 + vati_{en,l}) \cdot (1 + tci_{en,l})] + \quad (4.24)$$

$$\sum_{nen} [io_{nen,l} \cdot XD_l \cdot P_{nen} \cdot (1 + vati_{nen,l}) \cdot (1 + tci_{nen,l})]$$

At the second stage,  $KL_l$  is a CES aggregation of capital ( $KSK_l$ ) and labor ( $LSK_l$ ):

$$KL_l = (\gamma L11_l \cdot KSK_l^{-\rho L1_l} + \gamma L12_l \cdot LSK_l^{-\rho L1_l})^{-1/\rho L1_l} \quad (4.25)$$

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Minimizing the costs function:

$$Cost_l(KSK_l, LSK_l) = RK_l \cdot KSK_l + PI \cdot d_l \cdot KSK_l + PL \cdot wdif_l \cdot (1 + tsh_l) \cdot LSK_l \quad (4.26)$$

subject to (4.25) yields the demand equations for capital and labor for the coal, oil, and natural gas sectors:

$$KSK_l = KL_l \cdot [PKL_l / (RK_l + d_l \cdot PI)]^{\sigma L_l} \cdot \gamma L1_l^{\sigma L_l} \quad (4.27)$$

$$LSK_l = KL_l \cdot [PKL_l / ((1 + tsh_l) \cdot PL \cdot wdif_l)]^{\sigma L_l} \cdot \gamma L2_l^{\sigma L_l} \quad (4.28)$$

and zero profit condition:

$$PKL_l \cdot KL_l = RK_l \cdot KSK_l + DEP_l \cdot PI + (1 + tsh_l) \cdot PL \cdot wdif_l \cdot LSK_l \quad (4.29)$$

where  $RK_l$  is the sectoral rental rate for capital services in the coal, oil, and natural gas sectors,  $d_l$  is the depreciation rate,  $PL$  is the national average wage rate,  $wdif_l$  is the wage differential for sector  $l$ ,  $tsh_l$  is the social security contribution rate for the same sectors,  $\gamma L1_l$  and  $\gamma L2_l$  are the distribution parameters and  $\sigma L_l$  is the elasticity of substitution between capital and labor, where  $\sigma L_l = 1/(1 + \rho L_l)$ .

Treated at an aggregate level, firms receive income from sales of goods and subsidies and transfers from the government, they purchase non-energy intermediate inputs and energy inputs, make wage payments, pay taxes on production, social security contributions and corporate taxes, they make transfers to the household and the external sector and save. These activities are described in the following three equations:

$$YF = (1 - aich) \cdot \sum_i KSK_i \cdot RK_i + TRFG \cdot GDPDEF + GDEBTD_{-1} \cdot RGD \cdot intf \quad (4.30)$$

$$YFI = (1 - aich) \cdot \sum_i KSK_i \cdot RK_i + GDEBTD_{-1} \cdot RGD \cdot intf \quad (4.31)$$

$$SF = YF - tyf \cdot YFI - TRHF \cdot INDEX - ER \cdot TRWF \quad (4.32)$$

where  $aich$  is the capital income share parameter for households, so  $(1 - aich)$  gives the income share parameter for firms,  $INDEX$  is the Laspeyres consumer price index,  $GDPDEF$  is the GDP deflator,  $RGD$  is the domestic interest rate on public debt,  $intf$  is the share of interest payments to the firms,  $tyf$  is the corporate tax rate and  $ER$  is the exchange rate.

The total income of firms ( $YF$ ) consists of the income from capital, the interest payments on the public debt in the previous year ( $GDEBTD_{-1}$ ), and other transfers from the government ( $TRFG$ ). Other transfers from the government also include tax payments arrears. The treatment of these transfers is discussed in detail in chapter 5.

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The income from capital as it has been treated here represents the entire production process. So it reflects the income generation from sales of goods, implies purchases of non-energy intermediate inputs and energy inputs, wage payments, tax payments and subsidies on production and energy inputs, and tax payments on labor use. Furthermore, firms pay corporate taxes on taxable income ( $YFI$ ), make transfers to the households ( $TRHF$ ), and external sector ( $TRWF$ ) and generate savings  $SF$ . The transfers to the households and to the external sector and other transfers from the government are exogenous.

### 4.2.3. The households sector

Surprisingly, a high share of the household's income consists of capital income, 33.9 percent in 2000 (National Institute of Statistics, 2003), compared to the labor income which accounts for 39.3 percent. The households sector includes family associations and independent private entrepreneurs. Thus, capital income also comprises mixed income accruing to unincorporated enterprises owned by this sector<sup>44</sup>. By 2001 the small and medium-sized enterprises (SMEs) represented 56 percent of total turnover in the economy, of which individual entrepreneurs accounted for about 60 percent. Some of the new entrepreneurs benefited from earlier experience in public enterprises and from personal connections with banks and clients. This type of entrepreneurship developed mainly in the area of foreign trade, as well as in highly specialized segments of the manufacturing and service sectors (textiles, constructions, furniture and business services). Some other entrepreneurs, young, often inexperienced people, typically with a university education and eager to engage in new business, because of the difficult access to capital, engaged in business areas with lower entry costs, such as trade and services (OECD, 2002). In the agricultural sector, the family association has been the predominant way of organizing production.

The income distribution in Romania is highly unequal, with many people living below the poverty line. The highest incidence of poverty is reported for members of households whose heads are unemployed or of working age but not in the labor force mostly due to disability or home responsibilities. Relatively high poverty rates are also found in the households of farmers and other self-employed persons. Households headed by employees and by pensioners, have below-average poverty rates while the employers are found to have the lowest rates (OECD, 1998). Although a disaggregation of the household sector in different social groups would have been useful for an analysis of the income distribution effects of different types of fiscal measures, the lack of data doesn't allow such an analysis.

In the model, the representative household receives a fixed share of capital income ( $aich$ ), labor income from resident and non-resident firms in return for labor services and transfers from the government ( $TRHG$ ), the firms ( $TRHF$ ) and the external sector ( $TRHW$ ):

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<sup>44</sup>The mixed income is explained in detail in chapter 5.

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$$YH = aich \cdot \sum_i KSK_i \cdot RK_i + \sum_i LSK_i \cdot PL \cdot wdif_i + PLWZ \cdot ER \cdot LW + TRHG + TRHF \cdot INDEX + ER \cdot TRHW \quad (4.33)$$

where  $LW$  is the labor supplied to the non-resident firms and  $PLWZ$  is the average wage rate in foreign currency. The transfers from the government (see section 4.2.4) consist of unemployment benefits, interest payments for the public debt and other transfers ( $TRO$ ), while the exogenous transfers from the firms ( $TRHF$ ) refer mostly to insurance premiums and other transfers.

The household pays taxes on taxable income ( $YHI$ ) and social contributions to the government and save ( $SH$ ) a fixed fraction ( $mps$ ) of net income:

$$SH = mps \cdot (YH - ty \cdot YHI - tsch \cdot \sum_i LSK_i \cdot PL \cdot wdif_i) \quad (4.34)$$

where  $ty$  is the tax rate on income and  $tsch$  is the social contributions tax rate paid by the self employed members of the household sector. The taxable income is derived as:

$$YHI = aich \cdot \sum_i KSK_i \cdot RK_i + \sum_i LSK_i \cdot PL \cdot wdif_i + PLWZ \cdot ER \cdot LW + TRO \cdot INDEX + GDEBTD_{-1} \cdot RGD \cdot int h \quad (4.35)$$

where  $int h$  is the share of interest payments to the household sector.

The household's budget devoted to consumption of commodities ( $CBUD$ ) is further given by:

$$CBUD = YH - ty \cdot YHI - tsch \cdot \sum_i LSK_i \cdot PL \cdot wdif_i - SH \quad (4.36)$$

The optimal allocation between consumption commodities ( $C_i$ ) is given by the maximization of a Stone-Geary utility function:

$$U(C_i) = \prod_i (C_i - \mu H_i)^{\alpha H_i} \quad (4.37)$$

where:  $\sum_i \alpha H_i = 1$ ,

subject to the budget constraint:

$$CBUD = \sum_i (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot P_i \cdot C_i \quad (4.38)$$

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$P_i$  is the price of commodity  $i$  net of taxes but including subsidies,  $\mu H_i$  reflects the minimum (subsistence) level of consumption of commodity  $i$  demanded by the household, and  $\alpha H_i$  is the income elasticity of the demand for commodity  $i$ . A schematic representation of households' decisions is given in figure 4.3.

Commodities are disaggregated into 35 categories, following the same classification as the one used for the production sectors. This classification is dictated by the level of disaggregation of the SAM, but it should not necessarily be the same as the classification of the production sectors. Consumption is valued at purchaser's prices  $(1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot P_i$ , which incorporate value-added taxes ( $vat_i$ ) and excise duties ( $tc_i$ ) less subsidies ( $tsc_i$ ).

After some rearrangements<sup>45</sup>, the optimization process generates the demand equations for consumption commodities (the Linear Expenditure System)<sup>46</sup>:

$$C_i = \mu H_i + \alpha H_i \cdot [(1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot P_i]^{-1} \cdot [CBUD - \sum_j (1 + vat_j) \cdot (1 + tc_j) \cdot (1 - tsc_j) \cdot P_j \cdot \mu H_j] \quad (4.39)$$

To evaluate the overall change in consumer welfare we use the equivalent variation in income ( $EV$ ), which is based on the concept of a money metric indirect utility function (Varian, 1992):

$$EV = (VL - VL0) \cdot \prod_i \left[ \frac{PZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i)}{\alpha H_i} \right]^{\alpha H_i} \quad (4.40)$$

The indirect utility function of the LES function in the counter-factual (policy scenario) equilibrium ( $VL$ ) is defined as:

$$VL = \left[ CBUD - \sum_i P_i \cdot (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot \mu H_i \right] \cdot \prod_i [\alpha H_i / (P_i \cdot (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i))]^{\alpha H_i} \quad (4.41)$$

and the indirect utility function of the LES function in the benchmark equilibrium ( $VL0$ ) is given by:

$$VL0 = \left[ CBUDZ - \sum_i PZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i) \cdot \mu H_i \right] \cdot \prod_i [\alpha H_i / (PZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i))]^{\alpha H_i} \quad (4.42)$$

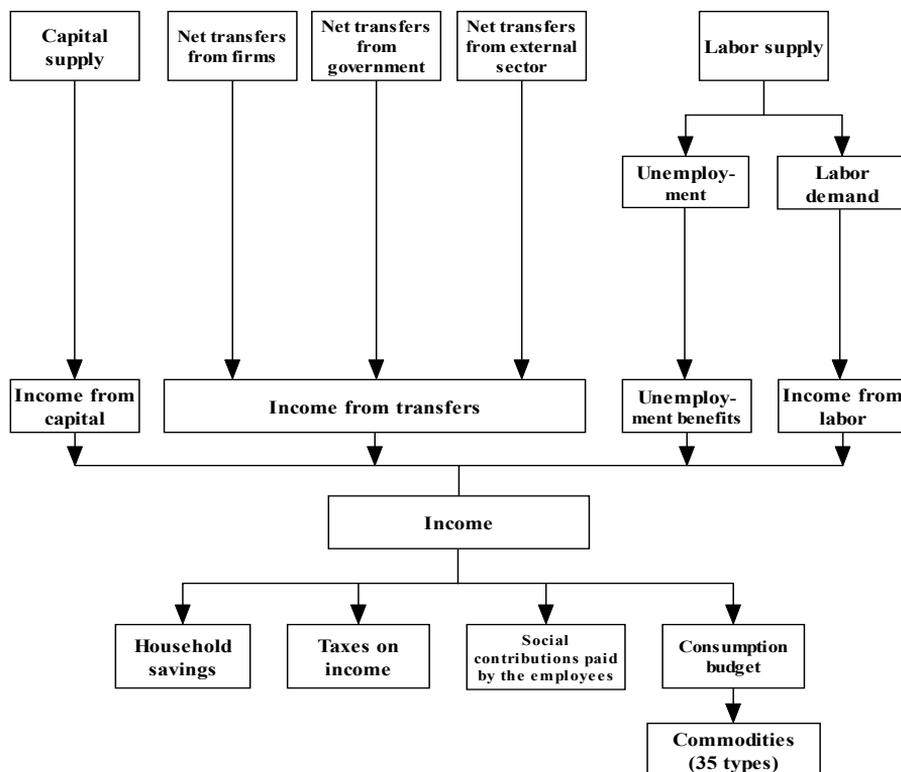
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<sup>45</sup> The derivation of the demand equations for consumption commodities is presented in appendix 4.A.

<sup>46</sup> The Linear Expenditure System (LES) was developed by Stone (1954) and represents a set of consumer demand equations linear in total expenditure. See appendix 4.A for more information.

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where  $CBUDZ$  reflects the household's budget available for consumption in the benchmark equilibrium,  $PZ_i$  is the price of commodity  $i$  in the benchmark and  $vat\theta_i$ ,  $tc\theta_i$  and  $tsc\theta_i$  are the VAT rate, the excise duty rate and the subsidy rate in the benchmark equilibrium, respectively.



**Figure 4.3. The resource and expenditure flows of the household**

The equivalent variation measures the income needed to make the household as well off as she is in the new counter-factual equilibrium (policy scenario) evaluated at benchmark prices. The equivalent variation is positive for welfare gains from the policy scenario and negative for losses (Harrison and Kriström, 1997).

### 4.2.4. The government sector

The principal budget entities are the state budget (representing 52.68 percent of general government spending in 2000); the social security fund, which covers old-age pensions and invalidity benefits (19.65 percent); and local government administrations, responsible for most local services (excluding health and education, which are centrally funded) and some basic social assistance benefits (11.70

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percent)<sup>47</sup>. In 2000 there were several smaller funds, covering additional areas of social support (including unemployment compensation and health insurance benefits) and some more specialized functions (such as energy projects and road constructions). Starting with 2003, all the funds with specialized functions have been included in the state budget. The consolidated budget also includes State Ownership Fund (SOF) which gathers the revenues from privatization. In the model however, the general government consolidated budget is presented from the revenues and expenditures perspective to reflect the contributions of the economic agents to the budget. The primary and the conventional balance are chosen to define the size of the fiscal surplus/deficit. A discussion on the size of fiscal deficits is given in appendix 4.D.

It would have been interesting to distinguish and model the revenues from privatization, but due to the lack of data this was not possible. Instead, these revenues are treated exogenously and are included in the net transfers to the firms sector. Similarly, the lack of data did not allow us to model the financial sector in greater detail, which could provide a deeper insight in the financing of the budget deficit. In 2000 all forms of quasi-fiscal spending were eliminated, with support for agriculture, industry and other activities brought fully in the budget. This decision was a significant step on the path towards a market-oriented economy and thereby, raised the degree of realism of the model proposed here even if the financing of the budget deficit is presented in a simplified manner in RoMod.

In the model, the government is represented in two ways: as a production sector<sup>48</sup> (public administration and defence; compulsory social security) and as an institutional sector. The public administration sector produces public services using non-energy intermediates, energy inputs, labor and capital. The government sector (seen as an institutional sector) collects taxes, subsidizes consumption and production, makes transfers and capital expenditures and buys public services from the public administration sector.

The government revenues (*TAXR*) consist of the taxes on both the intermediate and the final consumption (value added taxes and excise duties), the taxes on production, the social security contributions, the import tariffs, the taxes on household's income and the corporate taxes, and the net transfers from the external sector (*TRGW*) :

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<sup>47</sup> Data available at <http://www.mfinante.ro>

<sup>48</sup> The treatment of the public administration sector has been discussed together with the firms sector in section 4.2.2.

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$$\begin{aligned}
 TAXR = & ty \cdot YHI + tyf \cdot YFI + tsch \cdot \sum_i LSK_i \cdot PL \cdot wdf_i + \sum_i [P_i \cdot C_i \cdot (1 - tsc_i) \cdot tci + \\
 & P_i \cdot C_i \cdot (1 - tsc_i) \cdot (1 + tc_i) \cdot vat_i + tsh_i \cdot LSK_i \cdot PL \cdot wdf_i + tm_i \cdot M_i \cdot PWMZ_i \cdot ER + \\
 & XD_i \cdot PD_i \cdot tpi + P_i \cdot CG_i \cdot vatg_i + P_i \cdot I_i \cdot vatinv_i] + \sum_{nen} \sum_i [io_{nen,i} \cdot P_{nen} \cdot XD_i \cdot \\
 & tci_{nen,i} + io_{nen,i} \cdot P_{nen} \cdot XD_i \cdot (1 + tci_{nen,i}) \cdot vati_{nen,i}] + \sum_{en} \sum_i [ENINP_{en,i} \cdot P_{en} \cdot tci_{en,i} + \\
 & ENINP_{en,i} \cdot P_{en} \cdot (1 + tci_{en,i}) \cdot vati_{en,i}] + ER \cdot TRGW
 \end{aligned} \quad (4.43)$$

where  $tm_i$  is the average tariff rate on commodity  $i$ ,  $tp_i$  is the tax on production paid by sector  $i$ ,  $vatg_i$  is the average VAT rate paid on purchases of commodity  $i$  by the government,  $CG_i$  is government consumption of commodity  $i$ ,  $vatinv_i$  is the VAT rate paid on investment commodity  $i$ , and  $I_i$  is the demand for investment commodity  $i$ . As already pointed out, the social contributions are divided into those paid by the employers ( $tsh_i$ ) and those paid by self-employed members of the household ( $tsch$ ).

The government makes transfers to the households:

$$TRHG = trep \cdot PL \cdot UNEMP + TRO \cdot INDEX + GDEBTD_j \cdot RGD \cdot int h \quad (4.44)$$

which consist of unemployment benefits, determined by the combination of the replacement rate ( $trep$ ) and the national average real wage, other transfers ( $TRO$ ), such as pensions, translated into nominal terms by using the Laspeyres consumer price index ( $INDEX$ ), and a share ( $int h$ ) of interest payments on public debt.

Total government expenditures comprise transfers to firms and to households (including the interest payments on the public debt), subsidies on consumption ( $tsc_i$ ) and production ( $tsp_i$ ), purchases of goods and services and capital expenditures:

$$\begin{aligned}
 GEXP = & CGBUD + TRFG \cdot GDPDEF + trep \cdot PL \cdot UNEMP + TRO \cdot INDEX + \\
 & INTR + \sum_i [P_i \cdot C_i \cdot tsc_i + XD_i \cdot PD_i \cdot tsp_i]
 \end{aligned} \quad (4.45)$$

where the government disposable budget for current and capital expenditures ( $CGBUD$ ) is modeled as a fixed share ( $govsh$ ) of GDP at current market prices:

$$CGBUD = govsh \cdot GDPC \quad (4.46)$$

The optimal allocation between purchases of goods and services (including public services bought from the public administration sector) and capital expenditures is given by the maximization of a Cobb-Douglas utility function:

$$U(GFCFG, CG_i) = GFCFG^{\alpha GI} \cdot \prod_i CG_i^{\alpha Gi} \quad (4.47)$$

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subject to the budget constraint:

$$CGBUD = GFCFG \cdot PI + \sum_i (1 + vatg_i) \cdot P_i \cdot CG_i \quad (4.48)$$

with:  $\alpha GI + \sum_i \alpha G_i = 1$ .

The demand equations for government purchases of goods and services ( $CG_i$ ) and capital expenditures ( $GFCFG$ ) are derived as:

$$CG_i = [(1 + vatg_i) \cdot P_i]^{-1} \cdot \alpha G_i \cdot CGBUD \quad (4.49)$$

$$GFCFG = PI^{-1} \cdot \alpha GI \cdot CGBUD \quad (4.50)$$

where  $\alpha G_i$  is the income elasticity of government demand for commodity  $i$ , and  $\alpha GI$  is the income elasticity of government demand for capital expenditures.

The primary budget surplus ( $SGP$ ) is given by total revenues minus current and capital expenditures (except interest payments):

$$SGP = TAXR - CGBUD - TRFG \cdot GDPDEF - trep \cdot PL \cdot UNEMP - TRO \cdot INDEX - \sum_i [P_i \cdot C_i \cdot tsc_i + XD_i \cdot PD_i \cdot tsp_i] \quad (4.51)$$

The conventional budget deficit ( $SGC$ ) is then derived as<sup>49</sup>:

$$SGC = SGP - INTR \quad (4.52)$$

where  $INTR$  are the total interest payments. Total interest payments are computed as the sum of interest payments on domestic ( $GDEBTD_{-1}$ ) and foreign ( $GDEBT_{-1}$ ) debt in the previous period, where  $RGE$  is the world interest rate, which is exogenous:

$$INTR = GDEBTD_{-1} \cdot RGD \cdot intf + GDEBTD_{-1} \cdot RGD \cdot inth + GDEBT_{-1} \cdot RGE \cdot ER \quad (4.53)$$

The domestic interest rate on public debt is specified as:

$$RGD = RINT \cdot RISK \quad (4.54)$$

where  $RISK$  is the risk premium paid by the government over the domestic interest rate ( $RINT$ ). The domestic interest rate is given by the average rental rate of capital in the production sectors<sup>50</sup>:

$$RINT = \frac{\sum_i (RK_i \cdot KSK_i)}{\sum_i KSK_i} \quad (4.55)$$

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<sup>49</sup> See appendix 4.D for a definition of the primary and conventional budget balance.

<sup>50</sup> This is a crude way of modeling the interest rate in the absence of financial sector in the model.

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The model incorporates the calculation of the primary and conventional budget balance to GDP ratio, which are given in appendix 4.B, equations (4.B.40)-(4.B.41). The debt accumulation is explained in section 4.2.11 together with the model's dynamics.

### 4.2.5. The external sector

The trade regime is relatively liberal for most products. Imports are highly concentrated on industrial commodities, 80.3 percent in 2000, due to the high share of imports of electrical machinery, appliances and equipment (29.1 percent) textiles and clothing (18.6 percent) and chemicals (9.1 percent). Most textile imports are used as intermediate inputs by the domestic textile industry showing the high dependency of this sector on imports. Exports are also characterized by a high degree of concentration, with industrial commodities representing 83.1 percent of the total in 2000. Articles of apparel and clothing alone represent 27.4 percent of exports, and basic metals and fabricated metal products (iron and steel) 15.1 percent. Romania displays a large export surplus in the apparel and clothing segments and the largest deficit in the intermediate textile products (OECD, 2002). This reflects the very considerable subcontracting activities for firms in various European Union countries (mainly Italy and Germany). However, due to the lack of data on imports of intermediate inputs used by each sector, and on import tariffs by country of origin, it is not possible to analyze these aspects in detail.

For non-agricultural products the average (non-weighted) tariff rate was 16 percent in 2000, while for agricultural and food products it was nearly 34 percent. This issue is important in the process of preparation for EU accession. Besides, Romania does not apply any quantitative restriction to imports (OECD, 2002). Some restrictions on exports are applied for environmental reasons (in the case of wood), for preservation of mineral resources (ferrous and non-ferrous metals, precious metals, marble) and biological products (e.g. blood), but they are not specifically considered in the present model.

In the model, the specification of the foreign trade is based on the small-country assumption, which means that the country is a price taker in both its imports and exports markets. As a result, both world import prices and world export prices are exogenously fixed.

The assumption of limited substitution possibilities between domestically produced and imported goods, which goes back to Armington (1969)<sup>51</sup>, is now a standard feature of applied models and will also be adopted here. It indicates that domestic consumers use composite goods ( $X_i$ ) of imported and domestically produced goods, according to a CES function:

$$X_i = (\gamma A_i \cdot M_i^{-\rho A_i} + \gamma A_i \cdot XDD_i^{-\rho A_i})^{-1/\rho A_i} \quad (4.56)$$

Minimizing the cost function:

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<sup>51</sup> See appendix 4.A for a discussion on Armington approach.

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$$Cost_i(M_i, XDD_i) = PM_i \cdot M_i + PDD_i \cdot XDD_i \quad (4.57)$$

subject to (4.56), yields the demand equations for imports ( $M_i$ ) and domestically produced goods ( $XDD_i$ ):

$$M_i = X_i \cdot (P_i / PM_i)^{\sigma_{Ai}} \cdot \gamma A1_i^{\sigma_{Ai}} \quad (4.58)$$

$$XDD_i = X_i \cdot (P_i / PDD_i)^{\sigma_{Ai}} \cdot \gamma A2_i^{\sigma_{Ai}} \quad (4.59)$$

and the zero profit condition:

$$P_i \cdot X_i = PM_i \cdot M_i + PDD_i \cdot XDD_i \quad (4.60)$$

where  $\gamma A1_i$  and  $\gamma A2_i$  are the distribution parameters and the elasticity of substitution between imports and domestically produced goods ( $\sigma_{Ai}$ ) is given by  $1/(1 + \rho_{Ai})$ .  $PM_i$  is the domestic price of imports of commodity  $i$ , including tariffs, and  $PDD_i$  is the price of domestically produced goods delivered to the domestic market by sector  $i$ , including trade and transport margins. Total sales ( $X_i$ ) are given by the sum of spending on the domestic output and imports, valued at prices  $PDD_i$  and  $PM_i$ , respectively. In this case the prices include trade and transportation margins but do not include value-added taxes, excises and subsidies. Therefore, total sales are valued at the composite price  $P_i$  net of taxes less subsidies.

A limited substitution is also assumed to exist between goods produced for the domestic market ( $XDD_i$ ) and for export ( $E_i$ ) as captured by a constant elasticity of transformation (CET) function:

$$XD_i = (\gamma T1_i \cdot E_i^{-\rho_{Ti}} + \gamma T2_i \cdot XDD_i^{-\rho_{Ti}})^{-1/\rho_{Ti}} \quad (4.61)$$

where  $\gamma T1_i$  and  $\gamma T2_i$  are the distribution parameters, and the elasticity of transformation ( $\sigma_{Ti}$ ) is given by  $1/(1 + \rho_{Ti})$ .

By maximizing the revenue of the producer:

$$Revenue_i(E_i, XDD_i) = PE_i \cdot E_i + PDS_i \cdot XDD_i \quad (4.62)$$

subject to (4.61) we derive the supply equations for exports and domestically produced goods:

$$E_i = XD_i \cdot (PD_i / PE_i)^{\sigma_{Ti}} \cdot \gamma T1_i^{\sigma_{Ti}} \quad (4.63)$$

$$XDD_i = XD_i \cdot (PD_i / PDS_i)^{\sigma_{Ti}} \cdot \gamma T2_i^{\sigma_{Ti}} \quad (4.64)$$

and the zero profit condition:

$$PD_i \cdot XD_i = PE_i \cdot E_i + PDS_i \cdot XDD_i \quad (4.65)$$

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where  $PE_i$  is the domestic price of exports for sector  $i$ ,  $PDS_i$  is the price of domestic output supplied to domestic market excluding the trade and transportation margins. Both exports and domestic output delivered to the domestic market are valued at basic prices,  $PE_i$  and  $PDS_i$ .

The balance of payments is now determined as all international incoming and outgoing payments have been taken into account:

$$SW = \sum_i PWEZ_i \cdot E_i - \sum_i PWMZ_i \cdot M_i + TRHW + TRGW + LW \cdot PLWZ - TRWF - GDEBT_{-1} \cdot RGE \quad (4.66)$$

The current account deficit or surplus ( $SW$ ), expressed in foreign currency, is determined by the difference between exports and imports, valued at world prices,  $PWEZ_i$  and  $PWMZ_i$  respectively, the net transfers received by the households  $TRHW$  and the government  $TRGW$  from the external sector, the remuneration for labor supplied to the non-resident firms ( $LW \cdot PLWZ$ ), the transfers of the firms to the external sector ( $TRWF$ ) as well as the interest payments on foreign debt ( $GDEBT_{-1} \cdot RGE$ ). The income from labor received from the non-resident firms is defined by the labor supplied to the non-resident firms ( $LW$ ) multiplied by the average wage rate expressed in foreign currency ( $PLWZ$ ). The deficit of the current account reflects the net borrowing of the economy from the external sector.

### 4.2.6. Investment demand

There are no formal restrictions on foreign or domestic direct investment in any specific sector in Romania. The only exception refers to foreign companies wishing to establish a subsidiary, which are required as insurance to associate with a Romanian partner. Furthermore an amendment, passed in April 1997, to the 1991 Foreign Investment Law provides the right of a foreign investor established as a legal Romanian person to acquire real estate, including land, necessary to carrying out its activities.

In the model, investment is modeled through an optimization process, providing the optimal allocation of investment commodities. The input-output table provides only the investments disaggregated by type of commodity. Therefore, within a single period, the model generates savings, the demand for investment commodities, and the demand for capital goods. However, by assumption, these capital goods are not installed during the same period, so that investment simply represents a demand category with no effect on supply in the static part of the model (Robinson et al., 1999). The allocation of investment commodities between production sectors is further provided in the dynamic part of the model. However, due to the lack of data, the model does not show the composition of investment commodities distributed to each sector. Instead, a homogenous composite investment good is allocated for each production sector, in the dynamic part of the model.

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The demand for investment commodities ( $I_i$ ) is modeled in a very simple way, by maximizing a Cobb-Douglas utility function:

$$U(I_i) = \prod_i I_i^{\alpha I_i} \quad (4.67)$$

subject to the budget constraint:

$$(S - \sum_j SV_j \cdot P_j) = \sum_i I_i \cdot P_i \cdot (1 + \text{vatinv}_i) \quad (4.68)$$

with  $\sum_i \alpha I_i = 1$ , where  $\alpha I_i$  is the income elasticity of demand for investment commodity  $i$ ,  $\text{vatinv}_i$  is the value added tax rate on investment commodity  $i$ , and  $SV_i$  represents the changes in inventories for sector  $i$ . Changes in inventories are further derived by multiplying the domestic demand by the inventory investment ratio ( $\text{svr}_i$ ):

$$SV_i = \text{svr}_i \cdot X_i \quad (4.69)$$

Total available savings ( $S$ ) are determined as follows:

$$S = SH + SF + SGC + GFCFG \cdot PI - SW \cdot ER + \sum_i DEP_i \cdot PI \quad (4.70)$$

where  $DEP_i$  represents the depreciation by sector valued at the price of the composite investment commodity ( $PI$ ). The savings made available by the external sector (equivalent to net borrowing of the economy from the external sector) are expressed in domestic currency, by multiplying it with the exchange rate ( $ER$ ), and government savings (in fact dissavings) are expressed as the sum of the conventional budget deficit ( $SGC$ ) and public capital expenditures ( $GFCFG \cdot PI$ ). The price of the composite investment commodity is further derived as the Cobb-Douglas unit expenditure function:

$$PI = \prod_i [P_i \cdot (1 + \text{vatinv}_i) / \alpha I_i]^{\alpha I_i} \quad (4.71)$$

The sectoral depreciation is determined by the capital stock ( $KSK_i$ ) and the depreciation rate ( $d_i$ ):

$$DEP_i = d_i \cdot KSK_i \quad (4.72)$$

The maximization process yields the demand equations for investment commodities:

$$I_i = \alpha I_i \cdot [(1 + \text{vatinv}_i) \cdot P_i]^{\alpha I_i} \cdot (S - \sum_j SV_j \cdot P_j) \quad (4.73)$$

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which are valued at purchaser's prices  $[(1+\text{vatinv}_i) \cdot P_i]$ , including VAT taxes.

### 4.2.7. Price equations

A common assumption for a CGE model, which is also adopted here, is that the economy is initially in equilibrium with the quantities normalized in such a way that the prices are equal to unity. As already explained, an exception has been made for the capital and labor markets. Due to the homogeneity of degree zero in prices, the model can only determine relative prices. A particular price has been selected to provide the numeraire against which all the prices in the model will be measured. In the model, the GDP deflator is chosen as the numeraire:

$$\overline{GDPDEF} = \overline{GDPDEF} \quad (4.74)$$

Separate prices are distinguished for all the sectors, exports and imports. The domestic price of exports ( $PE_i$ ) reflects the price received by the domestic producers for selling their output on the external market, where  $PWEZ_i$  is the world price of exports and  $ER$  is the exchange rate (expressed as ROL<sup>52</sup>/EUR). The cost of trade, railways transport, land transport, and water transport inputs further reduces the domestic price received by the producers:

$$PE_i = PWEZ_i \cdot ER - \sum_{ct} tcoe_{ct,i} \cdot P_{ct} - \sum_{ctpr} tcroe_{ctpr,i} \cdot P_{ctpr} - \sum_{ctpa} tcao_{ctpa,i} \cdot P_{ctpa} - \sum_{ctpw} tcwoe_{ctpw,i} \cdot P_{ctpw} \quad (4.75)$$

where  $tcoe_{ct,i}$  is the quantity of commodity  $ct$  as trade input per unit of commodity  $i$  exported and  $P_{ct}$  represents the price of commodity  $ct$ . The commodity  $ct$  is in fact the wholesale and retail sale commodity. The cost of trade input for exports reflects the cost of moving the commodity  $i$  from the producer to the border, which is paid by the producer. In a similar way,  $tcroe_{ctpr,i}$  represents the quantity of commodity  $ctpr$  as railways transport input per unit of commodity  $i$  exported and  $P_{ctpr}$  the price of railways transport commodity;  $tcao_{ctpa,i}$  is the quantity of commodity  $ctpa$  as land transport input per unit of commodity  $i$  exported and  $P_{ctpa}$  the price of land transport commodity; and  $tcwoe_{ctpw,i}$  is the quantity of commodity  $ctpw$  as water transport input per unit of commodity  $i$  exported and  $P_{ctpw}$  the price of water transport commodity.

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<sup>52</sup> ROL stands for the Romanian national currency. On July 1, 2005 a denomination of the national currency was enacted such that 1 RON = 10,000 ROL. RON stands for the denominated national currency. Both types of banknotes will be used until the end of 2006.

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The domestic price of imports ( $PM_i$ ) is determined by the world price of imports ( $PWMZ_i$ ), the exchange rate, the tariff rate ( $tm_i$ ) and the cost of trade, railways transport, land transport and water transport inputs for imports:

$$PM_i = (1 + tm_i) \cdot ER \cdot PWMZ_i + \sum_{ct} tcom_{ct,i} \cdot P_{ct} + \sum_{ctpr} tcrom_{ctpr,i} \cdot P_{ctpr} + \sum_{ctpa} tcaom_{ctpa,i} \cdot P_{ctpa} + \sum_{ctpw} tcwom_{ctpw,i} \cdot P_{ctpw} \quad (4.76)$$

where  $tcom_{ct,i}$  is the quantity of commodity  $ct$  as trade input per imported unit of commodity  $i$ ,  $tcrom_{ctpr,i}$  is the quantity of commodity  $ctpr$  as railways transport input per imported unit of commodity  $i$ ,  $tcaom_{ctpa,i}$  is the quantity of commodity  $ctpa$  as land transport input per imported unit of commodity  $i$  and  $tcwom_{ctpw,i}$  is the quantity of commodity  $ctpw$  as water transport input per imported unit of commodity  $i$ . The cost of trade and transport inputs for imports reflects the cost of moving the commodity  $i$  from the border to the final consumer.

The model distinguishes the price of domestic output supplied to the domestic market paid by the consumers ( $PDD_i$ ) and the price received by the producers ( $PDS_i$ ). The difference between the two prices is represented by the cost of trade and transport inputs for domestic output delivered to domestic market:

$$PDD_i = PDS_i + \sum_{ct} tcod_{ct,i} \cdot P_{ct} + \sum_{ctpr} tcrod_{ctpr,i} \cdot P_{ctpr} + \sum_{ctpa} tcaod_{ctpa,i} \cdot P_{ctpa} + \sum_{ctpw} tcwod_{ctpw,i} \cdot P_{ctpw} \quad (4.77)$$

where  $tcod_{ct,i}$  is the quantity of commodity  $ct$  as trade input per unit of commodity  $i$  delivered to the domestic market,  $tcrod_{ctpr,i}$  is the quantity of commodity  $ctpr$  as railways transport input per unit of commodity  $i$  delivered to the domestic market,  $tcaod_{ctpa,i}$  is the quantity of commodity  $ctpa$  as land transport input per unit of commodity  $i$  delivered to the domestic market and  $tcwod_{ctpw,i}$  is the quantity of commodity  $ctpw$  as water transport input per unit of commodity  $i$  delivered to the domestic market.

The consumer price index ( $INDEX$ ) used in the model is of the Laspeyres type and is defined as:

$$INDEX = \frac{\sum_i [P_i \cdot CZ_i \cdot (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i)]}{\sum_i [PZ_i \cdot CZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i)]} \quad (4.78)$$

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where  $PZ_i$  is the price of the commodity  $i$  in the benchmark equilibrium,  $CZ_i$  is the consumption of commodity  $i$  in the benchmark equilibrium, and  $vat0_i$ ,  $tc0_i$  and  $tsc0_i$  are the VAT rate, excise duty rate and the subsidy rate on consumption of commodity  $i$  in the benchmark equilibrium. Some other price indexes (for investment commodities, exports and imports) of Laspeyres type are calculated in the model. They are provided in appendix 4.B, equations (4.B.59)-(4.B.61), and are used to calculate aggregate investment demand, overall exports and imports.

### 4.2.8. The labor market

The enterprise restructuring, which is meant to improve the profitability of firms across the Romanian economy, has increased the risk of layoff for many employees in the short-run. Wage differentials are substantial and growing, especially in private firms. As in many transition countries, formal educational attainment is a major criterion for wage differentiation. Wage bargaining is generally decentralized and not subject to direct intervention by the government, apart from the public administration and Régies Autonomes where the government has the final authority. The legal minimum wage was fixed at 1,000,000 ROL (51 EUR) per month in 2000. Almost all employees earn more than the legal minimum since it is low relative to average wages. The legal minimum wage serves primarily as a benchmark for social transfers, and as a lower limit for taxable income.

The usual unemployment-inflation relationship observed for the developed economies, is far from being valid for a country in transition like Romania, where for some periods hyperinflation has been associated with medium-term trends of increasing unemployment rates. One of the frequent explanations is the liberalization of the previous command economic system, allowing prices to adjust freely. Another explanation refers to the existence of hidden unemployment. Some authors (Ciupagea, 2000) point at the impact of hysteresis on the labor market in Romania. In our model labor market rigidities are introduced by using a wage curve, which seems quite realistic, at least in the long-run. The wage curve assumes a long-run negative relationship between the real average wage rate and the unemployment rate (Blanchflower and Oswald, 1994). Furthermore, the inter-sectoral wage differentials are included in the model, introducing more rigidities in the labor market.

The labor market is modeled in quite a simple manner. A deeper analysis of the labor market including the incorporation of various rigidities and institutional factors is left for future research.

In the model, firms use labor services in the production process (equation (4.6) for all sectors excluding coal, oil, and natural gas sectors and equation (4.28) for coal, oil and natural gas sectors). The inter-sectoral wage differentials introduce rigidities in the labor market, as already explained in section 4.2.2.

The labor market is closed by changes in unemployment:

$$\sum_i LSK_i = LSR - UNEMP \quad (4.79)$$

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where  $LSR$  is the total labor supply to the domestic economy. Further, total labor supply ( $LS$ ) is given by:

$$LS = LSR + LW \quad (4.80)$$

where  $LW$  is the labor supply to the external sector.

A labor supply curve, which assumes a positive correlation between the labor supply and the real average wage rate:

$$LSR = LSRZ \cdot ((PL \cdot INDEXZ)/(PLZ \cdot INDEX))^{elasLS} \quad (4.81)$$

is used to endogenize labor supply in the model, where  $PLZ$  is the economy-wide average wage rate in the benchmark year,  $INDEXZ$  is the consumer price index in the benchmark year,  $LSRZ$  is the labor supply in the benchmark year and  $elasLS$  is the real wage elasticity of labor supply.

As already mentioned, the model allows for unemployment. The average wage rate paid by the firms is a function of consumer prices and the unemployment rate, as follows:

$$(PL/INDEX)/(PLZ/INDEXZ)-1 = \beta \cdot [(UNEMP/LSR)/(UNEMPZ/LSRZ)-1] \quad (4.82)$$

where  $\beta$  is a parameter.

### 4.2.9. Market clearing equations

The equilibrium in the commodity and capital markets requires that demand equals supply at the prevailing prices. The capital stock is exogenously fixed by sector, restricting the mobility of capital between sectors. Therefore, a market clearing equation for the capital market is not needed in the model.

On the non-energy commodities market excluding the wholesale and retail trade commodity, railways transport commodity, land transport commodity and water transport commodity, the sum of demand for household consumption, demand for investment commodities, demand for inventories and demand for non-energy intermediate inputs equal the supply of the composite commodity  $nct$  ( $X_{nct}$ ):

$$C_{nct} + I_{nct} + SV_{nct} + \sum_i io_{nct,i} \cdot XD_i + CG_{nct} = X_{nct} \quad (4.83)$$

For the wholesale and retail trade commodity the market clearing equation is given by:

$$C_{ct} + I_{ct} + SV_{ct} + \sum_i io_{ct,i} \cdot XD_i + CG_{ct} + MARG_{ct} = X_{ct} \quad (4.84)$$

where  $MARG_{ct}$  is the demand for trade services (Löfgren, Harris and Robinson, 2002). Total demand for trade services is further given by the sum of demand for trade services generated by the domestic output delivered to the domestic market (from moving the commodities from the producers to the domestic consumers), of

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the demand for trade services generated by the imports (from moving the commodities from the border to the domestic consumer), and of the demand for trade services generated by the exports (from moving the commodities from the domestic producer to the border):

$$MARG_{ct} = \sum_i (tcod_{ct,i} \cdot XDD_i + tcom_{ct,i} \cdot M_i + tcoe_{ct,i} \cdot E_i) \quad (4.85)$$

The market clearing equation for the railways transport commodity is given by:

$$C_{ctpr} + I_{ctpr} + SV_{ctpr} + \sum_i io_{ctpr,i} \cdot XD_i + CG_{ctpr} + MARGR_{ctpr} = X_{ctpr} \quad (4.86)$$

Total railways transport margins ( $MARGR_{ctpr}$ ) reflect the demand for railways transport services as a function of domestic output delivered to the domestic market, by imports and exports:

$$MARGR_{ctpr} = \sum_i (tcred_{ctpr,i} \cdot XDD_i + tcrrom_{ctpr,i} \cdot M_i + tcroe_{ctpr,i} \cdot E_i) \quad (4.87)$$

Further, the market clearing equation for the land transport commodity is given by:

$$C_{ctpa} + I_{ctpa} + SV_{ctpa} + \sum_i io_{ctpa,i} \cdot XD_i + CG_{ctpa} + MARGA_{ctpa} = X_{ctpa} \quad (4.88)$$

and for the water transport commodity by:

$$C_{ctpw} + I_{ctpw} + SV_{ctpw} + \sum_i io_{ctpw,i} \cdot XD_i + CG_{ctpw} + MARGW_{ctpw} = X_{ctpw} \quad (4.89)$$

where  $MARGA_{ctpa}$  is the demand for land transport services and  $MARGW_{ctpw}$  is the demand for water transport services. Total demand for land transport services is given by the sum of demand for land transport services as a function of domestic output delivered to the domestic market, by imports and exports:

$$MARGA_{ctpa} = \sum_i (tcaod_{ctpa,i} \cdot XDD_i + tcaom_{ctpa,i} \cdot M_i + tcaoe_{ctpa,i} \cdot E_i) \quad (4.90)$$

In a similar way, total demand for water transport services is given by:

$$MARGW_{ctpw} = \sum_i (tcwod_{ctpw,i} \cdot XDD_i + tcwom_{ctpw,i} \cdot M_i + tcwoe_{ctpw,i} \cdot E_i) \quad (4.91)$$

For the coal, oil, natural gas and electricity the market clearing equation is given by:

$$C_{en} + I_{en} + SV_{en} + \sum_i ENINP_{en,i} + CG_{en} = X_{en} \quad (4.92)$$

where  $ENINP_{en,i}$  represents the intermediate consumption of energy commodities  $en$  (coal, oil, natural gas, and electricity) by sector  $i$ .

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Finally, for the sectors with no exports or no domestic output delivered to the domestic market, the following equation allocates the entire output volume to one of these destinations:

$$XD_i = XDD_i + E_i \quad (4.93)$$

In the same way, for those sectors with no imports or no domestic output delivered to the domestic market, the entire volume of total sales are allocated to one of these destinations:

$$X_i = XDD_i + M_i \quad (4.94)$$

### 4.2.10. Other macroeconomic indicators

Gross domestic product at constant prices is defined in the model as:

$$GDP = \sum_i [C_i \cdot PZ_i \cdot (1+vat0_i) \cdot (1+tc0_i) \cdot (1-tsc0_i) + CG_i \cdot PZ_i \cdot (1+vatg0_i) + I_i \cdot PZ_i \cdot (1+vatinv0_i) + SV_i \cdot PZ_i + E_i \cdot PWEZ_i \cdot ERZ - M_i \cdot PWMZ_i \cdot ERZ] \quad (4.95)$$

where  $PZ_i$  reflects the price of commodity  $i$  in the benchmark year,  $ERZ$  represents the exchange rate in the benchmark year,  $vat0_i$ ,  $tc0_i$ ,  $tsc0_i$  are the VAT rate, excise duty rate and subsidy rate on private consumption in the benchmark year,  $vatg0_i$  is the VAT rate on public consumption in the benchmark and  $vatinv0_i$  is the value added tax rate on investment commodities in the benchmark year.

Gross domestic product in current prices is given by:

$$GDPC = \sum_i [C_i \cdot P_i \cdot (1+vat_i) \cdot (1+tc_i) \cdot (1-tsc_i) + CG_i \cdot P_i \cdot (1+vatg_i) + I_i \cdot P_i \cdot (1+vatinv_i) + SV_i \cdot P_i + E_i \cdot PWEZ_i \cdot ER - M_i \cdot PWMZ_i \cdot ER] \quad (4.96)$$

Derivation of some other macroeconomic indicators like total private consumption as well as aggregate demand for investment commodities, total imports and exports is given in appendix 4.B, equations (4.B.82)-(4.B.85).

### 4.2.11. Incorporation of recursive dynamics

The equations presented so far describe the static general equilibrium for 2000. However, an evaluation of tax policy measures based on a static equilibrium can be misleading. For example, investment is just a demand category in the static formulation of the model with no influence on the sectoral capital stock. However, changes in the allocation of investments between sectors, according to sectoral returns on capital, could have a great influence on capital stock accumulation and thus on sectoral gross output. Therefore, in the following we incorporate a recursive dynamic structure in the model. The recursive dynamic structure is composed of a sequence of several equilibria. The first equilibrium in the sequence is given by the

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benchmark year<sup>53</sup>. In the subsequent time periods, the model is solved for an equilibrium given the exogenous conditions assumed for that particular period. The equilibria are connected to each other through capital accumulation and population growth. In the benchmark case, we assume that the economy is on a steady-state growth path, where all the quantity variables grow at the same rate and all relative prices remain unchanged. When a policy measure is implemented the economy enters on a transition path, until, after some time it has reached a new steady-state growth path (Ballard, Fullerton, Shoven and Whalley, 1985). We are of course interested in the transition path induced by the policy measure and the characteristics of the new growth path.

The endogenous determination of investment behavior is essential for the dynamic part of the model. Investment and capital accumulation in year  $t$  depend on expected rates of return for year  $t+1$ , which are determined by actual returns on capital in year  $t$ . This approach involves adaptive expectations. Thus, investment is not only a demand category in the model. In the dynamic economic processes a homogenous composite investment commodity is allocated between sectors according to the actual (year  $t$ ) returns on capital in sector  $i$ .

The expected rate of return ( $ROR_{ng,t}$ ) required to maintain indefinitely the current rate of capital growth in all sectors  $ng$ , except the public administration sector, is specified as an inverse logistic function (see figure 4.4) of the proportionate growth in sector's  $ng$  capital stock (Dixon and Rimmer, 2002):

$$ROR_{ng,t} = RORZ_{ng,t} + (1/B_{ng}) \cdot [\ln(KSKg_{ng,t} - KSKg_{min_{ng}}) - \ln(KSKg_{max_{ng}} - KSKg_{ng,t}) - \ln(KSKtrend_{ng} - KSKg_{min_{ng}}) + \ln(KSKg_{max_{ng}} - KSKtrend_{ng})] \quad (4.97)$$

where  $RORZ_{ng,t}$  is the sector's historically normal rate of return,  $KSKg_{ng,t}$  is the actual capital growth rate in sector  $ng$ ,  $KSKg_{min_{ng}}$  and  $KSKg_{max_{ng}}$  are the minimum and the maximum possible growth rates of capital in sector  $ng$ ,  $KSKtrend_{ng}$  is the sector's historically normal growth rate and  $B_{ng}$  is a positive parameter. The minimum possible growth rate is set at the negative of the rate of depreciation in sector  $ng$ , while the maximum rate is set at  $KSKtrend_{ng}$  plus 0.06<sup>54</sup> in order to avoid unrealistically large simulated growth rate (Dixon and Rimmer, 2002).

Parameter ( $B_{ng}$ ) reflects the sensitivity of capital growth in sector  $ng$  to variations in its expected rate of return. It is derived by differentiating equation (4.97) with respect to  $KSKg_{ng,t}$ :

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<sup>53</sup> Year 2000 has been chosen as benchmark equilibrium for RoMod.

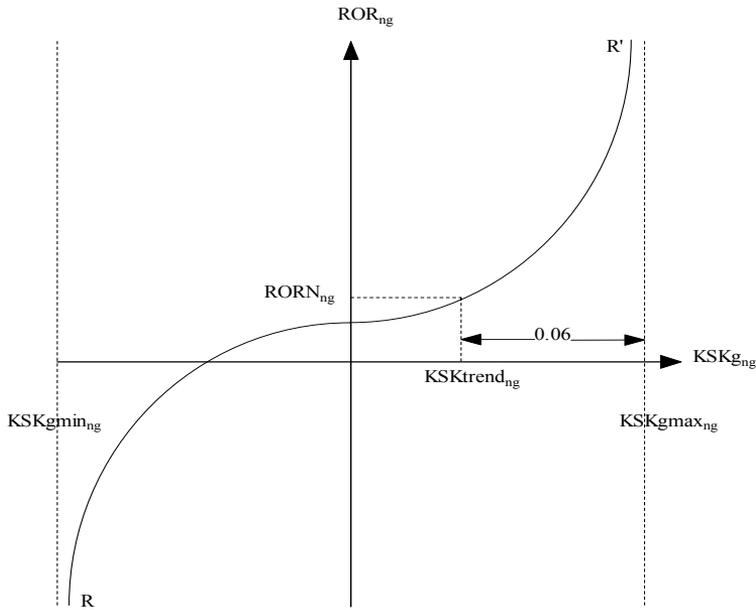
<sup>54</sup> The specification of the maximum possible growth rate implies that if the historically normal rate in a sector is 4 percent, the upper limit in any year  $t$  would not exceed 10 percent.

## A CGE Model for the Romanian economy

$$B_{ng} = SEA \cdot \left[ \frac{KSKg_{max_{ng}} - KSKg_{min_{ng}}}{(KSKg_{max_{ng}} - KSKtrend_{ng}) \cdot (KSKtrend_{ng} - KSKg_{min_{ng}})} \right] \quad (4.98)$$

where:

$$SEA = \left( \frac{\partial ROR_{ng,t}}{\partial KSKg_{ng,t}} \right)^{-1} \quad (4.99)$$



Source: Dixon and Rimmer, 2002.

**Figure 4.4. The equilibrium expected rate of return for sector  $ng$**

Evaluating (4.99) in the region of  $KSKg_{ng,t} = KSKtrend_{ng}$  provides:

$$SEA = \left( \frac{\partial ROR_{ng,t}}{\partial KSKg_{ng,t}} \Big|_{KSKg_{ng,t} = KSKtrend_{ng}} \right)^{-1} \quad (4.100)$$

where  $SEA$  is the reciprocal of the slope of the  $RR'$  in figure 4.4, which is considered to be the same for all sectors due to the lack of detailed sectoral estimations.

The present value ( $PVK_{ng,t}$ ) of investing a unit of capital in sector  $ng$ , in year  $t$  is defined as:

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$$PVK_{ng,t} = -PI_t + [RK_{ng,t+1} + PI_{t+1} \cdot d_{ng} + PI_{t+1} \cdot (1 - d_{ng})] / [1 + RINT_t] \quad (4.101)$$

where  $PI_t$  is the cost of buying a unit of capital (the price of composite investment commodity) in year  $t$ ,  $RK_{ng,t} + PI_{t+1} \cdot d_{ng}$  is the rental rate on sector's  $ng$  capital,  $d_{ng}$  is the depreciation rate in sector  $ng$  and  $RINT_t$  is the interest rate in year  $t$  (Dixon and Rimmer, 2002). The purchase of one unit of capital in year  $t$  by sector  $ng$  involves an immediate expenditure ( $PI_t$ ), followed by two benefits in year  $t+1$  which are discounted by  $(1 + RINT_t)$ : the rental value of an extra unit of capital in year  $t+1$  ( $RK_{ng,t} + PI_{t+1} \cdot d_{ng}$ ), including the depreciation, and the value at which the depreciated unit of capital can be sold in year  $t+1$  [ $PI_{t+1} \cdot (1 - d_{ng})$ ]. The expected rate of return on investment in sector  $ng$  in year  $t$  is further given by dividing both sides of (4.101) by  $PI_t$ , and reflects the present value of an investment of one ROL<sup>55</sup>:

$$ROR_{ng,t} = -1 + [RK_{ng,t+1} / PI_t + PI_{t+1} / PI_t] / [1 + RINT_t] \quad (4.102)$$

The expected rate of return ( $ROR_{ng,t}$ ) under adaptive expectations is derived as:

$$ROR_{ng,t} = -1 + [RK_{ng,t} / PI_t + 1] / [1 + RINT_t / GDPDEF_t] \quad (4.103)$$

where we assume that investors expect no change in the price of composite investment commodity ( $PI_t$ ) and rental rates ( $RK_{ng,t}$ ). As explained above in the static formulation of the model, the real interest rate in year  $t$  is given by:

$$RINT_t = \sum_i (RK_{i,t} \cdot KSK_{i,t}) / \sum_i KSK_{i,t} \quad (4.104)$$

and  $[1 + RINT_t / GDPDEF_t]$  reflects the adaptive expectation of the real interest rate.

The capital stock by sector in the next period (year  $t+1$ ) is given by:

$$KSK_{ng,t+1} = (1 - d_{ng}) \cdot KSK_{ng,t} + INV_{ng,t} \quad (4.105)$$

where  $KSK_{ng,t}$  for the current year (year  $t$ ) is derived using a CES function (see equations (4.10) and (4.27)).

The actual capital growth rate in sector  $ng$  can be derived from equation (4.97) as:

$$KSKg_{ng,t} = \left[ \alpha ROR_{ng,t} \cdot KSKg_{max_{ng}} \cdot (KSKtrend_{ng} - KSKg_{min_{ng}}) + KSKg_{min_{ng}} \cdot (KSKg_{max_{ng}} - KSKtrend_{ng}) \right] / \left[ \alpha ROR_{ng,t} \cdot (KSKtrend_{ng} - KSKg_{min_{ng}}) + (KSKg_{max_{ng}} - KSKtrend_{ng}) \right] \quad (4.106)$$

<sup>55</sup> ROL stands for the Romanian national currency. As already explained, 1 RON = 10,000 ROL.

## A CGE Model for the Romanian economy

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where:

$$\alpha ROR_{ng,t} = e^{B_{ng} \cdot (ROR_{ng,t} - RORZ_{ng,t})} \quad (4.107)$$

and the capital growth rate in terms of capital stock in year  $t+1$  and the capital stock in year  $t$  is given by:

$$KSKg_{ng,t} = KSK_{ng,t+1} / KSK_{ng,t} - 1 \quad (4.108)$$

From equations (4.105)-(4.108) we derive the investment carried out in sector  $ng$  in year  $t$ :

$$\begin{aligned} INV_{ng,t} = & KSK_{ng,t} \cdot \left\{ \left[ \alpha ROR_{ng,t} \cdot KSKg_{max_{ng}} \cdot (KSKtrend_{ng} - KSKg_{min_{ng}}) + \right. \right. \\ & \left. \left. KSKg_{min_{ng}} \cdot (KSKg_{max_{ng}} - KSKtrend_{ng}) \right] / \left[ \alpha ROR_{ng,t} \cdot (KSKtrend_{ng} - \right. \right. \\ & \left. \left. KSKg_{min_{ng}}) + (KSKg_{max_{ng}} - KSKtrend_{ng}) \right] + 1 \right\} - KSK_{ng,t} \cdot (1 - d_{ng}) \end{aligned} \quad (4.109)$$

The accumulation of the public capital stock is modeled in a simple way. As already explained in section 4.2.4, in each year  $t$  the public capital expenditures ( $GFCFG$ ) are derived through an optimization process. Then, the accumulation of capital in the public administration sector is given by:

$$KSK_{gov,t+1} = (1 - d_{gov}) \cdot KSK_{gov,t} + GFCFG_{gov,t} \quad (4.110)$$

It is not possible to solve the model for an infinite time horizon. Therefore, after a transition period (after year  $T$ ) we assume that the economy returns to the steady-state growth path. In the terminal period  $T$  we impose a constraint on investments carried out in sectors  $ng$  and the public administration sector:

$$INV_{ng,T} = (g + d_{ng}) \cdot KSK_{ng,T} \quad (4.111)$$

$$INV_{gov,T} = (g + d_{gov}) \cdot KSK_{gov,T} \quad (4.112)$$

This constraint assures sufficient investment to cover growth plus depreciation in each sector in the last period (Lau, Pahlke and Rutherford, 2000), where  $g$  is the exogenous growth rate.

Government debt accumulation is given by the following equations:

$$GDEBTD_{t+1} = GDEBTD_t \cdot GDPDEF_t - SGC_t \cdot shdebt_d \quad (4.113)$$

$$GDEBT_{t+1} = GDEBT_t \cdot ER_t - SGC_t \cdot (1 - shdebt_d) \quad (4.114)$$

$$GDEBTT_{t+1} = GDEBTD_{t+1} + GDEBT_{t+1} \quad (4.115)$$

where  $GDEBTD_t$  is the domestic debt in year  $t$ ,  $GDEBT_t$  is the foreign debt in foreign currency in year  $t$  and  $GDEBTT_t$  is the gross government debt in year  $t$  expressed in domestic currency. Domestic debt is given in nominal terms by using

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the GDP deflator ( $GDPDEF_t$ ) while the foreign debt is expressed in domestic currency by using the exchange rate. Parameter  $shdebt_d$  reflects the share of the conventional budget deficit that is covered from domestic sources, and  $(1-shdebt_d)$  gives the share of the deficit covered from external sources<sup>56</sup>.

To evaluate the long-run change in consumer welfare we use the present value of the equivalent variation in income (Ballard, Fullerton, Shoven and Whalley, 1985), which is defined for a LES function as:

$$PVEV = (PVVL - PVVL0) \cdot \prod_i \left[ \frac{PZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i)}{\alpha H_i} \right]^{\alpha H_i} \quad (4.116)$$

The present value of the indirect utility function in the counter-factual equilibrium (policy scenario) prices ( $PVVL$ ) is given by:

$$PVVL = \sum_t \frac{VL_t}{(1+g)^t \cdot (1+\rho)^t} + \frac{VL_T}{\rho \cdot (1+g)^T \cdot (1+\rho)^T} \quad (4.117)$$

and the present value of the indirect utility function in the benchmark prices ( $PVVL0$ ) is:

$$PVVL0 = \sum_t \frac{VL0_t}{(1+g)^t \cdot (1+\rho)^t} + \frac{VL0_T}{\rho \cdot (1+g)^T \cdot (1+\rho)^T} \quad (4.118)$$

where  $\rho$  is the consumer's rate of time preference and  $g$  is the population's growth rate. The indirect utility function is discounted by  $g$  to consider the initial size of the population in the benchmark year (year 2000). The last term on the right hand side of equation (4.117) reflects the present value of the indirect utility for the terminal period. By discounting with  $\rho$  we transform the indirect utility function into a present value at time T. Further dividing by  $(1+\rho)^T$  we discount the utility to the benchmark year (year 2000). The present value of the equivalent variation in income is sensitive with respect to the number of years between the first and the last equilibrium. Therefore, a longer sequence of equilibria is needed in order to guarantee that indirect utility is close to the actual steady-state values (Ballard, Fullerton, Shoven and Whalley, 1985).

The model is solved dynamically with annual steps. The simulation horizon of the model has been set at 30 years but it can easily be extended. In between periods, some other variables like the transfers between firms, government and the rest of the world, and the current account deficit (foreign savings) are updated exogenously.

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<sup>56</sup> The conventional budget deficit is subtracted rather than added to the government debt because it is negative.

### 4.2.12. Closure rules

A general discussion of closure rules has already been presented in chapter 3. Due to its size, for the present model a combination of closure rules is needed. The particular set of closure rules should also be consistent, to the largest extent possible, with the institutional structure of the economy and with the purpose of the model. Specifically, for a country like Romania, where the transition process implies a lot of institutional change, the closure should not be too restrictive.

To balance the number of endogenous variables and the number of linearly independent equations in the model, additional assumptions are needed. First of all, in each year  $t$  the transfers received by the households from the firms ( $TRHF$ ), from the external sector ( $TRHW$ ) and from the government ( $TRO$ ), as well as the transfers received by the firms from the government ( $TRFG$ ), the transfers received by the government from the external sector ( $TRGW$ ), and the transfers of the firms to the external sector ( $TRWF$ ) are exogenously fixed. Due to the lack of detailed data, it was not possible to model these transfers.

The inter-sectoral mobility of both labor and capital is limited in the model. In the labor market allowance for unemployment and inter-sectoral wage differentials introduce rigidities. Unemployment is endogenously determined through a wage curve and a labor supply curve assumes a positive relation between labor supply and the real wage rate. Labor supply to the external sector  $LW$  is treated as an exogenous variable. In the capital market the supply of capital is exogenously fixed by sector, restricting the factor inter-sectoral mobility.

The most widely accepted macro closure rule for CGE models implies that investment and savings balance. In the model, the investment is assumed to adjust to the available domestic and foreign savings. This reflects an economy in which savings form a binding constraint. The interest rate is assumed to effectively balance the supply and demand for investments, even if the specific mechanism is not incorporated in the model. This may also be interpreted as a stylized representation of a restrictive monetary policy (Roberts and Zolkiewski, 1996). This macro closure rule is neoclassical in spirit, as already discussed in chapter 3. However, the fact that the model allows for unemployment introduces a Keynesian element. As already mentioned, in models of this size it is not uncommon that a few closure rules are combined to get as close as possible to a realistic representation of the economy.

The government behavior is modeled through an optimization process, which yields the optimal allocation of government consumption and public capital expenditures. Further, the production of public services is modeled in a similar way as the other production activities. The government budget for purchases of goods and services and public capital expenditures ( $CGBUD$ ) is specified as a fixed share of GDP at current market prices. Two alternative closure rules are specified relating to government behavior. Under the first one, the primary and conventional budget balances are endogenously determined. Under the alternative closure rule, the conventional budget balance is fixed as a share of GDP at current market prices, and

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the social security contributions rate adjusts to bring the budget deficit toward this value. The world interest rate ( $RGE$ ) and the government risk premium over domestic interest rate ( $RISK$ ), used to calculate the interest payments, are given exogenously.

For the external sector, the current account balance in foreign currency is considered as given and the varying exchange rate is assumed to steer the balance of payments towards this number. This assumption may be interpreted as the government's obligation to reach a balance of payments target.

According to Walras' law if (n-1) markets are cleared the n<sup>th</sup> one is cleared as well. Therefore, in order to avoid overdetermination of the model, the balance of payments equation has been dropped (equation (4.66)). However, the system of equations guarantees, through Walras' law, that the current account balance equals the difference between imports and exports and the transfers between different institutional sectors and the external sector.

### 4.3. Conclusions

The real CGE model developed in this chapter provides a general framework for modeling the Romanian economy, which is suitable for fiscal policy simulations. RoMod follows the neoclassical tradition but introduces some rigidities in the labor and capital markets. It incorporates the behavior of firms, households, the government sector and the external sector. The tax system is represented in a detailed way. RoMod has a recursive dynamic structure with adaptive expectations. The model provides an insight into the government debt accumulation even though a specific modeling of the financial sector was not possible due to the lack of data. It takes into account the technical specifications of the energy producing sectors and the trade and transportation margins. RoMod provides a general framework which can be developed in the future, by incorporating intertemporal dynamic features and the financial sector.

The model is calibrated on the SAM for 2000, which is presented in the following chapter, and takes into account both country specific elements and data limitations. The calibration procedure is further explained in chapter 6.

## **Chapter 5**

### **A Social Accounting Matrix for Romania, 2000**

#### **5.1. Introduction**

The widespread use of the Social Accounting Matrix (SAM) that started in the 1980s, was the result of efforts to integrate in policy analysis the “social” with the “economic” dimension. The SAM provides a framework that integrates disaggregated data on production, income and expenditure, thereby allowing a systematic recording of diversified economic transactions for the study of growth and its distribution in a particular country (Lafeber and Tuyl, 1993).

A Social Accounting Matrix also enables among others the identification of structural relationships between the economic agents. In the SAM the economic agents are usually classified according to the main institutional sectors: households sector, non-financial and financial corporations sector, government sector and the external sector. The performance of each institutional sector is analyzed in terms of, e.g. its contribution to net value added, net disposable income and net saving. Further, the current external balance of the economy can be derived within the SAM.

More important, the SAM represents a consistent framework, which gives a bird’s eye view of the economy. It provides a clear picture of the structure of the economy and indicates the roots of the system’s disequilibrium. The SAM also provides a framework for a simple, linear model. However, the standard formulation of such a model is not well suited to situations where many economic agents maximize independently their own welfare functions and cause an outcome that can be affected only indirectly by the policymakers. The Romanian economy, like most other economies, is characterized by a mixed economic system in which a great part of economic activity is not under the direct control of policymakers. The autonomous decision making of various economic agents under the market mechanism has an important impact on the resource allocation. A model of a mixed economic system that is meant to be used for policy purposes should incorporate the decision making process of individual actors as well as the instruments controlled by policymakers in

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order to be able to relate the computed variables to any actual policy decision (Dervis, De Melo and Robinson, 1982). As already explained in chapter 3, Computable General Equilibrium (CGE) models imply an optimizing behavior of the economic agents and prove to be suitable to a mixed economic system. The Social Accounting Matrix can be used as a database for initializing these models. By using the calibration approach, most of the parameters of a CGE model are directly derived from the SAM while some other parameters, usually elasticities of substitution, are taken from other sources. The calibration procedure is further explained in chapter 6.

This chapter describes the construction of a SAM for Romania for 2000. Further, the SAM is used to analyze the structure of the Romanian economy and to provide the benchmark data set for the CGE model, presented in chapter 4. Even if the construction of the CGE model and the SAM are presented separately, in line with the normal practice in CGE modeling, they have actually been built simultaneously. In this way, the CGE model has been constructed while taking into account both the data limitations and the specific characteristics of the Romanian economy.

The reference year for the SAM, 2000, has been chosen for three reasons. First, it is the latest year for which the required data are available. Second, it represents the beginning of a process of economic recovery and growth. A radical change in the restructuring strategy of the economy has started in 1997. In early 1997 the government committed itself to a “shock therapy” program of both macroeconomic and institutional reforms. Even though the macrostabilization plan of 1997 failed, dragging the economy into a deep transitional recession, it created some irreversible conditions that made room for improved monetary and fiscal policies starting with 2000 (OECD, 2002). The significant change in the economic structure and the return to economic growth renders 2000 a suitable benchmark year for calibrating the CGE model. Third, in 1998 the National Institute of Statistics adopted the ESA 95<sup>57</sup> methodology, which is an important step towards harmonization with the EU requirements. Thus, by using the common methodology the interpretation of the policy measures discussed in chapter 7, aiming at tax harmonization with EU standards and public expenditures restructuring, is much facilitated.

The chapter is organized as follows. First, some theoretical aspects regarding the SAM and its conceptual framework are discussed. Further, section 5.3 presents the construction of SAM for Romania for 2000, which serves as a benchmark data set for the CGE model presented in chapter 4. Some characteristics of the Romanian economy are also discussed together with the presentation of the SAM followed by some concluding remarks.

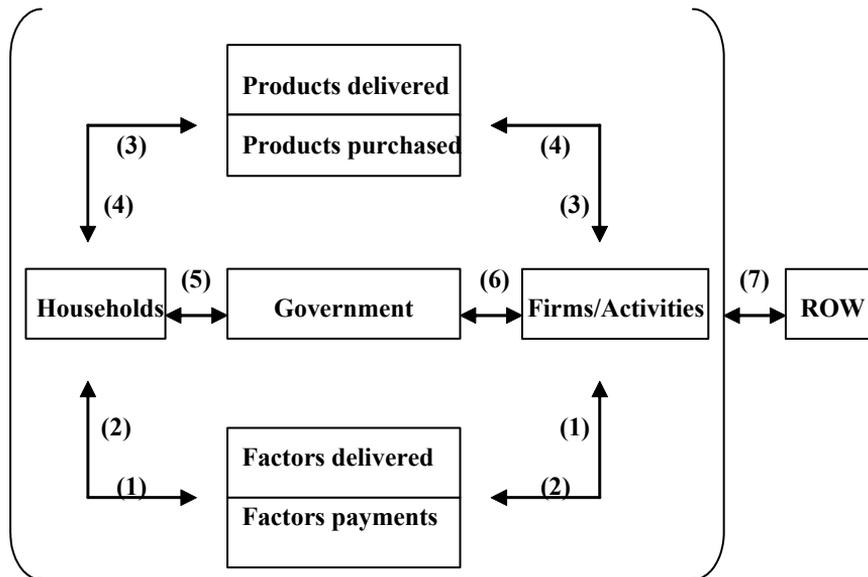
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<sup>57</sup> ESA 95 stands for the European System of Accounts ESA 1995 (Eurostat and European Commission, 1996).

## 5.2. What is a SAM?

A SAM is a presentation of the ESA<sup>58</sup> accounts in a matrix, which elaborates the linkages between the supply and use tables and the institutional sector accounts (Eurostat and European Commission, 1996). A SAM usually encompasses a somewhat less detailed supply and use table or input-output (IO) table. A clear distinction must be made between the IO table and the SAM. The essence of the IO table is the way industries are interrelated through transactions, while the SAM also presents the transactions and the transfers between the different types of economic agents like households, various categories of companies, government and the rest of the world (Pyatt, 1999).

In a simplified manner, the SAM is the transformation of the circular flow of figure 5.1 into a matrix of transactions between the various economic agents (Lafeber and Tuyl, 1993).



**Figure 5.1. The circular flow of transactions between various economic agents**

The households supply labor and capital to the firms (1), who organize the production activities. In return they receive payments for the use of their labor and capital factors (2). These payments may take the form of wages, interests or dividends. Furthermore, the households spend their income on products (3), which are delivered by firms/activities (4). The government is involved in transfers to and from households (5) and firms/activities (6). The transfers may refer to taxes on products and on production, subsidies, income taxes, social security contributions, social benefits, etc. The economic relations between the country and the rest of the

<sup>58</sup>ESA is an abbreviation for European System of Accounts.

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world (ROW) are given by (7) in figure 5.1. These relations may take the form of imports and exports of goods and services, compensation of employees and property income to and from ROW, taxes less subsidies on production and current transfers to and from ROW, adjustments for the change in net equity of households on pension funds reserves to and from ROW and capital transfers to and from ROW.

A SAM is presented as a square matrix designed to provide a record of these transactions between various economic agents, using a single-entry form of booking (Pyatt, 1988). It can be represented as:

$$T = [t_{jk}] \quad (5.1)$$

where  $j$  is the number of the row and  $k$  the number of the column. By convention, receipts are shown in the rows and outlays are shown in the columns. According to this convention,  $t_{jk}$  is the value of all receipts of  $j$  from  $k$  during the accounting period. Correspondingly,  $t_{kj}$  measures payments to  $k$  by  $j$ .

The design and the construction methods of the Social Accounting Matrices are not standardized but they should fulfill simultaneously two conditions:

- SAMs should be square matrices, in the sense that each account has its own row and column;
- the row totals and column totals for each account should be equal. This restriction can be written as:

$$T \cdot i = y = i' \cdot T' \quad i' = [1 \dots \dots \dots 1] \quad (5.2)$$

where  $y$  is the column vector of row totals and column totals of  $T$  and  $T'$  is the transpose of the matrix  $T$ .

A conceptual SAM is presented in table 5.1. Each group of economic agents has its own row, booking the receipts, and its own column, booking the payments during the accounting period. The first two rows and columns: commodities and production sectors represent an aggregate supply and use table specifically linked with other national accounts. The first column reflects total supply of commodities to the domestic market. Total supply is given by a part of domestic output delivered to the domestic market, cell (2,1), valued at basic prices and imports from the external sector, valued free on board (f.o.b), cell (11,1). Taxes less subsidies on commodities are booked in cell (8,1), and the trade and transport margins in cell (3,1). The first row shows demand for commodities at purchaser's prices, used for intermediate consumption in the production process, cell (1,2), for trade and transportation services, cell (1,3), for final consumption by the households, cell (1,5) and government, cell (1,7), and demand for investment commodities, cell (1,9), and inventories, cell (1,10). Purchaser's prices, compared to the basic prices, include taxes (excluding deductible taxes) less subsidies and transport margins paid by

## A Social Accounting Matrix for Romania, 2000

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consumers<sup>59</sup>. To keep total domestic demand for commodities (the row total) equal to total supply of commodities to the domestic market, the balance of taxes and subsidies and the transaction costs by product have to be recorded in the column of the first account.

The second column records the intermediate inputs consumed in the production process, net value added at factor costs generated by the use of labor and capital, cell (4,2), taxes less subsidies on production paid to a tax collection account, cell (8,2), and consumption of fixed capital (depreciation), cell (9,2). The value added at factor costs is not a concept in the ESA, but can be derived by subtracting taxes less subsidies on production from the value added at basic prices (Eurostat and European Commission, 1996). The column total gives gross output at basic prices, which is either supplied to the domestic market, cell (2,1) or exported (second row), cell (2,11). Exports are valued free on board (f.o.b) which include the value of products at basic prices, the transport and distributive services costs up to the border and taxes less subsidies on exports (Eurostat and European Commission, 1996).

The third row shows the trade and transport margins by product, cell (3,1). Their total is equal to the total of trade margins by the trade industries and the total of transport margins by the transportation activities booked in the third column, cell (1,3).

The fourth row gives net value added at factor costs, which reflects the value newly created in the production process by the use of labor and capital (factors of production), and the net factor income from the external sector, cell (4,11). The remuneration of labor and capital provided by the household and firms is reflected in the fourth column, cells (5-6,4).

The households sector account records on the row the income from labor and capital provided to the production sectors, cell (5,4), and the net transfers received from the government (social benefits) and firms, cells (5,6-7), and the external sector, cell (5,11). Further, the households use their total income for final consumption, for paying taxes on income and wealth to a tax collection account, cell (8,5) and for saving, cell (9,5). The sixth row shows the income received by the firms sector for providing capital in the production process, cell (6,4). The firms sector uses its income to pay corporate taxes to a tax collection account, cell (8,6), to make transfers to the households sector, cell (5,6), to the external sector, cell (11,6), and to save, cell (9,6). The government sector receives all tax revenues from the tax collection account, cell (7,8), which consists of taxes on commodities, on production and on income and wealth. It uses those revenues to consume, to make transfers to households and firms, cells (5-6,7) and to the rest of the world, cell (11,7) and to save, cell (9,7). Row 8 books all tax revenues. The use of a separate account for taxes and subsidies appears to be useful when analyzing the effects of alternative fiscal policies.

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<sup>59</sup>The treatment of transport margins are explained in detail in section 5.3 together with the presentation of the SAM for Romania.

**Table 5.1. The framework of a Social Accounting Matrix**

No.	Commodities	Production sectors	Transaction costs	Factors of production	Households sector	Firms sector	Government sector	Taxes less subsidies	Investment/ savings	Changes in stocks	External sector	Total
No.	1	2	3	4	5	6	7	8	9	10	11	12
Commodities	1	Intermediate consumption	Trade and transport margins		Consumption demand		Consumption demand		Investment demand	Inventories		Domestic demand
Production sectors	2	Domestic output delivered to domestic market									Exports	Total demand
Transaction costs	3	Transaction costs										Total trade and transport margins
Factors of production	4	Net value added									Net factor income from ROW	Net value added
Households sector	5			Household' income		Net transfers	Net transfers				Remittances from abroad	Household' receipts
Firms sector	6			Firms income			Net transfers					Firms receipts
Government sector	7							Taxes less subsidies				Government receipts
Taxes less subsidies	8	Taxes less subsidies on commodities	Taxes less subsidies on production		Taxes on income	Corporate taxes						Total taxes less subsidies
Investment/ Savings	9		Depreciation		Household' savings	Firms savings	Government savings				Foreign savings	Total savings
Changes in stocks	10								Total inventories			Total changes in inventories
External sector	11	Imports				Net transfers to ROW	Net transfers to ROW					Foreign receipts
Total	12	Total supply to the domestic market	Gross output	Total trade and transport margins	Net value added	Household' outlays	Firms outlays	Government outlays	Total taxes less subsidies	Total investment	Total changes in inventories	Foreign outlays

## **A Social Accounting Matrix for Romania, 2000**

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The savings/investment account presents in row 9 the consumption of fixed capital, and the savings of household, firms, government and the external sector. In the column demand for investment goods is provided at purchaser's prices. The changes in stocks account gives the demand for inventories at purchaser's prices in cell (1,10), and is further balanced through the savings/investment account, cell (10,9).

Finally, the external sector (rest of the world) account shows the domestic economy's imports and net transfers of the firms and the government in the row, which represents an income for the foreign sector, and the exports supply to the rest of the world, net factor income, remittances from abroad, and the foreign savings in the column. Foreign savings, when interpreted from the standpoint of the domestic economy, reflect the surplus/deficit of the current account.

### **5.3. Building a SAM for Romania, 2000**

So far, the only SAMs for Romania were constructed for 1989/1990 by the National Institute of Statistics (Ciucea, Ivan-Ungureanu and Tanase, 1995). Given the amount of work needed to build a new SAM from scratch, Social Accounting Matrices are typically derived by updating old ones on the basis of nonsurvey techniques and fragmentary new data. It should therefore be emphasized that the present SAM for Romania for 2000 has been built independently of the 1989/1990 SAMs.

The Social Accounting Matrix developed in this section serves two purposes. First, it helps in understanding the structure of the economy and its main characteristics. Second, it provides a database for the CGE model presented in chapter 4. Most of the parameters of the CGE model discussed in chapter 4, are directly derived from the SAM, while some other parameters such as elasticities of substitution are drawn from the literature. The calibration of the CGE model using the SAM is further discussed in chapter 6.

The major sources of data for building the Social Accounting Matrix for Romania are the national accounts and the input-output table for 2000, prepared by the National Institute of Statistics (National Institute of Statistics, 2003). Other sources of data have been the Ministry of Finance, the Ministry of Economy and Commerce, the IMF (IMF, 2003) and the OECD (OECD, 2002).

As already mentioned, the design and the construction methods of the Social Accounting Matrices are not standardized. A SAM should only fulfill two conditions: the matrix must be square and the row total and column total for each account must be equal. Due to the use of different source of data and statistical discrepancies, the Romanian SAM was not initially balanced. To fulfill the requirement that the row total and column total for each account should be equal, the SAM needs to be balanced. For this purpose, the cross entropy method was used (Robinson and El-Said, 2000). A discussion of this method and some technical details are given in appendix 5.A. Only the balanced SAM is provided in table 5.2.

## Chapter 5

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The Romanian SAM for 2000 follows the structure of the SAM framework presented in table 5.1. It incorporates the same eleven main accounts: commodities, production sectors, transaction costs, factors of production, households sector account, firms sector account, government sector account, taxes less subsidies, investment/savings, changes in stocks and the external sector account. The distinction between commodities and production sectors allows differentiation between supply from domestic sources and from imports and allows disaggregation of the supply of goods and services by product and by type of supplier (Eurostat and European Commission, 1996). Thus, it enables in principle a set-up in which production sectors produce multiple commodities. In this case however, only the symmetric input-output table is available where the same classification is used for products and activities. This implies that each production sector can be shown to produce only one type of commodity. The classification of commodities and production sectors used in the Romanian SAM and their corresponding codes<sup>60</sup> is given in appendix 4.C, table 4.C.1.

As already explained in the presentation of the SAM framework, the government activities have been split into a main government account and a taxes and subsidies account. The disaggregation proves useful for the calibration of the CGE model, especially when analyzing the impact of different fiscal policies. Each of these accounts will be discussed in the following sections.

The Social Accounting Matrix for Romania is denominated in billions ROL<sup>61</sup>. In the presentation of the SAM (see table 5.2), the cells are zero either when the values of the transaction happen to be zero or when the transactions corresponding to the cells are not defined.

### 5.3.1. Commodity accounts

The purpose of the commodities accounts is to show how the available products are used (Eurostat and EC, 1996). 35 different types of commodities are distinguished in the SAM. The correspondence between the classification of the commodities in the Romanian SAM and ESA 95, NACE Rev.1 is given in appendix 4.C, table 4.C.1.

On the supply side (in the columns) the commodities are delivered to the domestic market either by the domestic activities (production sectors), cells (36-70,1-35), or by the external sector through imports, cells (102,1-35). As already mentioned, the use of the symmetric input-output table implies that each activity is producing one type of product. Thus, the domestic supply to the domestic market is recorded on the diagonal of the cells (36-70,1-35).

Taxes less subsidies, cells (88-99,1-35), and trade and transport margins, cells (71-82,1-35), are booked in the columns to balance the corresponding commodities

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<sup>60</sup>In table 5.2 as well as in table 4.C.1 (see appendix 4.C), the codes corresponding to the sectoral classification are denoted by *sec* followed by the number of the sector. As already mentioned both commodities and production sectors follow the same classification and use the same codes.

<sup>61</sup>ROL stands for the Romanian national currency. As already explained in chapter 4, starting with July 1, 2005 one unit of the denominated national currency (RON) has been set equal to 10,000 ROL. Both types of banknotes will be used until the end of 2006.

## A Social Accounting Matrix for Romania, 2000

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accounts, as domestic output is valued at basic prices and imports at f.o.b. prices, while the uses (in the rows) are valued at purchaser's prices. The transaction costs and indirect taxes on commodities are discussed later on, in sections 5.3.3, 5.3.7 and 5.3.8.

The services sector supply the highest share of goods to the domestic market with 44.6 percent, cells (57-70,22-35), followed by industrial commodities, 36.3 percent, cells (37-55,2-20), agricultural products, 12.3 percent, cell (36,1) and construction goods, 6.7 percent, cells (56,21). Nevertheless, the share of agricultural and processed food products of 24.4 percent underlines the country's agricultural profile.

On the demand side, intermediate consumption is mapped according to commodity type and activity type, showing the specific consumption of each sector, cells (1-35,36-70). Households' consumption at purchaser's prices, cells (1-35,85), comprise consumption by the households sector and by the non-profit institutions serving households (NPISHs). Furthermore, according to ESA 95 accounting principles, final consumption includes the goods or services produced as outputs of unincorporated enterprises owned by households that are retained for own consumption by the household. Industrial commodities represent the highest share of households' consumption, 49.1 percent, followed by services, 36.5 percent, agricultural commodities, 13.7 percent, and construction goods, 0.7 percent. The relatively low share of agricultural consumption for Romania is caused by the low prices of subsistence goods, due to government interventions. In 2000 most subsistence goods were still subsidized by the government.

The main part of the government consumption consists of services, cells (1-35,87). It comprises the value of the commodities produced by the government itself and purchases of products by the government from market producers which are supplied to households<sup>62</sup>. The services produced by the government itself consist mostly of public services which are produced by the public administration sector (sec32) in the SAM, cell (103,67).

On the demand side, the investment goods are booked in cells (1-35,100) and the changes in inventories in cells (1-35,101). Investment goods represent the acquisitions, less disposals, of fixed assets by domestic producers. They are recorded by type of commodity and should not be interpreted as the investment carried out in a particular sector. Demand for investment goods consists mostly of machinery and transport equipment, 49.9 percent, and construction goods, 44.9 percent. An adjustment has been made for agricultural investment goods. In 2000 the acquisitions, less disposals, of cultivated assets have been negative due to a reduction of the livestock. Because it represents a specific situation, it is not a good starting point for the modeling of demand for agricultural investment commodities in RoMod. Thus, the negative value for the agricultural investment goods in 2000 has been replaced in the SAM by the average value, for the years 1990-2000.

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<sup>62</sup>It implies that the government just pays the commodities provided to the household by the seller (Eurostat and European Commission, 1996).

Table 5.2. A Social Accounting Matrix for Romania. 2000

No.	No. Comm																																			
	scd1	scd2	scd3	scd4	scd5	scd6	scd7	scd8	scd9	scd10	scd11	scd12	scd13	scd14	scd15	scd16	scd17	scd18	scd19	scd20	scd21	scd22	scd23	scd24	scd25	scd26	scd27	scd28	scd29	scd30	scd31	scd32	scd33	scd34	scd35	
Comm	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
scd1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
scd35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: All zero cells represent either non defined transactions or transactions with zero value.  
 Notation: Comm – Commodities.

Table 5.2. A Social Accounting Matrix for Romania, 2000 (continued)

No. Prod	No. Comm																																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
sec1	163006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec2	0	11635	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec3	0	0	40387	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec4	0	0	0	31780	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec5	0	0	0	0	159834	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec6	0	0	0	0	0	27680	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec7	0	0	0	0	0	0	13025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec8	0	0	0	0	0	0	0	6601	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec9	0	0	0	0	0	0	0	0	8884	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec10	0	0	0	0	0	0	0	0	0	14302	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec11	0	0	0	0	0	0	0	0	0	0	7003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec12	0	0	0	0	0	0	0	0	0	0	0	8323	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec13	0	0	0	0	0	0	0	0	0	0	0	0	5187	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec14	0	0	0	0	0	0	0	0	0	0	0	0	0	1515	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12389	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11626	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44526	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8887	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	124132	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sec23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33266	0	0	0	0	0	0	0	0	0	0	0	0	0
sec24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23377	0	0	0	0	0	0	0	0	0	0	0
sec25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4932	0	0	0	0	0	0	0	0	
sec26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1657	0	0	0	0	0	0	0	
sec27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250	0	0	0	0	0	0	
sec28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40612	0	0	0	0	0	
sec29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1515	0	0	0	0	
sec30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10125	0	0	0	0
sec31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2545	0	0	0
sec32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34383	0	0
sec33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32250
sec34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56721
sec35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4580

Note: All zero cells represent either non defined transactions or transactions with zero value.  
 Notations: Comm – Commodities; Prod – Production sectors.







# A Social Accounting Matrix for Romania, 2000

**Table 5.2. A Social Accounting Matrix for Romania, 2000 (continued)**

No.	Prod	sec1	sec2	sec3	sec4	sec5	sec6	sec7	sec8	sec9	sec10	sec11	sec12	sec13	sec14	sec15	sec16	sec17	sec18	sec19	sec20	sec21	sec22	sec23	sec24	sec25	sec26	sec27	sec28	sec29	sec30	sec31	sec32	sec33	sec34	sec35	
70	Trade costs	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	
71	Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	Imp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	Exp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	Imp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	Exp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	Imp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	Exp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	Imp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	Exp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	Factor	63	72363	88	6423	7144	37021	18908	6476	1811	5585	2832	1381	1608	1183	2430	4236	1025	620	4633	874	11093	1812	33322	9633	3163	13632	1406	1504	5208	346	37846	7442	4488	2081	538	5524
84	Capital	1035	2438	6185	481	10225	13344	5844	726	1338	3385	833	1432	1538	2670	3362	5087	456	3387	5300	3701	13778	28085	5315	4143	12273	257	473	7630	8887	1582	7037	22862	1516	10003	11033	
85	Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
86	Househ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	Gov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88	Tax on prod	3336	73	666	87	337	1034	410	61	100	682	16	147	125	228	307	668	253	473	688	844	1588	3014	1027	866	2072	239	180	4165	705	2385	545	0	704	559	2733	
89	Soc contr	3718	1074	2541	205	3573	4240	2046	254	468	1188	281	522	615	1044	370	1184	160	1339	1873	3645	4752	8630	2070	1871	4298	90	276	2831	2836	477	2463	7066	9296	3783	3883	
90	VAT on ID	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	VAT on priv cons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	VAT on gov cons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	VAT on inv cons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	VAT on int cons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	Excise on ID	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	Excise on priv cons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	Tax on inc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
98	Tax on comm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	Subs on prod	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	Sav-Inv	2	120	33	632	34	121	34	30	54	37	30	22	47	80	13	12	87	16	207	354	746	181	11	255	26	36	284	6	1032	133	84	33	11	103		
101	Stock ch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
102	External sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
103	TOTAL	183483	11636	3520	4483	16345	50219	34540	6508	8783	28805	7468	1053	8932	16336	6384	2047	3534	26432	23800	36066	38464	184782	33183	25012	37631	4339	6058	4387	8821	10325	33319	54883	36221	45888		

Note: All zero cells represent either non defined transactions or transactions with zero value.

Notations: Prod – Production sectors; Dom – Domestic; Imp – Imports; Exp – Exports; Transp costs – Transport costs; Househ – Households; Gov – Government; Tax on prod – Taxes on production; Soc contr – Social security contributions; VAT on IO – VAT on intermediate consumption; VAT on priv cons – VAT on households' consumption; VAT on gov cons – VAT on government consumption; VAT on inv cons – VAT on investment commodities; Excises on IO – Excises on intermediate consumption; Excises on priv cons – Excises on households' consumption; Tax on inc – Taxes on income; Subs on comm – Subsidies on commodities; Subs on prod – Subsidies on production; Sav-Inv – Savings/Investment; Stock ch – Changes in stocks.

Table 5.2. A Social Accounting Matrix for Romania, 2000 (continued)

No.	Trade costs			Transp costs - rail			Transp costs - road			Transp costs - water			Factors		Househ Firms Gov					
	Dom	Imp	Exp	Dom	Imp	Exp	Dom	Imp	Exp	Dom	Imp	Exp	Capital	Labor	83	84	85	86	87	
Comm	71	12	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87			
sect1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77239	0	1365
sect2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	142	0	0
sect3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30050	0	0
sect4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0
sect5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145629	0	0
sect6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20735	0	0
sect7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7520	0	0
sect8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1654	0	0
sect9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2214	0	28
sect10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1536	0	0
sect11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11343	0	0
sect12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1644	0	0
sect13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1537	0	0
sect14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2321	0	0
sect15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2395	0	0
sect16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	323	0	0
sect17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6452	0	0
sect18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17978	0	0
sect19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9727	0	0
sect20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13117	0	4588
sect21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3953	0	3818
sect22	67225	25374	26455	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5297	0	0
sect23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30520	0	0
sect24	0	0	0	5382	2274	1547	0	0	0	0	0	0	0	0	0	0	0	7363	0	115
sect25	0	0	0	0	0	0	13506	5941	4733	0	0	0	0	0	0	0	0	10555	0	340
sect26	0	0	0	0	0	0	0	0	0	184	77	57	0	0	0	0	0	55	0	104
sect27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4322	0	407
sect28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9525	0	133
sect29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3839	0	0
sect30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90906	0	325
sect31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	410	0	301
sect32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3302	0	51097
sect33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6809	0	2441
sect34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5855	0	31066
sect35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20718	0	8032

Note: All zero cells represent either non defined transactions or transactions with zero value.  
 Notations: Comm – Commodities; Dom – Domestic; Imp – Imports; Exp – Exports; Transp costs – Transport costs; Househ – Households; Gov – Government.

# A Social Accounting Matrix for Romania, 2000

**Table 5.2. A Social Accounting Matrix for Romania, 2000 (continued)**

No.	Trade costs			Transp costs - rail			Transp costs - road			Transp costs - water			Factors		Househ	Firms	Gov
	Dom	Imp	Exp	Dom	Imp	Exp	Dom	Imp	Exp	Dom	Imp	Exp	Capital	Labor			
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*Note: All zero cells represent either non defined transactions or transactions with zero value.  
Notations: Prod – Production sectors; Dom – Domestic; Imp – Imports; Exp – Exports; Transp costs – Transport costs; Househ – Households; Gov – Government.*



# A Social Accounting Matrix for Romania, 2000

**Table 5.2. A Social Accounting Matrix for Romania, 2000 (continued)**

No.	Comm	Tsz on prod		Soc contr		VAT on ID		VAT on priv cons		VAT on gov cons		Excises on ID		Excises on priv cons		Excises on Tariffs		Tax on inc		Subs on comm		Subs on prod		Sav-Inv		Stock ch		External sector		TOTAL	
		88	89	83	84	30	31	32	33	34	35	36	37	38	39	100	101	102	103												
1	sec1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	453	153	0	174473				
2	sec2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	0	0	17516			
3	sec3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	453	0	0	94560			
4	sec4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12534		
5	sec5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1039	0	0	233241			
6	sec6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	306	0	0	65065			
7	sec7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2571	166	0	26223				
8	sec8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	176	0	0	13629				
9	sec9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	53	0	10966				
10	sec10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	247	0	0	40883				
11	sec11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	160	0	0	21391			
12	sec12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140	0	0	21311			
13	sec13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	179	0	0	10711			
14	sec14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	225	0	0	23714			
15	sec15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2054	133	0	66097			
16	sec16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35606	-1539	0	42151				
17	sec17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	283	98	0	7156				
18	sec18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17662	778	0	66394				
19	sec19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18027	311	0	40765				
20	sec20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96668			
21	sec21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68933	0	0	90988				
22	sec22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120935		
23	sec23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33023		
24	sec24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27172		
25	sec25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59337		
26	sec26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4392		
27	sec27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6139		
28	sec28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43384		
29	sec29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18416		
30	sec30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10479		
31	sec31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7488	0	0	38909			
32	sec32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54389		
33	sec33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32250		
34	sec34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38721		
35	sec35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60995	

*Note: All zero cells represent either non defined transactions or transactions with zero value.*  
*Notations: Comm – Commodities; Tax on prod – Taxes on production; Soc contr - Social security contributions;*  
*VAT on IO – VAT on intermediate consumption; VAT on priv cons – VAT on households' consumption; VAT on gov cons – VAT on government consumption;*  
*VAT on inv comm – VAT on investment commodities; Excises on IO – Excises on intermediate consumption; Excises on priv cons – Excises on households' consumption;*  
*Tax on inc – Taxes on income; Subs on comm – Subsidies on commodities; Subs on prod – Subsidies on production; Sav-Inv – Savings/Investment; Stock ch – Changes in stocks.*

**Table 5.2. A Social Accounting Matrix for Romania, 2000 (continued)**

No.	Tax on prod	Soc contr	VAT on IO	VAT on priv cons	VAT on gov cons	VAT on int comm	Excises on IO	Excises on Tariffs	Tax on inc	Subs on comm	Subs on prod	Sav-lar	Stock ch	External sector	TOTAL
Prod	88	83	0	0	0	0	0	0	0	0	0	0	0	0	0
sec1	36	0	0	0	0	0	0	0	0	0	0	0	0	6143	163455
sec2	37	0	0	0	0	0	0	0	0	0	0	0	0	21	1856
sec3	38	0	0	0	0	0	0	0	0	0	0	0	0	14323	55210
sec4	39	0	0	0	0	0	0	0	0	0	0	0	0	683	4463
sec5	40	0	0	0	0	0	0	0	0	0	0	0	0	3231	163145
sec6	41	0	0	0	0	0	0	0	0	0	0	0	0	22559	50219
sec7	42	0	0	0	0	0	0	0	0	0	0	0	0	21815	34840
sec8	43	0	0	0	0	0	0	0	0	0	0	0	0	1104	8305
sec9	44	0	0	0	0	0	0	0	0	0	0	0	0	109	8133
sec10	45	0	0	0	0	0	0	0	0	0	0	0	0	14303	28805
sec11	46	0	0	0	0	0	0	0	0	0	0	0	0	464	1468
sec12	47	0	0	0	0	0	0	0	0	0	0	0	0	1930	10313
sec13	48	0	0	0	0	0	0	0	0	0	0	0	0	3395	8522
sec14	49	0	0	0	0	0	0	0	0	0	0	0	0	1420	16556
sec15	50	0	0	0	0	0	0	0	0	0	0	0	0	40874	63054
sec16	51	0	0	0	0	0	0	0	0	0	0	0	0	7957	21547
sec17	52	0	0	0	0	0	0	0	0	0	0	0	0	1478	3534
sec18	53	0	0	0	0	0	0	0	0	0	0	0	0	24136	26432
sec19	54	0	0	0	0	0	0	0	0	0	0	0	0	11504	23130
sec20	55	0	0	0	0	0	0	0	0	0	0	0	0	1570	96096
sec21	56	0	0	0	0	0	0	0	0	0	0	0	0	807	83464
sec22	57	0	0	0	0	0	0	0	0	0	0	0	0	0	124732
sec23	58	0	0	0	0	0	0	0	0	0	0	0	0	1873	35133
sec24	59	0	0	0	0	0	0	0	0	0	0	0	0	1035	23012
sec25	60	0	0	0	0	0	0	0	0	0	0	0	0	8349	51931
sec26	61	0	0	0	0	0	0	0	0	0	0	0	0	2443	4339
sec27	62	0	0	0	0	0	0	0	0	0	0	0	0	3548	6058
sec28	63	0	0	0	0	0	0	0	0	0	0	0	0	3305	43977
sec29	64	0	0	0	0	0	0	0	0	0	0	0	0	2386	18321
sec30	65	0	0	0	0	0	0	0	0	0	0	0	0	0	101525
sec31	66	0	0	0	0	0	0	0	0	0	0	0	0	7864	33319
sec32	67	0	0	0	0	0	0	0	0	0	0	0	0	0	54389
sec33	68	0	0	0	0	0	0	0	0	0	0	0	0	0	32250
sec34	69	0	0	0	0	0	0	0	0	0	0	0	0	0	36721
sec35	70	0	0	0	0	0	0	0	0	0	0	0	0	419	49666

Note: All zero cells represent either non defined transactions or transactions with zero value.

Notations: Prod – Production sectors; Tax on prod – Taxes on production; Soc contr – Social security contributions; VAT on IO – VAT on intermediate consumption;

VAT on priv cons – VAT on households' consumption; VAT on gov cons – VAT on government consumption; VAT on inv comm – VAT on investment commodities;

Excises on IO – Excises on intermediate consumption; Excises on priv cons – Excises on households' consumption; Tax on inc – Taxes on income; Subs on comm – Subsidies

on commodities; Subs on prod – Subsidies on production; Sav-Inv – Savings/Investment; Stock ch – Changes in stocks.

# A Social Accounting Matrix for Romania, 2000

**Table 5.2. A Social Accounting Matrix for Romania, 2000 (continued)**

No.	Trade costs	Transp costs	Transp rail	Transp costs	Transp road	Transp water	Factors	Househ	Firms	Gov	Tax on prod	Soc contr ID	VAT on ID	VAT on priv cons	VAT on gov cons	VAT on inv comm	Excises on ID	Excises on priv cons	Excises on tariffs	Tax on inc	Subs on comm	Subs on prod	Sav-Inv	Stock ch	External sector	TOTAL
71	Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	Imp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	Exp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	Imp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	Exp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	Imp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	Exp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	Imp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	Exp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	Labor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	Househ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
86	Firms	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	Gov	34380	103656	21933	24063	396	4300	15284	21487	3052	51225	-4667	-10206	0	0	0	0	0	0	0	0	0	0	0	0	0
88	Tax on prod	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
89	Soc contr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	VAT on ID	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	VAT on priv cons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	VAT on gov cons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
93	VAT on inv comm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	Excises on ID	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	Excises on priv cons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	Tariffs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97	Tax on inc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
98	Subs on comm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
99	Subs on prod	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	Sav-Inv	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	Stock ch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102	External sector	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
103	TOTAL	34380	103656	21933	24063	396	4300	15284	21487	3052	51225	-4667	-10206	0	0	0	0	0	0	0	0	0	0	0	0	0

*Note: All zero cells represent either non defined transactions or transactions with zero value.*

*Notations: Dom – Domestic; Imp – Imports; Exp – Exports; Transp costs – Transport costs; Househ – Households; Gov – Government; Tax on prod – Taxes on production; Soc contr – Social security contributions; VAT on ID – VAT on intermediate consumption; VAT on priv cons – VAT on households' consumption; VAT on gov cons – VAT on government consumption; VAT on inv comm – VAT on investment commodities; Excises on ID – Excises on intermediate consumption; Excises on priv cons – Excises on households' consumption; Tax on inc – Taxes on income; Subs on comm – Subsidies on commodities; Subs on prod – Subsidies on production; Sav-Inv – Savings/Investment; Stock ch – Changes in stocks.*

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To keep the agricultural commodity account balanced, changes in inventories for agricultural products have been further adjusted with the same amount, cell (1,101).

For each type of commodity, total domestic demand (row total) equals total supply, both domestically produced and imported (column total).

### 5.3.2. Production sectors accounts

As already mentioned, the production sectors accounts are disaggregated in the same way as the commodities account, distinguishing 35 activities. On the expenditure side (in the columns), the production accounts register the intermediate consumption, cells (1-35,36-70), the capital and labor outlays, cells (83-84,36-70), the social security contributions, cells (89,36-70), and the taxes on production, cells (88,36-70), and depreciation, cells (100,36-70). Subsidies on production, cells (99,36-70), are paid by the government to the sectors. Therefore, they are registered with a negative sign on the expenditure side. The gross output at basic prices, the columns totals, is delivered to the domestic market or exported, cells (36-70,102) and shown in the rows of the production sectors accounts. The gross output includes the market output, the output produced for own final use and other non-market outputs. Although the output produced for own final use is not supplied to the market, in the ESA 95 accounting framework, and thus also in the present SAM, it is included in the valuation of final households' consumption as well as in gross output. Therefore, the domestic deliveries also include the share of output produced for own final use. The other non-market output consists of output that is provided free to the market or at prices that are not economically significant and it mostly consists of the value of output produced by the public producers<sup>63</sup>.

In the discussion of the SAM framework in section 5.2 it was mentioned that the capital and labor outlays are valued at factor costs. The highest capital outlays are incurred by the service sector, 48.4 percent, followed by the manufacturing sectors, 26.6 percent, and agriculture, 20.6 percent. The high share of capital outlays in the agricultural sector derives from the remuneration for work carried out by the owner or members of the family that cannot be distinguished from profits in unincorporated enterprises. In the agricultural sector in Romania unincorporated enterprises are the main organizational form. In the Romanian input-output table, which is the main source of data for building the production accounts in the SAM, these labor remunerations are summed together with capital outlays even though they represent labor costs.

The highest labor costs are incurred by the services sectors, 55.6 percent, and the manufacturing sectors, 34.5 percent. However, these figures might be misleading. While in most advanced transition countries labor resources shift from agriculture and industry towards the service sector, in Romania the agricultural sector has been acting as a buffer to absorb the downsizing of industry (OECD, 1998). In 2000, the share of agriculture in total employment has been around 38.4 percent, followed by

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<sup>63</sup>A public producer is a producer controlled by the government (Eurostat and European Commission, 1996).

## **A Social Accounting Matrix for Romania, 2000**

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services with 36.2 percent, industry with 21.6 percent and construction with 3.8 percent. The lowest labor outlays are still found in the agricultural sector, cell (84,36). This is a consequence of the very low wages paid by this sector compared to services and industry, and of recording the remuneration for work carried out by the owner as capital outlays (see above).

The social security contributions paid by the employer and taxes less subsidies on production are further discussed in section 5.3.7 and section 5.3.8. The data on depreciation are available in the Romanian national accounts only at an aggregate level. Thus, total depreciation has been attributed to the production sectors according to the share of capital services of the sector (capital outlays) in total capital services. Then, sectoral depreciation has been subtracted from sectoral gross operating surplus (gross capital services) to yield net capital services by sector. By summing up the net capital outlays (net operating surplus), the labor outlays (compensation of employees), the social security contributions and the taxes on production less subsidies we get the net sectoral value added at basic prices.

On the demand side of the production sectors account, the highest share of domestically produced goods supplied to the domestic market consists of services, as already discussed in section 5.3.1. Exports are further discussed in section 5.3.10 together with the external sector account.

The gross output of each production sector (columns totals) equals the total demand for each type of commodity from the domestic market and from the external sector (rows totals).

### **5.3.3. Transactions costs accounts**

In the commodities accounts the transition from the supply of commodities valued at basic prices to the use of products valued at purchaser's prices requires reallocating the trade and transport margins. Thus, the transactions costs accounts register the trade and transport margins associated with the trade flows. The transport costs are distinguished by type of transport in the SAM: by rail, by road, and by water. The accounts are further disaggregated according to the transactions costs associated with domestic trade, imports and exports.

The trade margins represent the distribution costs and they are given by the differences between the actual prices of products that are purchased for resale and the prices that the distributor has to pay to replace the goods at the time they are sold. Transport margins include the transportation costs paid separately by the purchaser, which are included in the purchaser's prices but not in the basic prices of a manufacturer's output or in the trade margins of wholesale or retail traders (Eurostat and European Commission, 1996). Thus, the trade and transport margins for domestic trade reflect the distribution and transportation costs of transferring commodities from the producers to the domestic consumers and are booked in cells (71,1-35), (74,1-35), (77,1-35) and (80,1-35). The transaction costs for imports represent the distribution and transportation costs of transferring commodities from the border to the domestic consumer, recorded in cells (72,1-35), (75,1-35), (78,1-35) and (81,1-35), and the transaction costs for exports show the distribution and

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transportation costs of transferring the commodity from the producer to the border, booked in cells (73,1-35), (76,1-35), (79,1-35) and (82,1-35). In the SAM, the transaction costs for exports are presented separately to allow a distinction in the CGE model (RoMod) between the export price of commodities and the domestic price of exports received by the producer. Exports are valued at f.o.b. prices, which include the value of commodities at basic prices and the transaction costs up to the border of the exporting country. Therefore, to value exports at basic prices (the prices received by the producers) in RoMod the trade and transportation margins for exports are subtracted from the export price of commodities.

In the input-output table, trade and transportation margins are distinguished for each commodity, but they are not split in trade and transport margins for domestic trade, imports and exports. In order to divide them, we used the share of domestic trade, imports and exports in the total by commodity.

The total trade costs associated with the domestic trade, imports and exports are equal to the sum of the trade margins of the wholesale and retail trade services (sec22), registered in the columns, cells (22,71-73). Similarly, total transportation costs for the domestic trade, imports and exports equal the transport margins of the railway transport sector (sec24), land transport sector (sec25) and water transport sector (sec26), recorded in cells (24,74-76), (25,77-79) and (26,80-82), respectively.

### 5.3.4. Factors of production accounts

The factors of production accounts distinguish two types of production factors: capital and labor. In the rows, the accounts describe the capital and labor outlays of the production sectors, cells (83-84,36-70), as discussed in 5.3.2. The supply of labor to the external sector is further registered in cell (84,102). The columns of the accounts reflect the remuneration of factors provided to households and firms. The compensation of employees, which represents the payments for the use of labor in the production process, is received by the household sector through wages, cell (85,84). This income also includes the remuneration for labor used by the external sector. Income from capital, cells (85-86,83), is in fact the net operating surplus, which represents the surplus accruing from the process of production before deducting interest charges, rents or other property incomes payable on the assets related to production. The highest share of income from capital is received by the household sector, 60.6 percent, followed by firms with 39.4 percent. As already pointed out in section 5.3.2, the high capital income of the household sector can be explained by the mixed income accruing to the unincorporated enterprises owned by this sector.

### 5.3.5. Households sector account

The households sector consists of all the resident households, including the unincorporated enterprises owned by households (Eurostat and European Commission, 1996). The non-profit organizations serving households (NPISHs), consisting of political parties, religious societies, trade unions and non-profit associations, have also been included in this institutional sector. To analyze the

income distribution effects of different fiscal policy measures with the CGE model presented in chapter 4, a further disaggregation of the households sector by socioeconomic groups would have been needed. Unfortunately, such a disaggregation is not possible due to the lack of data.

The households sector receives income from labor and capital, and net transfers from the firms, cell (85,86), the government, cell (85,87), and the external sector, cell (85,102). The net transfers from firms are derived as a difference between the transfers of firms to households and the transfers of households to firms. They mainly include net non-life insurance claims<sup>64</sup> and miscellaneous current transfers between firms and households. The net transfers from the government, computed as the difference between the transfers of the government to households and transfers of households to the government, include the social benefits transferred to the households sector, interest payments on the public debt, rents paid to the government by households, and net miscellaneous current transfers. The net transfers from the external sector comprise net miscellaneous current transfers.

On the expenditure side, households' income is used for consumption purposes, cells (1-35,85), for paying the taxes on income and wealth, cell (97,85), and the social contributions<sup>65</sup>, cell (89,85). The rest of income is saved, cell (100,85).

### 5.3.6. Firms sector account

The firms sector includes the non-financial and financial corporations. The financial corporations incorporate: the National Bank of Romania, the Savings Bank, commercial and investment banks, investment funds, exchange offices and credit cooperatives, etc. (National Institute of Statistics, 2003). The firms sector contains both public and private market producers.

On the income side, on the account's row, firms receive income from capital, cell (86,83), and net transfers from the government, cell (86,87). The net transfers from the government reflect the difference between the transfers from the government to the firms and the transfers from the firms to the government. The net transfers include interest payments for the public debt, rents paid by the firms to the government, and other current transfers, further discussed in section 5.3.7.

On the expenditure side, on the account's column, firms make net transfers to the households, cell (85,86), pay corporate taxes to the government, cell (97,86) and save, cell (100,86). The net transfers to the households have already been presented in section 5.3.5. The corporate taxes paid to the government through the tax collection account mainly include the taxes on profits. They are further discussed in section 5.3.7.

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<sup>64</sup>Firms sector includes both financial and non-financial corporations. In this case the non-life insurance claims are received from the financial corporations.

<sup>65</sup> The social contribution taxes are paid in this case by self-employed persons, while social contribution taxes paid by the employers for their employees are registered as an outlay in the production sectors account.

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### 5.3.7. Government sector account

The government sector consists of the central and local government levels, judicial and prosecutor's bodies, institutions carrying out activities related to education, health, culture, defense and other public institutions, all financed by the public budget, extra budgetary funds and equity, social security funds (National Institute of Statistics, 2003). Public corporations that are market producers are not included, in contrast to the public corporations which are considered to be other non-market producers. According to the ESA 95 accounting framework, other non-market producers are institutional units whose major part of output is provided free or at not economically significant prices to the market. They are financed by the government and/or compulsory payments made by other sectors.

The government account has been disaggregated into a main government sector account and different taxes and subsidies accounts. The disaggregation proves useful because it allows distinguishing different types of taxes, by production sector or by commodity. As a consequence, the government sector account receives income from taxes paid to the taxes account and makes transfers to the subsidies account for subsidies on commodities and on production.

On the account's row, the government sector receives income from taxes, cells (87,88-97), and transfers from the external sector, cell (87,102). Subsidies are also booked on the account's row, but because they actually represent government expenditures they are booked with a negative sign, cells (87,98-99). The treatment of taxes in the ESA 95 framework is a critical issue in the context of the EU's excessive deficit procedure. Given the implementation of the accrual principle, taxes and social contributions are generally recorded when the transactions or activities which create the liability to pay taxes occur. Thus, in most cases the taxes evidenced by the tax assessments but which are never paid are treated as if they have been paid (Eurostat and European Commission, 1996). However, the net lending/borrowing of the government sector should not include amounts unlikely to be collected (European Commission and Eurostat, 2002). Thus, Regulation (EC) no. 2516/2000 provides three alternatives to deal with this discrepancy:

- the recorded amounts are those due to be paid but they are adjusted by a coefficient reflecting taxes never collected;
- the amounts due to be paid are entirely booked as taxes and social contributions and the discrepancy between the theoretical value and the actual cash receipts is recorded as a capital transfer in favor of the defaulting taxpayers;
- taxes and social contributions are recorded on a cash basis but they are time-adjusted to correspond to the period when the liability occurs<sup>66</sup>.

The National Institute of Statistics adopted a combination of the second and the third method of tax adjustment. The value added taxes, import tariffs, excises and social

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<sup>66</sup>Regulation (EC) no. 2516/2000 of the European Parliament and of the Council of 7 November 2000, modifying the common principles of the European system of national and regional accounts in the Community (ESA) 95 as concerns taxes and social contributions and amending Council Regulation (EC) no. 2223/96.

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security contributions are valued on an accrual basis and the difference between the theoretical value and the cash receipts is recorded as a capital transfer in favor of the households and firms sectors. Direct taxes are still valued on a cash basis due to lack of reliable data (National Institute of Statistics, 2003). Therefore, in the SAM taxes and social contributions are valued following the same methodology.

The highest tax component evaluated on an accrual basis consists of social contribution taxes, cell (87,89), with 13.6 percent of GDP. As already explained in chapter 2, the statutory social security contributions rates in 2000 are established at 35 percent of gross wages for normal work conditions, at 40 percent for particular work conditions and at 45 percent for special work conditions<sup>67</sup>. The high statutory social contribution rates result from the deep structural problems in the social security system. The ratio of pensioners to employees contributing to the social security system is nearly unity for 2000. Besides, the arrears in payments of social contributions are large, accounting for about 10 percent of their theoretical value. Thus, the social security budget ended up with a deficit in 2000 (National Bank of Romania, 2001).

The consumption taxes are disaggregated into the value-added taxes (VAT), cells (87,90-93) and other taxes on consumption, mainly the excise duties, cells (87,94-95). The VAT revenue on accrual basis represents 6.4 percent of GDP, while the excises duties reach 4.6 percent of GDP. With a statutory rate of 19 percent, international experience suggests that VAT revenue collections of 9 percent of GDP are well within reach (IMF, 2001). The payments arrears for value-added taxes are rather small, amounting to 0.1 percent of GDP. Thus, the poor collection performance, amounting to 6.3 percent of GDP, is mainly caused by tax avoidance. It should be stressed that in the ESA 95 framework the taxes not evidenced by the tax assessments are not recorded.

Corporate taxes paid by the firms to the government represent 2.8 percent of GDP, and taxes on income and wealth paid by households 3.5 percent of GDP. Their total value received by the government from the tax collection accounts is booked in cell (87,97). The relatively low level of corporate taxes is a consequence of tax avoidance and payments arrears. Besides, a reduced rate of 6 percent has been applied starting with 2000 on taxable profits from export revenues<sup>68</sup>, while the general statutory rate is 25 percent. Taxes on households' income and wealth include taxes on wages, property, taxes on income of owners of unincorporated enterprises, pensions, etc. Taxes on wages and pensions are levied according to progressive rates, ranging from 18 to 40 percent. Also, taxes on income are recorded on a cash basis. Their poor collection is mainly caused by tax avoidance.

The import tariffs account for about 1.1 percent of the GDP, cell (87,96). As already explained in chapter 2 and chapter 4, the Romanian trade regime is relatively liberal for most products. The taxes on production, cell (87,88) refer to stamp taxes, taxes

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<sup>67</sup>Law no.19/2000, regarding the public pension system and other social security rights, state that the yearly social security tax rates and the unemployment tax rates are established by the Social security budget law.

<sup>68</sup>OUG no.217/1999 for the modification of OG no.70/1994 regarding the tax on profits.

## Chapter 5

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on transport means, taxes on buildings and other taxes. They account for 4.3 percent of GDP. The government subsidizes both production, cell (87,99), and consumption of basic commodities, cell (87,98). Highest are direct subsidies to production activities, 1.3 percent of GDP while, subsidies on commodities account for 0.6 percent of GDP.

On the expenditure side, in the column, the government's final consumption accounts for almost 16.1 percent of GDP, cells (1-35,87). Its composition has already been discussed in section 5.3.1. Because the production of public services by the government sector is represented in the public administration sector account (sec32), the government's wages and capital outlays are booked in the same account. Other government expenditures are transfers to households, cell (85,87), and to firms, cell (86,87). Net government transfers to firms and to households represent 15.6 percent of GDP. The reason for their high level compared to the one provided in the consolidated government budget, 12.3 percent (IMF, 2003), is the inclusion of the tax arrears payments (the difference between the theoretical value calculated on an accrual basis and the cash receipts). The government transfers to the external sector reflect the net current international cooperation transfers, interest payments on the foreign debt and lending minus repayments, cell (102,87). Net savings of the government sector are booked in cell (100,87). They represent the balance of the consolidated budget before public capital expenditures. By further subtracting capital expenditures we get the conventional budget deficit<sup>69</sup>, which represents about 4 percent of GDP in 2000. Adding the interest payments to the conventional budget deficit we obtain the primary budget balance, which amounts to 0.9 percent of GDP.

### 5.3.8. Taxes and subsidies accounts

The taxes and subsidies accounts are disaggregated according to the type of tax or subsidy. They include taxes on production, social security contribution taxes, VAT, other taxes on consumption (mainly excises), import tariffs, taxes on income, subsidies on commodities and subsidies on production. The VAT account is further divided in VAT on intermediate consumption, VAT on households' final consumption, VAT on government's final consumption and VAT on investment commodities. All four accounts book non-deductible value-added taxes. The excise duties distinguish excises on intermediate consumption and excise duties on households' consumption.

In the rows, the taxes accounts (rows 88-97) show the payments of taxes made to this account by commodities, production sectors, households, firms and the government. In the columns, income from taxes is transferred to the government sector account. The subsidies accounts (rows 98-99) show in the rows the subsidies on commodities and direct subsidies transferred to the production sectors. Thus, they are recorded with a negative sign. In the columns, the subsidies expenditures are transferred from the government and again booked with a negative sign. The structure of the tax revenues and subsidies as a percentage of GDP has already been

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<sup>69</sup>See appendix 4.D for a discussion on different ways of measuring government deficit.

## A Social Accounting Matrix for Romania, 2000

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discussed in section 5.3.7. In the remaining part of this section, only a few methodological issues and sectoral characteristics will be discussed.

In the input-output table (National Institute of Statistics, 2003) the value-added tax rates are distinguished by type of commodity, but not according to the type of use (intermediate consumption, households' consumption, government consumption, investment goods). However, a division by type of use is required for modeling the VAT rates in RoMod. The only data available in this regard indicate for each type of use the percentage of sales liable to VAT: 33.2 percent of intermediate consumption, 78.5 percent of households' consumption, 100 percent of government consumption, 24.7 percent of investment commodities<sup>70</sup>. Thus, value added taxes on each commodity have been attributed to each type of use using these shares. First, the value of consumption by type of use<sup>71</sup>, including non-deductible VAT, has been calculated for each commodity. Their values have been added up for each commodity and the share of each type of use in the total has been derived for each product. These shares have been used to split the value-added taxes by type of use for each commodity. The low average value-added tax rates on publishing and printing materials, cells (90-93,9), and on other community and social services, cells (90-93,35), for all categories of uses, is a consequence of the exemptions<sup>72</sup> on the supply of books (other than material wholly or substantially devoted to advertising matter) and on admissions to shows, theatres, circuses, fairs, museums, etc.

Also, the excise duties are provided by commodity in the input-output table. The only categories of final uses on which excise duties are levied are intermediate consumption and households' consumption. To attribute the excise duties to each category for each commodity it has been assumed that they are proportional with the share of intermediate consumption and of households' consumption in total intermediate consumption and households' consumption for each product. This assumption is not unrealistic given that the excise duty levels by product are not differentiated according to the destination of the product. For example, the excise duty level for unleaded petrol (220 EUR/tonne in 2000<sup>73</sup>) is the same for the agricultural sector, the manufacturing sectors and the households.

Direct subsidies to the production activities represent about 1.3 percent of GDP. Roughly half of them support public passenger transport, cells (99,59-62), out of which 85 percent goes to railways public transport, cell (99,59). The problem resulting from the large amount of direct subsidization is that it allows the survival of unstructured and inefficient state owned enterprises (OECD, 2002). The subsidies on commodities are mainly directed towards subsistence goods like agricultural products and coal (used for heating). They are a consequence of the efforts to minimize the social costs associated with the transition period.

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<sup>70</sup>Data provided by the National Institute of Statistics.

<sup>71</sup>The type of uses refers here to intermediate consumption, households' consumption, government consumption and investment commodities.

<sup>72</sup>OGU 215/1999 regarding the modification and completion of some regulations concerning the value-added tax.

<sup>73</sup>OG 27/2000 regarding the excise duties.

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### 5.3.9. Saving/investment account and changes in stocks account

The saving/investment account shows the consumption of fixed capital in the production process (depreciation) and net savings of households, firms, the government sector, and the foreign sector on the row and the demand for investment commodities in the column. The derivation of depreciation has already been explained in section 5.3.2. The value of depreciation has been subtracted from savings to compute the net savings for each institutional sector (household, firms and government). The highest net savings are made in the firms sector, cell (100,86), but its value should be interpreted with caution due to the large tax payments arrears booked as a transfer received from the government by this sector. The government sector displays negative net savings, cell (100,87). Foreign sector savings, cell (100,102), represent in fact the balance of the current account. In this case, having a positive sign, it shows the deficit of the Romanian current account, which accounts for 4 percent of GDP. The demand for investment commodities has already been discussed in section 5.3.1.

The changes in stocks account shows the demand for inventories in the column, which have already been explained in section 5.3.1. The account is closed through the saving/investment account, cell (101,100).

### 5.3.10. The external sector account

The external sector account presents the income of the foreign sector in the corresponding row and the expenditure in the column. The income consists of imports, net transfers of firms and transfers of the government to the foreign sector, while the expenditure includes the exports of the domestic economy, the net transfers to the households, transfers to the government and net labor outlays. The net saving of the foreign sector is booked in cell (100,102). Most of these income and expenditure elements have already been explained. Furthermore, some sectoral characteristics of exports and imports have already been discussed in chapter 4, together with the presentation of the CGE model. In the following we only present a number of methodological issues regarding imports and exports valuation.

A few adjustments had to be made to the imports and exports. The first one refers to imports of textile and leather products (sec6). About 76 percent<sup>74</sup> of the firms manufacturing of textile and leather are involved in subcontracting activities for firms in various European Union countries (mainly Italy and Germany). These activities imply that leather and textile products are imported without change of ownership. According to the principles stated in ESA 95 these products are recorded as imports and exports. Thus, imports represent 69.5 percent<sup>75</sup> of the exports of the same products, which explain why in the Romanian input-output table, the value of exports of these products is higher than domestic production. This would lead to an artificial negative domestic supply to the domestic market. In the SAM, to overcome

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<sup>74</sup>Figure provided by the Ministry of Economy and Commerce.

<sup>75</sup>Figure provided by the Ministry of Economy and Commerce.

this problem, the share of imports of textile products which is re-exported is subtracted from both imports and exports.

The second adjustment refers to the difference between the cost-insurance-freight (c.i.f.) and the free on board (f.o.b.) valuation of imports. In the input-output table the imports of individual commodity groups are valued at c.i.f. prices. However, total imports should be valued free on board at the border of the exporting country according to ESA 95. Therefore, adjustment items are introduced in a separate column in the input-output table to reconcile the two valuation principles. The adjustment items are equal to the value of the transport and insurance services provided by residents, and refer to the transport and insurance from the border of the exporting country to the border of the importing country (Eurostat and European Commission, 1996). In the input-output table the adjustment between the c.i.f. and the f.o.b. price is not indicated for each commodity group. Their aggregate value is attributed to the transport sectors (sec24-sec27) and financial intermediation sector (sec29). However, in the SAM we have to book the imports for each commodity group valued at free on board prices. Therefore, the aggregate value of the adjustment items has been distributed between commodities according to the share of each commodity group in the total commodities. Services have not been adjusted as they do not imply any transport and insurance costs.

The last adjustment relates to direct purchases abroad by residents and purchases on the domestic territory by non-residents. In the input-output table special adjustment items are introduced to initial estimates of imports, exports and final households' consumption (for the part of consumption as purchases abroad). They are not distinguished by group of product. Only the aggregate value is given for each of the three categories: imports, exports and private consumption. In the SAM we have to attribute these adjustment items to each commodity group. Therefore, they have been distributed between commodities according to the share of each product group in the total value of the products (including services).

### **5.4. Conclusions**

The only Social Accounting Matrix for Romania published until now has been constructed by the National Institute of Statistics for 1989/1990. In this chapter, the construction of a new SAM for the Romanian economy, for 2000 has been discussed. Due to the use of different sources of data for building the SAM and the resulting statistical discrepancies, the SAM was not initially balanced. Therefore, the cross entropy method was used to correct this. The structural relationships between the main institutional sectors (households, firms, government) as represented by the SAM provide an opportunity to outline some characteristics of the Romanian economy, with special emphasis on the government sector. Also, some data limitations problems have been mentioned. The Social Accounting Matrix is further used in chapter 6 to calibrate the CGE model for the Romanian economy (RoMod).



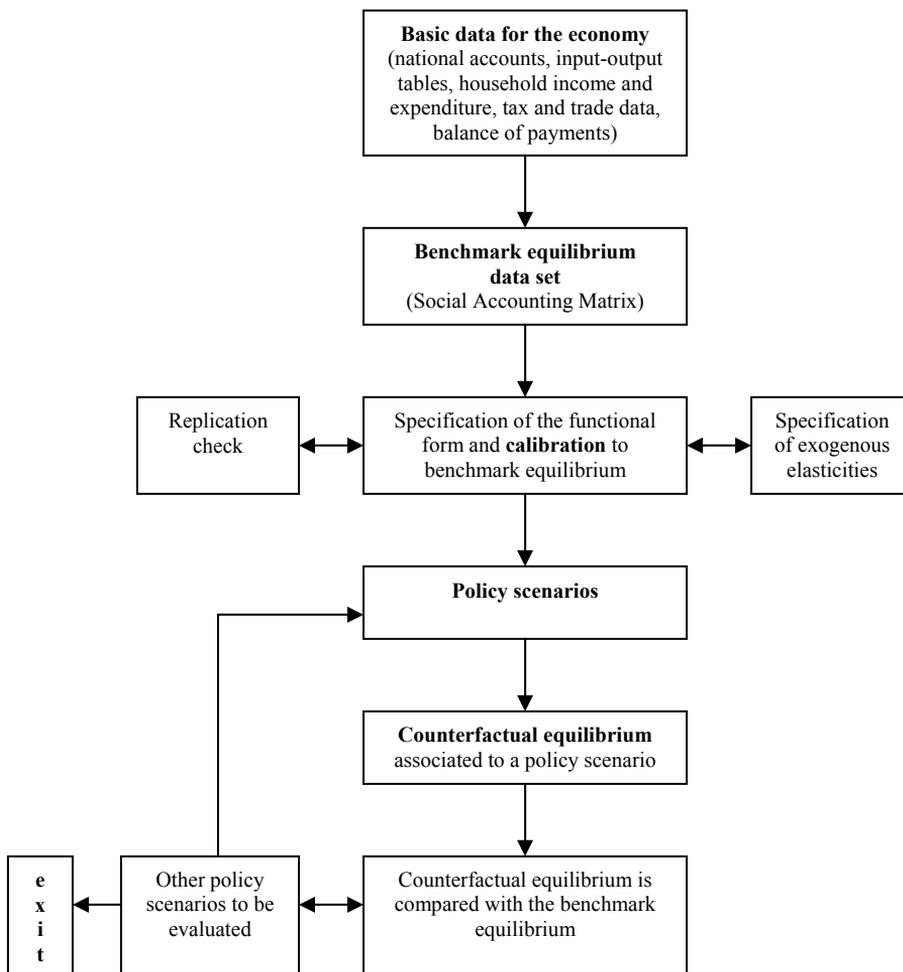
## **Chapter 6**

### **Calibration of the CGE model**

#### **6.1. Introduction**

The design of a CGE model requires several steps. First, the structure of the general model is determined. Then, a particular functional form has to be chosen for the production and demand functions. Usually Cobb-Douglas, Linear Expenditure System (LES) or Constant Elasticity of Substitution (CES) specifications are selected for this purpose. Finally, the parameter values for the functional forms must be derived. Ideally, all the parameters in the CGE model may be econometrically estimated, using simultaneous equation estimation methods that take into account the overall model structure. However, given the size of CGE models, the required sophistication of techniques, the identification problems and the lack of data, this procedure is considered infeasible (Gunning and Keyzer, 1995). Therefore, the most commonly used procedure to determine the parameter values is calibration (Mansur and Whalley, 1984). The calibration procedure implies that the parameters of the model are identified on the basis of a single observation of the economy. The economy under consideration is assumed to be in equilibrium, a so-called reference equilibrium or benchmark equilibrium. In practice, the benchmark equilibrium or benchmark data set is a Social Accounting Matrix, constructed from national accounts or other governmental data sources. The calibration procedure ensures that the parameters of the model are specified in such a way that the model will reproduce the initial data set as an equilibrium solution.

Once the parameters are calibrated, the model is complete and different policy changes can be simulated. The parameter values are crucial in determining the results of the policy simulations. A schematic presentation, outlining the calibration procedure and the CGE model use is given in figure 6.1 (Shoven and Whalley, 1992).



Source: Shoven and Whalley, 1992.

**Figure 6.1. A schematic presentation outlining the calibration procedure and the CGE model use**

According to figure 6.1, the basic data for the economy are first used to build a consistent framework, the Social Accounting Matrix, which represents the benchmark equilibrium data set for the CGE model. Then, after specifying the functional forms the model is calibrated to the benchmark equilibrium. For the Cobb-Douglas functions the parameters values are uniquely determined through the calibration procedure, from the Social Accounting Matrix. Instead, for the LES and CES specifications, exogenous elasticities values are also required. The values of

these elasticities are usually from the literature. Further, after the calibration of the model, the replication check of the benchmark equilibrium serves as an accuracy test of the computer code of the model. Finally, different policy changes are simulated with the model and the counterfactual equilibrium associated to each of them is compared to the benchmark equilibrium.

This chapter presents the calibration of the CGE model for the Romanian economy (RoMod). The benchmark equilibrium data set used for calibration is the Romanian Social Accounting Matrix for 2000 especially constructed for this purpose. The chapter is organized as follows. First, some theoretical aspects regarding the calibration are discussed. The calibration approach is compared to the econometric approach, pointing out the advantages and disadvantages of using the calibration procedure. The calibration of RoMod's parameters is further presented. To keep the presentation clear, the explanations regarding the calibration of the parameters follow the structure of the model in chapter 4.

### 6.2. Principles of calibration

A CGE model can be written as a system of equations containing a set of unknown parameters  $\theta$ , such that a vector of exogenous variables,  $X$ , produces a vector of endogenous variables  $Y$  (Adams and Higgs, 1990):

$$G(Y, X, \theta, \varepsilon) = 0 \quad (6.1)$$

where  $\varepsilon$  is a vector of stochastic disturbances of either known, partially known or unknown distribution.

The calibration approach implies that:

$$\varepsilon = 0 \quad (6.2)$$

Therefore, the resulting system of equations can be solved for the vector of parameters  $\theta$ , using only one observation for the base year. The base year data represent the benchmark equilibrium data set or, more specifically, the Social Accounting Matrix. Parameters whose values cannot be inferred from the benchmark equilibrium data set (such as elasticities of substitution in most cases) are obtained from a search of the literature, or are set arbitrarily.

The restriction  $\varepsilon = 0$  indicates that the calibration is interpreted as a non-stochastic approach, as opposed to the stochastic approach of econometrics. This does not mean that economic reality is seen as deterministic when calibrating the CGE models. However, the CGE modeling analyzes the systematic, not the random, responses of economic variables to exogenous stimuli. Thus, ideally, the set of parameters  $\theta$  of the CGE model produces the systematic part of the total response in  $Y$ , with a given  $X$ .

An important feature of calibration is that the model specification is not statistically tested due to the deterministic procedure of deriving the parameter values from the benchmark data set. Thus the approach uses the key assumption that the benchmark

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data represent an equilibrium for the economy under investigation. Compared to econometric models, which often simplify the structure of the economy to allow for a substantial statistical specification, the calibrated CGE models allow for a richer economic structure (Shoven and Whalley, 1992). Furthermore, because the benchmark data set is usually presented in value terms, to separate price and quantity observations, certain units should be chosen for goods and factors. The most commonly used convention, introduced by Harberger (1962), is to choose units (efficiency units) for both goods and factors such that they have a price of unity in the benchmark equilibrium.

The main advantage of the calibration approach concerns the relatively limited data requirements. The parameters can be specified by using only one observation, the benchmark equilibrium data set. This is particularly important for the transition economies of Eastern European countries, including Romania, where reliable data are scarce. The time series for most economic variables in the CGE model consist of fifteen data, which renders the use of the econometric approach to estimate the parameters inappropriate. The significant change in the economic structure is an additional reason to use calibration to determine the parameters of RoMod. Sometimes, it may be preferable to use the calibration procedure based on data only for the period after the structural change, if the data available do not allow estimating model parameters after the structural break (Taylor, 1990a). As already mentioned in chapter 2, in the case of Romania a structural break occurred in 1997 due to the radical change in the restructuring strategy. Finally, the change in the methodology for deriving the national accounts<sup>76</sup>, starting with 1998, makes the time series inappropriate for econometric estimation of the parameters. Thus, the calibration procedure seems more appropriate to derive the parameters values for the Romanian model.

### 6.3. The econometric critique of calibration

The parameters of the CGE models are commonly determined by calibration procedure for reasons mentioned above. However, the calibration approach has been strongly criticized by, among others, Jorgenson (1984), Lau (1984) and McKittrick (1998) on several grounds:

- the unreliability of parameters;
- the dependency of the quality of model on the quality of data for an arbitrarily chosen benchmark year;
- the limitations in the structure of the model.

The unreliability of parameters is a serious problem in CGE modeling especially because the parameter values are crucial in determining the results of policy simulations. As already mentioned, most of the parameters are derived from the benchmark data set through the calibration procedure, while others (mostly

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<sup>76</sup>Starting with 1998 the National Institute of Statistics changed the methodology for computing the national accounts from SNA 1993 to ESA 1995.

substitution elasticities) are drawn from the literature. Researchers often use elasticities estimated for other commodity or industry classifications, then those included in the models. Sometimes estimates for other countries or for other years are used. In extreme cases, when no published figures are available, they are based on outright guesses. Often it is not possible to assess the evidence supporting the choice of parameter values, although an indication of reliability can be given by the systematic uncertainty analysis proposed by Harrison, Jones, Kimbell and Wigle (1993). Unfortunately, due to the large amount of simulations required, this method is not widely used.

Further, the quality of the data for the arbitrarily chosen benchmark year has a direct bearing on the quality of the model. In econometric models stochastic disturbances capture the effect of errors of measurement of exogenous and endogenous variables and omitted variables. The calibration procedure implies that the stochastic disturbance term equals zero forcing the calibrated parameters to absorb all random errors in the data for the benchmark year. This further influences the validity of the generalizations drawn from the model. Moreover, the Social Accounting Matrix used as benchmark data set, is usually not balanced (the total of the row is not equal to the total of the column for each account). The various scaling processes used to force micro-consistency introduce untraceable biases into the rows and columns, which directly influence the parameters resulting from the calibration.

The limitations in the structure of the model imposed by calibration refer mainly to the functional forms. As Lau (1984) points out, the number of parameters that can be determined through calibration cannot be larger than the number of equations. As a consequence, only relatively simple functional forms can be used, affecting the structure of the model. McKittrick (1998) uses two short-run CGE models for the Canadian economy to show the implications of these restrictions on the model structure. One of the CGE models is based on CES functional forms while the other is based on normalized quadratic functions. The equations of both models are econometrically estimated. In his study, the functional forms appear to strongly influence the results from a policy simulation at both the industry-specific and macroeconomic levels.

To meet the econometric critique Thissen (2000) proposes a refinement of the existing calibration approach. His approach is based on an estimation of the parameters using data for several years. In mathematical terms, the proposed calibration method can be described by minimizing:

$$RMS = \sqrt{\frac{1}{T \cdot n} \cdot \sum_{t=1}^T \sum_{i=1}^n \left( \frac{Y_{i,t}^s - Y_{i,t}^a}{Y_{i,t}^a} \right)^2} \quad (6.3)$$

subject to:

$$G(Y_{i,t}^s, X, \theta) = 0 \quad (6.4)$$

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where  $Y_{i,t}^s$  and  $Y_{i,t}^a$  are vectors of the simulated and actual  $i$  endogenous variables in period  $t$ ,  $X$  is a vector of exogenous variables,  $\theta$  is a vector of unknown parameters,  $T$  gives the number of periods in the simulation and  $n$  represents the number of variables taken into account in the objective function. The parameters in the model are determined by minimizing an adjusted Root Mean Square percentage error (RMS) for the endogenous variables and for several years. The Root Mean Square percentage error is an accepted measure to evaluate the performance of a model. The additional constraint in the minimization process, given by equation (6.4), represents the CGE model. His approach results in an increased reliability of the parameter estimates and gives a measure of reliability. Also, it takes into account the effects of omitted variables and addresses the identification problem in a more appropriate way.

Some other authors (Kehoe, Polo and Sancho 1995; Dixon and Rimmer, 2002) proposed a simple “validation” procedure as an alternative to the econometric estimation of parameters, while Arndt, Robinson and Tarp (2002) employ a maximum entropy approach to estimate the CGE models’ parameters. However, due to the 1998 shift in definitions used to compute the Romanian national accounts, time series of available data became too short to apply this refined calibration method. Thus, RoMod is calibrated using the classic approach.

### 6.4. Calibration of RoMod

The benchmark equilibrium data set for RoMod is the Social Accounting Matrix for 2000. The data of the Social Accounting Matrix are expressed in value terms, while the calibration procedure requires a separation of prices and quantities. Here we use the approach proposed by Harberger (1962), and measure physical quantities such that all commodities prices are normalized to unity. An exception has been made for the factors of production, labor and capital.

#### 6.4.1. Calibration of the firms sector

To calibrate the production function parameters, the model equations are solved in reverse. The initial values of the variables are given in the SAM. Knowing the initial values for all of the variables we solve for the parameters.

As already explained in chapter 4, gross output for each production sector except coal, oil and extraction of natural gas sectors is determined from a nested production structure. At the outer nest producers are assumed to choose intermediate inputs of non-energy goods and a capital-labor-energy ( $KLE_c$ ) bundle, according to a Leontief production function (see chapter 4, equation (4.1)). The  $KLE_c$  composite relates to output through a fixed coefficient, where  $aP_c$  is calibrated as the ratio of the benchmark value of capital-labor-energy bundle ( $KLEZ_c$ ) to the benchmark value of gross output ( $XDZ_c$ ) of sector  $c$ . The income definition (see chapter 4, equation (4.2)) which gives the sector’s  $c$  output at basic prices in terms of factors

costs, contains five parameters that need to be calibrated. The average tax rate on production ( $tp_c$ ) and the average subsidy rate on production ( $tsp_c$ ) of sector  $c$  are derived as:

$$tp_c = TRPZ_c / (XDZ_c \cdot PDZ_c) \quad (6.5)$$

$$tsp_c = |TRSPZ_c| / (XDZ_c \cdot PDZ_c) \quad (6.6)$$

where  $TRPZ_c$  are the taxes on production paid by sector  $c$  and  $|TRSPZ_c|$  is the absolute value<sup>77</sup> of direct subsidies on production received by sector  $c$ , provided in the SAM.  $PDZ_c$  is the benchmark price of output, normalized to one. To calculate the average VAT rate ( $vati_{nen,c}$ ) and the average excise rate ( $tci_{nen,c}$ ) on intermediate consumption of non-energy inputs  $nen$  by sector  $c$  we need to make some additional assumptions. The Romanian Social Accounting Matrix provides only the value-added taxes and the excise duties on consumption of non-energy inputs ( $nen$ ) by all the sectors. Due to the lack of data we allocate the VAT and excise duties on consumption of non-energy inputs by sector proportionally. Then, the average excise duty and VAT rates are derived as:

$$tci_{nen,c} = TCSH_{nen,c} / (IOZ_{nen,c} \cdot PZ_{nen}) \quad (6.7)$$

$$vati_{nen,c} = VAISH_{nen,c} / [(IOZ_{nen,c} + TCSH_{nen,c}) \cdot PZ_{nen}] \quad (6.8)$$

where  $TCSH_{nen,c}$  are the excise duties on commodity  $nen$  consumed by sector  $c$ ,  $IOZ_{nen,c}$  is the intermediate consumption of commodity  $nen$  by sector  $c$ ,  $VAISH_{nen,c}$  are the value added taxes paid by sector  $c$  on the consumption of commodity  $nen$ , and  $PZ_{nen}$  is the benchmark price of commodity  $nen$  which is equal to one. The specification of the value-added taxes and excise duties in the model and their calibration accounts for the order in which they are levied on the products<sup>78</sup>. Thus, the value-added tax is applied to the price which includes the excise duties. Finally, the technical coefficients ( $io_{nen,c}$ ) are calibrated as the ratio of intermediate consumption of non-energy input  $nen$  to the value of output of sector  $c$ :

$$io_{nen,c} = IOZ_{nen,c} / XDZ_c \quad (6.9)$$

The substitution possibilities between labor and capital-energy composite are reflected by a constant elasticity of substitution (CES) function (see chapter 4, equation (4.3)). The initial value of demand for capital-energy composite ( $KEZ_c$ ) can be obtained from the Social Accounting Matrix, while the initial labor demand ( $LSKZ_c$ ) reflects the number of employed persons by sector  $c$ , provided by the labor

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<sup>77</sup>The direct subsidies on production are booked in the Romanian SAM with a negative sign. Their absolute value is used in the derivations.

<sup>78</sup>OUG 215/1999 regarding the modification and completion of some regulations concerning the value-added tax.

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survey (National Institute of Statistics, 2001). The SAM provides the labor costs by sector, allowing derivation of the benchmark net of tax average national wage rate ( $PLZ$ ) as the ratio of total labor costs to total number of employed at the national level. Further, inter-sectoral wage differentials ( $wdif_c$ ) are derived as the ratio of sectoral average wage to the average national wage rate.

The average social security contribution rate paid by the employers ( $tsh_c$ ) in sector  $c$  is simply calculated as the ratio of taxes to total labor outlays:

$$tsh_c = TSCHZ_c / (LSKZ_c \cdot PLZ \cdot wdif_c) \quad (6.10)$$

where  $TSCHZ_c$  represents the benchmark social security contributions paid by sector  $c$  to the government, provided in the SAM, and  $(LSKZ_c \cdot PLZ \cdot wdif_c)$  are the initial labor outlays of sector  $c$  also provided in the SAM.

For the capital-energy bundle the initial price  $PKEZ_c$  has been chosen equal to one such that the value of  $KEZ_c$  from the SAM reflects the equilibrium quantity. Further, the CES function is characterized by three parameters: the elasticity of substitution between labor and the capital-energy composite ( $\sigma Pl_c$ ) for sector  $c$ , the distribution parameter for the capital-energy bundle ( $\gamma Pl1_c$ ) and the distribution parameter for labor ( $\gamma Pl2_c$ ). Having an idea about the value of the elasticity of substitution between labor and the capital-energy composite, the distribution parameters can be calibrated from the demand equations (see chapter 4, equations (4.5)-(4.6)) as:

$$\gamma Pl1_c = (KEZ_c / KLEZ_c)^{1/\sigma Pl_c} \cdot (PKEZ_c / PKLEZ_c) \quad (6.11)$$

$$\gamma Pl2_c = (LSKZ_c / KLEZ_c)^{1/\sigma Pl_c} \cdot [(1 + tsh_c) \cdot PLZ \cdot wdif_c] / PKLEZ_c \quad (6.12)$$

where  $PKLEZ_c$  is the benchmark price of the capital-labor-energy composite, normalized to one.

The values for the elasticity of substitution between the labor and the capital-energy bundle for each sector are usually taken from the literature. However, for the Romanian economy no such econometric estimates are published. Therefore the elasticities of substitution used in the model are based on expert opinion and on examination of the values of the elasticities for other Eastern European countries (Van Leeuwen, 1997) and some estimates used by MIT (Babiker et al., 2001). The values of elasticities are presented in table 6.1. The selected values are consistent with the findings of Duffy and Papageorgiou (2000). Using a panel of 82 countries over a 28-year period to estimate a general CES production function specification they find that capital and labor are more substitutable in the rich countries and are less substitutable in the poor countries. The same can be implied for the substitution possibilities between capital-energy and labor. However, uncertainty and sensitivity analysis would be required to assess the reliability of such estimates.

**Table 6.1. Elasticities of substitution for all the production sectors, except coal, oil and extraction of natural gas sectors**

Sectors		$\sigma P1_c$	$\sigma P2_c$	$\sigma P3_c$	$\sigma P4_c$
Agriculture, forestry and fishing	<b>sec1</b>	0.40	0.80	0.40	0.35
Manufacture of food products and beverages; tobacco	<b>sec5</b>	0.60	0.95	0.40	0.35
Manufacture of textile and leather products	<b>sec6</b>	0.60	0.95	0.40	0.35
Manufacture of wood and products of wood	<b>sec7</b>	0.65	0.40	0.40	0.35
Manufacture of paper and paper products	<b>sec8</b>	0.65	0.40	0.40	0.35
Manufacture of publishing and printing	<b>sec9</b>	0.65	0.50	0.40	0.35
Manufacture of chemicals and chemical products	<b>sec10</b>	0.40	0.80	0.40	0.35
Manufacture of pharmaceutical products and cosmetics	<b>sec11</b>	0.60	0.80	0.40	0.35
Manufacture of rubber and plastic products	<b>sec12</b>	0.60	0.80	0.40	0.35
Manufacture of glass and glass products	<b>sec13</b>	0.45	0.40	0.40	0.35
Other mining and quarrying; manufacture of other non-metallic mineral products	<b>sec14</b>	0.45	0.40	0.40	0.35
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	<b>sec15</b>	0.45	0.40	0.40	0.35
Manufacture of general purpose machinery; manufacture of special purpose machinery	<b>sec16</b>	0.70	0.95	0.40	0.35
Manufacture of domestic appliances	<b>sec17</b>	0.70	0.95	0.40	0.35
Manufacture of electrical and machinery and apparatus	<b>sec18</b>	0.70	0.95	0.40	0.35
Manufacture of transport equipment	<b>sec19</b>	0.70	0.95	0.40	0.35
Electricity, gas and water supply	<b>sec20</b>	0.75	0.80	0.40	0.35
Construction	<b>sec21</b>	0.75	0.80	0.40	0.35
Wholesale and retail trade	<b>sec22</b>	0.80	0.80	0.40	0.35
Hotels and restaurants; activities of travel agencies	<b>sec23</b>	0.80	0.80	0.40	0.35
Transport via railways	<b>sec24</b>	0.55	0.40	0.40	0.35
Other land transport; transport via pipelines	<b>sec25</b>	0.55	0.40	0.40	0.35
Water transport	<b>sec26</b>	0.55	0.40	0.40	0.35
Air transport	<b>sec27</b>	0.55	0.40	0.40	0.35
Post and telecommunications	<b>sec28</b>	0.80	0.80	0.40	0.35
Financial intermediation	<b>sec29</b>	0.80	0.80	0.40	0.35
Real estate activities	<b>sec30</b>	0.40	0.55	0.40	0.35
Other business activities	<b>sec31</b>	0.80	0.80	0.40	0.35
Public administration and defence; compulsory social security	<b>sec32</b>	0.40	0.55	0.40	0.35
Education	<b>sec33</b>	0.40	0.55	0.40	0.35
Health and social work	<b>sec34</b>	0.40	0.55	0.40	0.35
Other community, social and personal service activities	<b>sec35</b>	0.40	0.55	0.40	0.35

*Note:  $\sigma P1_c$  stands for the elasticity of substitution between the labor and the capital-energy composite,  $\sigma P2_c$  for the elasticity of substitution between capital and the energy composite,  $\sigma P3_c$  for the elasticity of substitution between the electricity and the non-electric energy composite, and  $\sigma P4_c$  for the elasticity of substitution between different non-electric energy inputs.*

The demand equations for the capital and energy composite (see chapter 4, equations (4.10)-(4.11)), for the electricity and the non-electric energy composite (see chapter 4, equations (4.15)-(4.16)), and different non-electric energy inputs (see chapter 4, equation (4.20)) are calibrated in the same way. The elasticity of substitution between the capital and the energy composite for each sector ( $\sigma P2_c$ ), the elasticity

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of substitution between the electricity and the non-electric energy composite for each sector ( $\sigma P3_c$ ), and the elasticity of substitution between different non-electric energy inputs for each sector ( $\sigma P4_c$ ) are provided in table 6.1.

For the coal, oil, and extraction of natural gas sectors, the capital-labor bundle ( $KL_l$ ) is related in the first stage to output through a fixed coefficient, where  $aL1_l$  is calibrated as the ratio of the benchmark value of the capital-labor composite ( $KLZ_l$ ) to gross output of sector  $l$ . Energy inputs are also related to output through fixed coefficients, where  $aL2_{en,l}$  are calibrated as the ratio of energy inputs to the gross output of sector  $l$ . In the second stage, the substitution possibilities between capital and labor are given by a CES function (see chapter 4, equation (4.25)). The elasticity of substitution between capital and labor is fixed at 0.4 for the coal, oil and the extraction of the natural gas sectors. Further, the distribution parameters are calibrated in the same way as above.

The share of interest payments (*intf*) on public debt to the firms (see chapter 4, equation (4.30)) is calibrated as the ratio of benchmark interest payments to the firms to the total benchmark interest payments on domestic debt.

### 6.4.2. Calibration of the households sector

The Linear Expenditure System is frequently used to describe consumption behavior in CGE models. This system, which derives demand for commodities through an optimization process, is also used in RoMod.

The optimal allocation of consumption commodities is given by maximizing a Stone-Geary utility function:

$$U(C_i) = \prod_i (C_i - \mu H_i)^{\alpha H_i} \quad (6.13)$$

subject to the budget constraint:

$$CBUD = \sum_i (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot P_i \cdot C_i \quad (6.14)$$

giving the demand equations for consumption commodities (see chapter 4, equation (4.39)). For calibration purposes, the initial values for some of the variables are directly obtained from the SAM, like the demand for commodities ( $CZ_i$ ). The values for some other parameters are simply calculated. For example, the average subsidy rate ( $tsc_i$ ), the average excise duty rate ( $tc_i$ ), and the average value-added tax rate ( $vat_i$ ) on households' consumption of commodity  $i$  are derived as:

$$tsc_i = |TRSCHZ_i| / (CZ_i \cdot PZ_i) \quad (6.15)$$

$$tc_i = TRCZ_i / [(CZ_i - |TRSCHZ_i|) \cdot PZ_i] \quad (6.16)$$

$$vat_i = VATZ_i / [(CZ_i + TRCZ_i - |TRSCHZ_i|) \cdot PZ_i] \quad (6.17)$$

where  $|TRSCHZ_i|$  is the absolute value<sup>79</sup> of the subsidies on commodity  $i$ ,  $TRCZ_i$  is the value of excise duties paid on the commodity  $i$  and  $VATZ_i$  is the level of value-added taxes paid on commodity  $i$  by the households. The excise duties are applied on the price of commodity  $i$  less subsidies, while the value added taxes are applied on the price of commodity  $i$  less subsidies but including excise duties.  $PZ_i$  is the benchmark price of commodity  $i$ , which is set to one to separate prices from quantities.

The only remaining parameters that have to be calibrated are the marginal budget shares ( $\alpha H_i$ ) and the subsistence levels of consumption of commodities ( $\mu H_i$ ). There are two possible ways to calibrate these parameters (EcoMod, 2002):

- when  $\mu H_i$  is known,  $\alpha H_i$  can be derived straightforward from the demand equations (see chapter 4, equation (4.39)) as:

$$\alpha H_i = \frac{(1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot PZ_i \cdot (CZ_i - \mu H_i)}{CBUDZ - \sum_j (1 + vat_j) \cdot (1 + tc_j) \cdot (1 - tsc_j) \cdot PZ_j \cdot \mu H_j} \quad (6.18)$$

- when the income elasticity of demand for commodity  $i$ ,  $E(CZ_i, CBUDZ)$ <sup>80</sup>, is known (based on econometric estimates drawn from the literature)  $\alpha H_i$  is derived as:

$$\alpha H_i = \frac{E(CZ_i, CBUDZ) \cdot (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot PZ_i \cdot CZ_i}{CBUDZ} \quad (6.19)$$

Due to the use of values for income elasticities from outside sources, it is not guaranteed that  $\sum_i \alpha H_i = 1$ . Therefore, the marginal budget shares should be scaled:

$$\alpha H_i = \frac{\alpha H_i}{\sum_i \alpha H_i} \quad (6.20)$$

Further, to determine the subsistence level of consumption of commodities,  $\mu H_i$ , we should have an idea about the value of the expenditure elasticity of the marginal

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<sup>79</sup>The subsidies on consumption of commodities are booked in the Romanian SAM with a negative sign. Their absolute value is used in the derivations.

<sup>80</sup> For convenience, the income elasticity of demand for commodity  $i$  is denoted by  $eY_i$  in table 6.2, section 6.4.4 and in chapter 7.

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utility of expenditure (Frisch parameter)<sup>81</sup> applied to the benchmark households' disposable budget ( $CBUDZ$ ):

$$\phi = -\frac{CBUDZ}{CBUDZ - \sum_i (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot PZ_i \cdot \mu H_i} \quad (6.21)$$

With the prices normalized to one, the  $\mu H_i$  are easily derived as:

$$\mu H_i = CZ_i + \frac{\alpha H_i \cdot CBUDZ}{\phi \cdot (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i)} \quad (6.22)$$

Due to the lack of data on the subsistence levels of consumption of commodities it is not possible to calibrate the marginal budget shares using  $\mu H_i$ . Thus, the approach adopted for RoMod is to calibrate the share parameters and the subsistence levels starting from the income elasticities of demand for the commodities. The values of income elasticities of the demand for the commodities used in RoMod,  $E(CZ_i, CBUDZ)$ , are presented in table 6.2, section 6.4.4. The estimates are based on a review of the literature, and on the presumption that consumer demand for agricultural products is quite insensitive, while demand for industrial products and services is very sensitive to income changes in Romania. The main source for the elasticities values has been version 5 of the GTAP database (Dimaranan and McDougall, 2002). The last exogenous parameter needed to calibrate the subsistence parameters  $\mu H_i$  is the Frisch parameter. The frequently used estimate for the Frisch parameter for developing countries is  $-2.0$  (Taylor, 1979). Taylor states that the supernumerary income ratio takes a value of about 0.5 for most consumer groups. However, Taylor's findings are based on earlier studies estimating the supernumerary income ratio for high-income countries<sup>82</sup>. But Lluch, Powell and Williams (1977) argue that the Frisch parameter for low-income countries is much lower. For RoMod therefore, the chosen value for the Frisch parameter is  $-3.5$ , consistent with a level of GNP per capita over 1,000 USD.

The lack of econometric estimates for the Romanian economy of income elasticities of demand for the various commodities and of the Frisch parameter forced us to rely mostly on estimates for other countries or outright guesses. The reliability of such estimates for the Romanian economy has to be further tested, for example using uncertainty and sensitivity analysis.

The share of capital income ( $aich$ ) received by the households (see chapter 4, equation (4.30)) is derived as the ratio of the benchmark value of households' capital income to the total capital income. The tax rate on income ( $ty$ ) and the social security contribution rate paid by self employed members of the households ( $tsc$ )

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<sup>81</sup>More details about the Frisch parameter can be found in appendix 4.A.

<sup>82</sup>For an overview, see Brown and Deaton (1972) and Sato (1972).

are derived as the ratio of taxes on income or social contributions to the total income or labor income, respectively (see chapter 4, equation (4.34)).

### 6.4.3. Calibration of the government sector

The government collects taxes, subsidizes consumption and production, makes transfers and capital expenditures and buys public services from the public administration sector (see chapter 4, equations (4.43)-(4.45)). The derivation of most of the average tax and subsidy rates has already been discussed in the previous sections. The average corporate tax rate ( $tyf$ ), the average import tariffs rate on commodity  $i$  ( $tm_i$ ), the average VAT rate on government consumption of commodity  $i$  ( $vatg_i$ ) and the average VAT rate on investment commodity  $i$ , are calibrated in a similar fashion, as the ratio of taxes to the income, imports or consumption of commodities. The benchmark values of other variables used to calculate total government revenues and total government expenditures are directly obtained from the SAM.

As already discussed in chapter 4, the government is assumed to maximize a Cobb-Douglas utility function:

$$U(GFCFG, CG_i) = GFCFG^{\alpha_{GI}} \cdot \prod_i CG_i^{\alpha_{G_i}} \quad (6.23)$$

subject to the budget constraint:

$$CGBUD = GFCFG \cdot PI + \sum_i (1 + vatg_i) \cdot P_i \cdot CG_i \quad (6.24)$$

in order to derive the optimal allocation between purchases of goods and services and capital expenditures. The benchmark values of government purchases of goods and services ( $CGZ_i$ ) are derived from the SAM, while the capital expenditures ( $GFCFGZ$ ) are provided in the national accounts (National Institute of Statistics, 2003). The disposable budget available for current and capital expenditures ( $CGBUDZ$ ) is computed as their sum. With prices of commodities equal to one, the only parameters that have to be calibrated are the marginal budget shares,  $\alpha_{GI}$  and  $\alpha_{G_i}$ , which are easily calculated from the demand equations (see chapter 4, equations (4.49)-(4.50)) as:

$$\alpha_{GI} = PIZ \cdot GFCFGZ / CGBUDZ \quad (6.25)$$

$$\alpha_{G_i} = PZ_i \cdot CGZ_i \cdot (1 + vatg_i) / CGBUDZ \quad (6.26)$$

The calibration of the benchmark price of the composite investment good ( $PIZ$ ) is further explained in section 6.4.5. No other estimates from outside sources are needed in this case because of the use of a Cobb-Douglas function.

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### 6.4.4. Calibration of the external sector

The domestic composites ( $X_i$ ) of imported and domestically produced goods are modeled following the Armington approach (1969), according to a CES function (see chapter 4, equation (4.56)). The benchmark value of imports ( $MZ_i$ ), the domestically produced goods ( $XDDZ_i$ ) and the demand for the composite goods ( $XZ_i$ ) are directly obtained from the SAM. The benchmark domestic price of imports ( $PMZ_i$ ), and the initial price of domestically produced goods including the trade and transport margins ( $PDDZ_i$ ) are further calculated (see chapter 4, equation (4.76)-(4.77)) according to:

$$PMZ_i = (1 + tm_i) \cdot ERZ \cdot PWMZ_i + \sum_{ct} tcom_{ct,i} \cdot PZ_{ct} + \sum_{ctpr} tcrom_{ctpr,i} \cdot PZ_{ctpr} + \sum_{ctpa} tcaom_{ctpa,i} \cdot PZ_{ctpa} + \sum_{ctpw} tcwom_{ctpw,i} \cdot PZ_{ctpw} \quad (6.27)$$

$$PDDZ_i = PDSZ_i + \sum_{ct} tcod_{ct,i} \cdot PZ_{ct} + \sum_{ctpr} tcrod_{ctpr,i} \cdot PZ_{ctpr} + \sum_{ctpa} tcaod_{ctpa,i} \cdot PZ_{ctpa} + \sum_{ctpw} tcwod_{ctpw,i} \cdot PZ_{ctpw} \quad (6.28)$$

where  $PWMZ_i$  is the world price of imports of commodity  $i$ ,  $ERZ$  is the benchmark value of exchange rate, and  $PDSZ_i$  is the basic price of domestically produced goods (excluding trade and transport margins) which all equal to one. The trade margin parameter for imports of commodity  $i$  ( $tcom_{ct,i}$ ) is derived as:

$$tcom_{ct,i} = COMZ_i / MZ_i \quad (6.29)$$

where  $COMZ_i$  are the distribution costs of moving the commodity  $i$  from the border to the final consumer. The parameters for the rail transport margin ( $tcrom_{ctpr,i}$ ), land transport margin ( $tcaom_{ctpa,i}$ ) and water transport margin ( $tcwom_{ctpw,i}$ ) for imports of commodity  $i$  are computed in a similar manner. Further, the trade margin parameter for commodity  $i$  delivered to the domestic market ( $tcod_{ct,i}$ ) is given by:

$$tcod_{ct,i} = CODZ_i / XDDZ_i \quad (6.30)$$

where  $CODZ_i$  reflect the distribution costs of moving commodity  $i$  from the producer to the domestic consumer. The parameters for the rail transport margin ( $tcrod_{ctpr,i}$ ), land transport margin ( $tcaod_{ctpa,i}$ ) and water transport margin ( $tcwod_{ctpw,i}$ ) for commodity  $i$  delivered to the domestic market are computed in the same way as explained above.

Once the prices have been calibrated, the CES function is characterized by three parameters: the elasticity of substitution between the imports and domestically

produced goods ( $\sigma A_i$ ), the distribution parameter for imports ( $\gamma A I_i$ ) and the distribution parameter for domestically produced goods ( $\gamma A 2_i$ ). Having an idea about the elasticity of substitution, the distribution parameters are calibrated from the demand equations (see chapter 4, equations (4.58)-(4.59)) as:

$$\gamma A I_i = (M Z_i / X Z_i)^{1 / \sigma A_i} \cdot (P M Z_i / P Z_i) \quad (6.31)$$

$$\gamma A 2_i = (X D D Z_i / X Z_i)^{1 / \sigma A_i} \cdot (P D D Z_i / P Z_i) \quad (6.32)$$

Further, as explained in chapter 4, the limited substitution between goods produced for the domestic market and exports is captured by a constant elasticity of transformation (CET) function (see chapter 4, equation (4.61)). The domestic price of exports ( $P E Z_i$ ) is calibrated following the same technique as the one used for the domestic price of imports and the price of domestic deliveries to domestic market (see equations (6.27)-(6.28)). Then, the distribution parameters for exports ( $\gamma T I_i$ ) and domestic goods supplied to the domestic market ( $\gamma T 2_i$ ) are computed from the demand equations (see chapter 4, equations (4.63)-(4.64)) as:

$$\gamma T I_i = (E Z_i / X D Z_i)^{1 / \sigma T_i} \cdot (P E Z_i / P D Z_i) \quad (6.33)$$

$$\gamma T 2_i = (X D D Z_i / X D Z_i)^{1 / \sigma T_i} \cdot (P D S Z_i / P D Z_i) \quad (6.34)$$

where  $E Z_i$  is the benchmark value of exports provided in the SAM.

The elasticities of substitution between imports and domestically produced goods ( $\sigma A_i$ ) and the elasticities of transformation ( $\sigma T_i$ ) are given in table 6.2. The main sources used for the Armington and CET elasticities are version 5 of the GTAP database (Dimaranan and McDougall, 2002) and Weyerbrock (2001). Unfortunately no econometric estimates are available for Romania. Therefore, estimates for other Eastern European countries have been adopted here. Tarhoaca (2000), on the basis of a review of the literature, discusses the existence of four intervals for the elasticities values: 0.3-0.8, 0.8-1.2, 1.2-3.0, and higher than 3.0 for low, relatively low, relatively high and high possibilities of substitution and transformation, respectively. His qualitative analysis suggests relatively low possibilities of both substitution and transformation for the Romanian economy. Therefore, he chooses both elasticities of substitution and transformation to be 0.6. Due to the choice of presenting the Constant Elasticity of Transformation in this form, the elasticity of transformation is negative<sup>83</sup> in this case. However, the values of elasticities selected for the calibration of RoMod are higher, in line with the estimates for other Eastern European economies. Further research would be required to improve the assessment of these elasticities.

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<sup>83</sup> See appendix 4.A for more details.

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**Table 6.2. Income elasticities of demand for commodities and other elasticities of substitution and transformation used to calibrate RoMod**

Commodities		$eY_i$	$\sigma A_i$	$\sigma T_i$
Agriculture, forestry and fishing	sec1	0.80	1.40	-3.75
Coal sector	sec2	1.25	4.00	-3.20
Oil sector	sec3	1.25	4.00	-3.20
Natural gas sector	sec4	1.25	3.50	-2.80
Manufacture of food products and beverages; tobacco	sec5	1.25	3.00	-2.70
Manufacture of textile and leather products	sec6	0.70	1.60	-1.40
Manufacture of wood and products of wood	sec7	0.95	1.80	-0.90
Manufacture of paper and paper products	sec8	1.25	1.90	-0.80
Manufacture of publishing and printing	sec9	1.25	1.40	-1.20
Manufacture of chemicals and chemical products	sec10	1.25	1.70	-0.70
Manufacture of pharmaceutical products and cosmetics	sec11	1.25	2.20	-0.60
Manufacture of rubber and plastic products	sec12	1.25	1.80	-0.85
Manufacture of glass and glass products	sec13	1.15	1.10	-0.70
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	1.15	1.40	-2.20
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	1.15	3.00	-1.10
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.20	3.00	-2.20
Manufacture of domestic appliances	sec17	1.25	3.00	-2.30
Manufacture of electrical and machinery and apparatus	sec18	1.25	2.80	-2.20
Manufacture of transport equipment	sec19	1.40	1.40	-1.90
Electricity, gas and water supply	sec20	1.35	1.80	-2.10
Construction	sec21	1.20	2.60	-2.20
Wholesale and retail trade	sec22	1.20	-	-
Hotels and restaurants; activities of travel agencies	sec23	1.15	1.40	-0.80
Transport via railways	sec24	1.15	1.40	-0.60
Other land transport; transport via pipelines	sec25	1.15	1.40	-0.60
Water transport	sec26	1.20	3.00	-2.20
Air transport	sec27	1.20	3.00	-2.20
Post and telecommunications	sec28	1.20	3.00	-2.20
Financial intermediation	sec29	1.20	3.00	-2.20
Real estate activities	sec30	1.20	-	-
Other business activities	sec31	1.20	3.00	-2.20
Public administration and defence; compulsory social security	sec32	1.20	-	-
Education	sec33	1.20	-	-
Health and social work	sec34	1.20	-	-
Other community, social and personal service activities	sec35	1.20	3.00	-2.20

Note:  $eY_i$  stands for the income elasticity of demand for commodities,  $\sigma A_i$  for the elasticity of substitution between imports and domestically produced goods and  $\sigma T_i$  for the elasticity of transformation.

### 6.4.5. Calibration of investment demand

The demand for investment commodities is modeled by maximizing a Cobb-Douglas utility function subject to a budget constraint (see chapter 4, equations (4.67)-(4.68) and (4.70)). The initial demand for investment commodity  $i$  ( $IZ_i$ ) and the changes in inventories of commodity  $i$  ( $SVZ_i$ ) are provided in the SAM. The benchmark value of total savings ( $SZ$ ) is given by:

$$SZ = SHZ + SFZ + SGCZ + GFCFGZ \cdot PIZ - SWZ \cdot ERZ + \sum_i DEPZ_i \cdot PIZ \quad (6.35)$$

where initial levels of households savings ( $SHZ$ ), firms savings ( $SFZ$ ), foreign savings ( $SWZ$ ) and depreciation ( $DEPZ_i$ ) are all provided in the SAM. As already explained in section 6.4.3 government capital expenditures ( $GFCFGZ$ ) have been taken from the national accounts (National Institute of Statistics, 2003). The total of capital expenditures and the conventional budget deficit of the government sector ( $SGCZ$ ) represent the government savings, given in the SAM. Thus, in the demand equation for investment commodities (see chapter 4, equation (4.73)) the parameter that must be calibrated is the marginal budget share ( $\alpha I_i$ ), which is equal to:

$$\alpha I_i = (IZ_i \cdot PZ_i + VATINVZ_i) / (SZ - \sum_j SVZ_j \cdot PZ_j) \quad (6.36)$$

where  $VATINVZ_i$  are the value-added taxes on investment commodity  $i$  given in the SAM and the benchmark price of commodity  $i$  ( $PZ_i$ ) is equal to one. In this case, the SAM provides all data needed to calibrate the parameters of the investment demand equations.

The benchmark price of composite investment commodity  $PIZ$  is further computed (see chapter 4, equation (4.71)) as:

$$PIZ = \prod_i [PZ_i \cdot (1 + vatinv_i) / \alpha I_i]^{\alpha I_i} \quad (6.37)$$

and the inventory investment ratio ( $svr_i$ ) is derived as the ratio of initial changes in inventories for commodity  $i$  to domestic sales of commodity  $i$ .

### 6.4.6. Calibration of the labor market

The benchmark unemployment value ( $UNEMPZ$ ), expressed in number of unemployed, as well as the labor supply to the non-resident firms ( $LWZ$ ), expressed in number of employed persons, are taken from labor surveys (National Institute of Statistics, 2001).

Rigidities in the labor market are introduced in the model by using a wage curve:

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$$(PL/INDEX)/(PLZ/INDEXZ)-1 = \beta \cdot [(UNEMP/LSR)/(UNEMPZ/LSRZ)-1] \quad (6.38)$$

where  $PLZ$  is the economy-wide average wage rate in the benchmark year,  $INDEXZ$  is the consumer price index in the benchmark year,  $LSRZ$  is the labor supply in the benchmark year and  $\beta$  is a parameter. All the benchmark values for labor supply and unemployment have been taken from labor surveys (National Institute of Statistics, 2001). The initial value of the consumer price index has been set to one. The value for parameter  $\beta$  has been taken from an econometric estimate of Ciupagea (2000), and has been fixed at -1.88, while the real wage elasticity of labor supply in the labor supply curve (see chapter 4, equation (4.81)) has been fixed at 0.15.

### 6.4.7. Calibration of the dynamic part of the model

Sectoral data on capital stock and depreciation are not available in the Romanian national accounts. Only their values by institutional sectors are provided (National Institute of Statistics, 2003). The derivation of the depreciation by sector has been presented in chapter 5, together with the construction of the SAM. In the initial stage, to allocate the total capital stock between sectors, the same rental rate of capital services ( $RK_{ng}$ ) has been assumed for all the sectors except for the public administration sector:

$$KSKZ_{ng} = \left[ (KZ_{ng} + DEPZ_{ng}) / \sum_{ngg} (KZ_{ngg} + DEPZ_{ngg}) \right] \cdot KTZ \quad (6.39)$$

where  $KSKZ_{ng}$  is the capital stock for sector  $ng$  in the benchmark year,  $KZ_{ng}$  is the capital service for sector  $ng$ , taken from the SAM,  $DEPZ_{ng}$  is the sectoral depreciation, and  $KTZ$  is the total capital stock (excluding government capital stock), according to National Institute of Statistics. Further, the depreciation rate by sector ( $d_{ng}$ ) has been derived as the ratio of depreciation for sector  $ng$  to the capital stock for sector  $ng$ <sup>84</sup>. The capital stock of the government sector (seen as institutional sector) has been considered as the capital stock of the public administration sector (see chapter 4, equation (4.110)).

To calibrate the investment carried out in sector  $ng$  (see chapter 4, equation (4.109)) some other parameters are needed. Thus, following Dixon and Rimmer (2002) the minimum possible growth rate of capital in sector  $ng$  is set at the negative of the rate of depreciation in sector  $ng$ , while the maximum rate in order to avoid unrealistically large simulated growth rates is made equal to the historically normal growth rate of the sector plus 0.06. Parameter  $B_{ng}$  which reflects the sensitivity of capital growth in sector  $ng$  to variations in its equilibrium expected rate of return is set to one (Dixon and Rimmer, 2002).

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<sup>84</sup> For exposition purposes, in the summations the subscript  $ng$  is replaced by  $ngg$ .

An average growth rate ( $g$ ) of 5 percent is used to update the time-dependent exogenous variables in the baseline, according to the Romanian Government's estimates (Romanian Government, 2004). Furthermore, the time preference rate (see chapter 4, equation (4.118)) is set equal to the benchmark value of the average real net rate of return following Ballard, Fullerton, Shoven and Whalley (1985).

### 6.5. Conclusions

The calibration method has become a standard procedure for deriving the parameters of a CGE model. The relative simplicity of this method, which provides an estimate for the parameters for one point in time, makes it very appealing. Furthermore, the poor quality of data and the frequent structural changes in transition countries rarely allow an alternative approach.

The short series of data for the Romanian economy, the structural breaks and the change in the methodology for computing the national accounts have been among the main reasons for choosing the calibration approach. Because CES and LES functions are used in the CGE model, exogenously specified elasticities values are also required. Their values are usually based on estimates obtained from the literature. Unfortunately, the lack of econometric estimates for the Romanian economy forced us to adopt elasticity values estimated for other countries or based on outright guesses. This aspect reflects one of the weaknesses of the calibration method emphasized by the econometric critique. Thus, we should be aware of the limited reliability of the policy simulations. One way to assess the robustness of the results of the policy simulations with respect to the choice of the elasticity values is to apply uncertainty and sensitivity analysis. The results of such an uncertainty and sensitivity analysis are presented in chapter 7 together with the results of the policy simulations.



# Chapter 7

## Policy simulations

### 7.1. Introduction

Tax harmonization with the EU requirements and the restructuring of public expenditures are important steps in the preparation for the EU accession, as already discussed in chapter 2. Therefore, an evaluation of the macro and sectoral effects of implementing such types of policy measures can prove to be useful for policymakers. So far, only the Dobrescu macro-model and the Romanian version of the RMSM-X have been used to estimate such effects. The Dobrescu macro-model is a macro-econometric model for the Romania economy developed at the Institute of Economic Forecasting. RMSM-X stands for Revised Minimum Standard Model – Extended. It is a flow of funds model which incorporates the features of a two gap model. RMSM-X has been developed at the World Bank. The purpose of these models is to monitor stabilization and structural adjustment measures, and to analyze development strategies and the sustainability of macro-economic policies. Their results have been used to develop the Pre-accession economic programs. However, neither of these models is able to provide detailed sectoral results as they only account for four main sectors: agriculture, forestry and fishing; manufacturing; construction and services. The model presented in this study goes into much more detail, however. Thus, the effects of the policy measures examined in this chapter will appear to have entirely different effects on the various sectors. Therefore more detailed sectoral estimates have an added value for policymakers.

This chapter uses the RoMod model to provide a comprehensive analysis of the possible effects of some of the policy measures already implemented or envisaged by the government in the 2003 Pre-accession program (Romanian Government, 2004)<sup>85</sup>. It further explains the mechanisms through which these measures affect

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<sup>85</sup> Because of the general elections in 2004, the 2004 Pre-accession economic program has been submitted twice: once in November 2004 and again by the new government, that took office in December 2004, at the end of February 2005. The official position of the European Commission with regard to the 2004 Pre-

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different economic agents, like households, firms and the government. The households' welfare gains or losses are assessed for each of the policy measures in terms of equivalent variation in income.

The chapter is organized as follows. First, a baseline scenario is defined in section 7.2 for the dynamic part of the model. The baseline scenario is further used as the benchmark equilibrium and all results are reported in relation to this scenario. Then, five main policy scenarios aiming for tax harmonization or public expenditures restructuring are discussed in section 7.3, underlining their budgetary and welfare effects. As already pointed out in chapter 6, the values selected for some exogenous parameters in the calibration process (mainly elasticities of substitution or transformation) are crucial in determining the outcomes of the policy simulations. Therefore, in section 7.4 we present uncertainty and sensitivity analysis results, followed by concluding remarks in section 7.5.

### 7.2. Baseline scenario

To assess the economic impact of a policy measure “the world with the policy measure” (the counterfactual equilibrium/policy scenario) should be compared with “the world without the policy measure” (the benchmark equilibrium/baseline scenario). An evaluation of the economic effects of implementing the policy measure is given by the difference between the two scenarios, and reflects changes in prices and quantities, factors employed by the production sectors, households' and firms' income, primary and conventional budget balance, domestic and foreign government debt and other macroeconomic and sectoral effects. The baseline scenario can have a great influence on the quantification and the interpretation of the policy simulation results. Therefore, it is important to provide well-defined and justifiable assumptions regarding the baseline scenario. The hypothesis should also be appropriate to the questions the analysis is intended to address, i.e. fiscal policy measures.

RoMod has a recursive dynamic structure. To develop the baseline scenario for such a model, two steps should to be considered:

- The first step implies a set of underlying suppositions about how exogenous (fixed) variables in the model evolve over the simulation horizon. This step requires updating time-dependent variables to account for different economic developments at the macro and sectoral levels, changes in tastes or technology.
- The second step consists in using these assumptions to construct the baseline projections about the endogenous variables.

One choice would be to define the steady-state growth path of the economy as being the baseline scenario. In this case, all economic variables and all sectors of the economy are presumed to grow with the same rate, which implies that the structure

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accession program was released just before the present study was completed. Therefore, the policy simulations presented in this chapter focus on the 2003 Pre-accession program.

of the economy remains unchanged compared to 2000<sup>86</sup>. Alternatively, a baseline scenario could allow for a different evolution of the economic variables at the macro and sectoral levels. In this case, the economy will no longer be on the steady-state growth path in the short-run.

While the latter type of baseline scenario would be more suitable to reflect the structural changes that occur in a transition economy like Romania, it is also more difficult to construct, as it requires a large quantity of macro and sectoral data about the future. As already mentioned, the only projections available at this stage are published by the Romanian Government in the Pre-accession program<sup>87</sup>. First, these projections are not detailed enough to allow the construction of a baseline scenario for a disaggregated model like RoMod. Furthermore, the projections presented by the government use different methodologies. While the Social Accounting Matrix for Romania<sup>88</sup> is built using the ESA 95 methodology, the projections are based on either the ESA 95 methodology or the internal methodology of the Ministry of Finance. For example, the structure of the government consolidated budget is presented in the 2003 Pre-accession program (Romanian Government, 2004) on a cash basis (using the Ministry of Finance methodology) while the representation of the taxes in the SAM is given on an accrual basis. Using these projections to build the baseline scenario for RoMod would bias the results.

Thus, in order to keep the analysis transparent and unbiased, the steady-state growth path has been chosen as a baseline scenario for RoMod. An average growth rate of 5 percent is used to update the time-dependent exogenous variables between 2000-2006, according to the Romanian Government's estimates (Romanian Government, 2004)<sup>89</sup>. This assumption implies that the structure of the economy does not change compared to 2000. Thus, the structure of the government consolidated budget (given as percent of GDP) also remains the same during 2000-2006 in the baseline scenario. The results of each of the policy scenarios are then presented as percentage changes compared to the baseline scenario.

### 7.3. Policy scenarios

In this section we analyze the economic impact of five policy scenarios, using RoMod. The first two are: the elimination of the VAT exemptions and the application of EU oriented VAT rates to certain goods and services, in accordance with the Annex H of the Sixth Council Directive (77/388/EEC); and the increase in the excise duties on mineral oils. Both aim at tax harmonization as stipulated in Chapter 10 on Taxation of the "*Acquis Communautaire*". These two scenarios are

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<sup>86</sup> 2000 is the benchmark year for the database.

<sup>87</sup> The prognosis has been elaborated using both the Romanian version of the RMSM-X, which is used by the Ministry of Development and Prognosis and National Bank of Romania, and the Dobrescu macro-model for the Romanian economy.

<sup>88</sup> The SAM represents the database for RoMod.

<sup>89</sup> The baseline is extended in the same way up to 2030 (the moment the economy is assumed to return to the steady-state growth path after the policy shock) in order to estimate the long-run welfare gains or losses for the households.

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set up in two alternative ways. First, the conventional budget deficit is allowed to adjust given the increase in revenues. Second, the additional revenues are recycled through a cut in the social security contributions rate, thus keeping the deficit to GDP ratio constant.

The next two scenarios, the elimination of direct subsidies supporting public passenger transport, and the shift of public expenditures from current to capital expenditures intend to capture the restructuring of the budgetary expenditures.

The fifth scenario aims at answering two questions: what is the overall effect of the tax harmonization and the public expenditures restructuring measures as presented in the first four scenarios, and by how much can the social security contributions rate be reduced by 2006, when the conventional budget deficit to GDP ratio is kept constant at a level of 3.6 percent, starting with 2003. The detailed results of all five scenarios are given in appendix 7.A.

It should be emphasized that no assumption has been made with regard to the efficiency improvement at the firm level induced by the policy measures. Thus, the restructuring effect of the unprofitable enterprises, stimulated by the policy measures, is ignored.

### **7.3.1. The elimination of the VAT exemptions and the application of EU oriented VAT rates to certain commodities and services**

The Romanian legislation on VAT is mostly harmonized with the Sixth Council Directive (77/388/EEC). The new Fiscal Code<sup>90</sup> enforced in 2004 further eliminates the exemptions on:

- Supply of books, other than material wholly or substantially devoted to advertising matter;
- Admissions to shows, theatres, circuses, fairs, museums, zoos, exhibitions and similar cultural events and facilities;
- Medical equipment, aids and other appliances normally intended to alleviate or treat disability, for the exclusive personal use of the disabled, including the repair of such goods;

and introduces a reduced rate of VAT of 9 percent on these commodities and services, in accordance with the Annex H of the Sixth Council Directive. The elimination of the VAT exemptions is also envisaged for programs produced and transmitted by the radio and TV channels (including cable TV companies) other than the national ones, and for the sales of films and program licences, subscriptions to the international news agencies and other rights of distribution destined to the radio and TV activities (Romanian Government, 2004). The elimination of exemptions aims at avoiding distortions of competition and harmonizing the taxable base by applying the Community rate to taxable transactions (77/388/EEC).

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<sup>90</sup> Law no.571/23 December 2003 regarding the Fiscal Code.

The reduced rate of VAT of 9 percent also replaces the statutory rate of 19 percent for:

- Newspapers and periodicals, other than material wholly or substantially devoted to advertising matter;
- Pharmaceutical products of a kind normally used for health care, prevention of diseases and treatment for medical and veterinary purposes;
- Accommodation provided by hotels and similar establishments and the letting of camping sites and caravan parks;

as of 2004. The application of the reduced VAT rate is generally based on the argument that it affects prices and increases competitiveness. In the labor-intensive sectors it can further stimulate employment.

The VAT reform implemented in 2004 as well as the elimination of the exemptions envisaged by the government in the 2003 Pre-accession program (Romanian Government, 2004) are evaluated using RoMod within two simulations<sup>91</sup>. In the first simulation (non-neutral VAT scenario) the tax revenues and the government conventional deficit are allowed to adjust. The second simulation (neutral VAT scenario) is made revenue neutral compared to the baseline by modifying the social security contributions rate starting with 2004. The conventional budget deficit is therefore kept constant as a share of GDP.

As already pointed out in chapter 4, RoMod does not take into account the statutory tax rates but the average effective ones. Therefore, a first step would be to estimate the changes in the effective VAT rates induced by the VAT reform. The difficulty consists in the lack of information on the taxable base. In this stage, the only estimate of the VAT base is produced by the National Institute of Statistics with a three years lag. Furthermore, it is not possible to track the products subject to a reduced VAT rate in great detail. As a consequence, the elimination of the exemption for the medical equipment and other appliances normally intended to alleviate or treat disability has not been considered in the two simulations. Therefore, the impact of the policy measure might be slightly underestimated. The average effective VAT rates in the baseline and the estimated rates used in the policy simulations are given in table 7.1.

**Table 7.1. Average effective VAT rates in the baseline and the policy simulations (%)**

Commodities	Average effective VAT rates			
	Baseline	2004	2005	2006
<b>Average effective VAT rates on household's consumption</b>				
Manufacture of publishing and printing (sec9)	0.67%	7.07%	7.07%	7.07%
Manufacture of pharmaceutical products and cosmetics (sec11)	7.82%	5.75%	5.75%	5.75%
Hotels and restaurants; activities of traveling agencies (sec23)	6.56%	5.55%	5.55%	5.55%
Other community, social and personal service activities (sec35)	2.25%	7.07%	7.07%	7.07%

Source: National Institute of Statistics and own estimates.

<sup>91</sup> The detailed results of the policy simulations are presented in appendix A.7, tables A.7.1-A.7.14.

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**Table 7.1. Average effective VAT rates in the baseline and the policy simulations (%) (continued)**

Commodities	Average effective VAT rates			
	Baseline	2004	2005	2006
<b>Average effective VAT rates on intermediate consumption</b>				
Manufacture of publishing and printing (sec9)	0.28%	2.99%	2.99%	2.99%
Manufacture of pharmaceutical products and cosmetics (sec11)	3.16%	2.33%	2.33%	2.33%
Hotels and restaurants; activities of traveling agencies (sec23)	2.67%	2.67%	2.67%	2.67%
Other community, social and personal service activities (sec35)	0.94%	2.99%	2.99%	2.99%
<b>Average effective VAT rates on government consumption</b>				
Manufacture of publishing and printing (sec9)	0.86%	9.00%	9.00%	9.00%
Manufacture of pharmaceutical products and cosmetics (sec11)	0.00%	0.00%	0.00%	0.00%
Hotels and restaurants; activities of traveling agencies (sec23)	0.00%	0.00%	0.00%	0.00%
Other community, social and personal service activities (sec35)	2.88%	9.00%	9.00%	9.00%

Source: National Institute of Statistics and own estimates.

### *Non-neutral VAT scenario*

The VAT reform has a direct effect on the costs and the prices. For the publishing and printing products (sec9) and other community services (sec35) the increase in the effective tax rates on private and public consumption augments the share of indirect taxation in consumer prices. Thus, the consumer prices including taxes rise by about 6.5 percent for publishing and printing (sec9) and by 4.6 percent for the other community services (sec35) compared to the baseline, pressuring down consumer prices net of taxes. The decline in private and public consumption triggers a downwards shift in the output price for the community services, and a fall in the profitability of both sectors<sup>92</sup> (see table 7.2).

Output supply of both sectors falls followed by a decline in employment, capital and energy demand. For the publishing and printing sector (sec9), the high share of inputs originating from the same sector (about 25 percent of the gross output) combined with the rise in the VAT rate on intermediate consumption outweighs the adjustment pressure on the consumer price and the output price goes up, inducing a rise in the consumer price net of taxes (see table 7.2).

The relative increase of the domestic prices relative to the world prices for the publishing and printing products and other community services makes supply on the domestic market more attractive and export supply of the two sectors diminish. Imports decline due to the lower domestic demand (see table 7.2). Furthermore, the rise in the non-deductible VAT on intermediate consumption for both publishing and printing (sec9) and other community services (sec35) produces an upward shift in the cost curves for the financial intermediation (sec29), other business activities (sec31) and public administration (sec32) sectors.

The reduction in the effective tax rates on private consumption for pharmaceutical products (sec11) and hotels services (sec23) lowers the share of indirect taxation in the consumer prices gross of taxes and induces an augmentation of private consumption. The profitability of both sectors improves. The gross output rises,

<sup>92</sup> Profitability is expressed here in terms of rental rate of capital.

stimulating job-creation and mounting the demand for capital and energy in the sectors (see table 7.3). The mechanism implies that increased production is covered by hiring new staff and not by rising productivity. The enhancement of domestic sales for pharmaceutical products (sec11) induces a slight rise in output price. The decline in trade and transportation costs offsets the upward shift in the cost curve of this sector and the price of domestic deliveries (including trade and transportation margins) drops producing an adjustment in the consumer price net of taxes.

**Table 7.2. Effects of the VAT reform on the publishing and printing sector and on other community, social and personal service activities**

Sectoral results	Non-neutral scenario			Neutral scenario		
	2004	2005	2006	2004	2005	2006
<b>Manufacture of publishing and printing (sec9)</b>						
Consumer price gross of taxes	6.44	6.47	6.49	6.38	6.41	6.43
Consumer price net of taxes	0.08	0.10	0.13	0.02	0.05	0.07
Rental rate of capital net of taxes	-2.93	-2.82	-2.73	-2.77	-2.63	-2.50
Price of gross output	0.12	0.15	0.18	0.07	0.10	0.13
Price of domestic deliveries (including trade and transportation margins)	0.09	0.12	0.15	0.04	0.07	0.10
Price of domestic deliveries (excluding trade and transportation margins)	0.12	0.15	0.18	0.07	0.11	0.14
Private consumption	-2.06	-2.05	-2.04	-1.84	-1.85	-1.86
Public consumption	-7.57	-7.58	-7.58	-7.51	-7.53	-7.56
Domestic sales	-0.93	-0.92	-0.91	-0.81	-0.82	-0.83
Gross output	-0.95	-0.95	-0.94	-0.85	-0.86	-0.87
Employment	-1.72	-1.70	-1.67	-1.53	-1.51	-1.48
Demand for capital-energy bundle	-0.19	-0.21	-0.23	-0.17	-0.22	-0.27
Investments carried out in the sector	0.00	-0.56	-0.52	0.00	-1.21	-1.21
Exports	-1.14	-1.17	-1.19	-1.13	-1.17	-1.22
Imports	-0.74	-0.70	-0.67	-0.54	-0.52	-0.49
<b>Other community, social and personal service activities (sec35)</b>						
Consumer price gross of taxes	4.54	4.57	4.61	4.47	4.50	4.53
Consumer price net of taxes	-0.17	-0.14	-0.11	-0.24	-0.21	-0.18
Rental rate of capital net of taxes	-4.24	-4.06	-3.90	-4.13	-3.93	-3.73
Price of gross output	-0.18	-0.14	-0.11	-0.24	-0.21	-0.18
Price of domestic deliveries (including trade and transportation margins)	-0.18	-0.14	-0.11	-0.24	-0.21	-0.18
Price of domestic deliveries (excluding trade and transportation margins)	-0.18	-0.14	-0.11	-0.24	-0.21	-0.18
Private consumption	-1.47	-1.46	-1.46	-1.25	-1.26	-1.27
Public consumption	-5.49	-5.50	-5.51	-5.41	-5.43	-5.46
Domestic sales	-1.48	-1.47	-1.47	-1.39	-1.40	-1.41
Gross output	-1.46	-1.46	-1.46	-1.38	-1.39	-1.40
Employment	-1.84	-1.82	-1.81	-1.73	-1.72	-1.72
Demand for capital-energy bundle	-0.80	-0.82	-0.84	-0.76	-0.81	-0.85
Investments carried out in the sector	0.00	-1.16	-1.12	0.00	-1.84	-1.84
Exports	-1.19	-1.26	-1.32	-1.22	-1.29	-1.36
Imports	-1.83	-1.74	-1.65	-1.60	-1.53	-1.46

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

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The fall in the real wage rate and the higher contribution of labor to value added (about 38 percent) for the hotels services (sec23) reverse the effect on the output price for this sector (see table 7.3). The export revenues increase for both sectors. The most notable effect of the decline in the average effective VAT rate on intermediate consumption for pharmaceutical products (sec11) resides in the downward shift in the cost curve for the health and social work sector (sec34). Pharmaceutical products represent about 22.2 percent out of the material inputs used by the health and social work sector (sec34).

**Table 7.3. Effects of the VAT reform on pharmaceutical products and hotels and restaurants; activities of travel agencies**

Sectoral results	Non-neutral scenario			Neutral scenario		
	2004	2005	2006	2004	2005	2006
<b>Manufacture of pharmaceutical products and cosmetics (sec11)</b>						
Consumer price gross of taxes	-1.96	-1.96	-1.96	-2.03	-2.04	-2.04
Consumer price net of taxes	-0.04	-0.04	-0.04	-0.12	-0.12	-0.12
Rental rate of capital net of taxes	0.53	0.48	0.42	0.69	0.66	0.63
Price of gross output	0.01	0.00	-0.01	-0.02	-0.03	-0.04
Price of domestic deliveries (including trade and transportation margins)	-0.01	-0.02	-0.03	-0.06	-0.06	-0.07
Price of domestic deliveries (excluding trade and transportation margins)	0.01	0.00	-0.01	-0.02	-0.02	-0.03
Private consumption	0.44	0.45	0.47	0.68	0.68	0.68
Domestic sales	0.25	0.27	0.28	0.42	0.42	0.42
Gross output	0.19	0.22	0.25	0.27	0.28	0.29
Employment	0.43	0.43	0.44	0.61	0.61	0.62
Demand for capital-energy bundle	0.08	0.12	0.17	0.11	0.13	0.14
Investments carried out in the sector	0.00	1.04	1.09	0.00	0.38	0.39
Exports	0.17	0.21	0.25	0.19	0.21	0.22
Imports	0.30	0.31	0.31	0.54	0.53	0.52
<b>Hotels and restaurants; activities of travel agencies (sec23)</b>						
Consumer price gross of taxes	-0.97	-0.98	-0.98	-0.97	-0.98	-0.98
Consumer price net of taxes	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
Rental rate of capital net of taxes	0.05	0.01	-0.02	0.23	0.22	0.20
Price of gross output	-0.03	-0.03	-0.03	-0.02	-0.02	-0.03
Price of domestic deliveries (including trade and transportation margins)	-0.02	-0.03	-0.03	-0.01	-0.01	-0.02
Price of domestic deliveries (excluding trade and transportation margins)	-0.02	-0.03	-0.03	-0.01	-0.01	-0.02
Private consumption	0.11	0.13	0.15	0.31	0.31	0.31
Domestic sales	0.08	0.10	0.12	0.23	0.23	0.23
Gross output	0.08	0.10	0.11	0.20	0.21	0.21
Employment	0.16	0.16	0.16	0.42	0.42	0.41
Demand for capital-energy bundle	0.02	0.05	0.09	0.06	0.07	0.07
Investments carried out in the sector	0.00	0.82	0.86	0.00	0.17	0.17
Exports	0.05	0.08	0.11	0.08	0.09	0.10
Imports	0.12	0.12	0.13	0.43	0.43	0.42

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

The overall rise in unemployment and the decline in the real wage rate have a negative impact on the households' income and savings (see table 7.4). Consequently, total private consumption diminishes. The overall decline in the firms' profitability results in changes in income distribution. Firms' income and savings decline in favor of government revenues (see table 7.4).

**Table 7.4. Macroeconomic effects of the VAT reform (% changes compared to the baseline)**

Macroeconomic results	Non-neutral scenario			Neutral scenario		
	2004	2005	2006	2004	2005	2006
GDP at constant prices	-0.04	-0.02	0.00	-0.02	-0.02	-0.02
Private consumption	-0.15	-0.13	-0.11	0.03	0.03	0.03
Labor supply	-0.01	-0.01	0.00	0.04	0.04	0.04
Unemployment	0.03	0.02	0.01	-0.12	-0.12	-0.12
<b>Households</b>						
Households' income	-0.22	-0.21	-0.20	0.03	0.03	0.03
Households' savings	-0.22	-0.21	-0.20	0.02	0.02	0.02
<b>Firms</b>						
Firms income	-0.30	-0.30	-0.29	-0.17	-0.17	-0.17
Firms savings	-0.36	-0.36	-0.35	-0.21	-0.21	-0.21
<b>Government</b>						
Total government revenues	0.40	0.42	0.44	-0.03	-0.03	-0.03
Total government expenditures	-0.09	-0.08	-0.08	-0.03	-0.03	-0.03
Government transfers to households	-0.12	-0.12	-0.13	-0.01	-0.01	-0.01
Interest payments	-0.32	-0.34	-0.36	-0.19	-0.19	-0.19
Primary budget surplus	18.18	18.67	19.17	-0.92	-0.92	-0.92
Conventional budget deficit	-4.57	-4.70	-4.84	-0.02	-0.02	-0.02
Foreign debt	-0.69	-0.71	-0.72	-0.15	-0.15	-0.15
Domestic debt	-0.96	-0.99	-1.02	0.00	0.00	0.00
Total debt	-0.80	-0.82	-0.84	-0.09	-0.09	-0.09
<b>Savings/Investment</b>						
National savings	0.64	0.68	0.71	-0.20	-0.20	-0.20
Total investment	0.62	0.66	0.69	-0.02	-0.02	-0.02
<b>Current account</b>						
Total exports	0.08	0.11	0.13	0.01	0.01	0.01
Total imports	0.06	0.08	0.10	0.02	0.02	0.01
<b>Prices</b>						
Exchange rate	-0.05	-0.05	-0.04	-0.17	-0.17	-0.17
Real interest rate	-0.34	-0.37	-0.39	-0.19	-0.19	-0.19
Average wage rate	-0.16	-0.14	-0.11	0.27	0.28	0.28
Equivalent variation (billions ROL)	-993	-928	-853	193	207	220
Change in the social security contributions rate	0.00	0.00	0.00	-2.21	-2.21	-2.22

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

The growth in the VAT revenues represents about 0.23 percent of GDP at current market prices in 2005 compared to the baseline. As a result, the primary budget surplus improves with positive effects on the conventional budget deficit, interest payments and the public debt (see table 7.4). The 4.7 percent drop in the conventional budget deficit compared to the baseline in 2005 is equivalent to 0.19 percent of GDP at current market prices.

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Total savings, defined as the change in the national wealth, expand due to the reduction of the government deficit (see table 7.4). The higher supply of loanable funds, i.e. savings, boosts investment incentives in all sectors except for manufacture of publishing and printing (sec9) and other community, social and personal service activities (sec35).

The equivalent variation in income expressed in terms of billions ROL over a one-year period, reflects household's welfare losses during 2004-2006. However, in the long-run the non-neutral VAT reform leads to a slight efficiency gain of 9,271 billions of 2000 ROL (which represents about 0.07 percent of the present value of households' income), expressed as the present value of the equivalent variation. The reason is the rise in the investments which reverses the negative impact on firms' profitability in the long-run. As a consequence, household's capital income grows, resulting in welfare gains.

### *Neutral VAT scenario*

Using the additional government revenues to reduce the social security contributions has positive effects in terms of welfare, by reducing the labor tax distortion (see table 7.4). As already discussed in chapter 2, statutory social security contributions paid by employers are differentiated according to the work conditions. In the neutral VAT scenario all contribution rates are cut by about 2.21 to 2.22 percent during 2004-2006 compared to the baseline, from 35 to 34.2 percent for normal work conditions, from 40 to 39.1 percent for particular conditions and from 45 to 44 percent for special work conditions. The decline in the social contribution rates has direct beneficial effects on labor intensive sectors like services and on sectors with particular and special work conditions, like oil sector (sec3), natural gas sector (sec4) and transport via railways (sec24). Overall, employment and the real wage rate increase. Furthermore, the profitability of labor intensive sectors and of sectors with particular and special work conditions improves compared to the non-neutral VAT scenario.

The increase in the households' labor and capital income limits the decline in private consumption of publishing and printing materials (sec9) and community, social and personal services (sec35). It further enhances the domestic sales and the output of pharmaceutical products (sec11) and hotels services (sec23), compared to the non-neutral scenario (see tables 7.2-7.3).

Even though the deficit ratio is kept constant starting with 2004, GDP retrenchment generates a slight fall in the deficit. In budgetary terms the cut in social security contributions represents about 0.2 percent of GDP at current market prices in 2005. Thus, the position of the primary budget balance worsens to some extent (see table 7.4). The fall in firms' savings outweighs the positive effects on household's savings and results in an overall investment decline.

The reduction of the social security contributions reverses the short-run negative impact of the measure on household's welfare (see table 7.4). However, it results in lower long-run efficiency gains compared to the non-neutral scenario (2,491 in billions of 2000 ROL, equivalent to 0.02 percent of the present value of households'

income). The reason is the slight decline in investments which affects firms' profitability in the long-run and thus household's capital income.

### 7.3.2. Increase in excise duties on mineral oils

Romania has accepted the gradual alignment of excise duties for all harmonized commodities according to the schedule stipulated in Chapter 10 on Taxation of the "Acquis Communautaire". For mineral oils, the minimum excise duties levels provided in Directive 92/82/EEC should be implemented by 31 December 2006. The minimum excise duties (in EUR/ton) adopted by the Council on 19/10/1992 (Directive 92/82/EEC) are given in table 7.5.

**Table 7.5. Statutory excise duties on mineral oils during 2000-2004 and some estimates for 2005-2006**

Excise duty on mineral oils (EUR/ton)	2000	2001	2002		2003		2004		2005		2006		EU*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
<b>Petrol</b>													
Leaded	270	270	290	319.6	404	404	404	414	414	424	424	438	438
Unleaded	220	220	235	262.6	347	347	347	353	353	363	363	373	373
<b>Gas oil</b>													
Used as propellant	105	105	115	115	187	221	221	245	245	263	263	285	285
Used for ind./comm. purposes	105	105	115	115	187	221	221	245	245	263	263	285	21
Used for heating purposes	105	105	115	115	187	221	221	245	245	263	263	285	21
<b>LPG and methane</b>													
Used as propellant	0	0	100	100	100	100	100	100	100	100	100	100	100
Used for ind./comm. purposes	0	0	100	100	100	100	100	100	100	100	100	100	36
Used for heating purposes	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Heavy fuel oil</b>	0	0	0	0	0	0	0	0	0	3.3	3.3	6.5	13
<b>Kerosene</b>													
Used as propellant	0	0	290	319.6	404	404	404	414	414	424	424	438	318
Used for ind./comm. purposes	0	0	290	319.6	404	404	404	414	414	424	424	438	23
Used for heating purposes	0	0	290	319.6	404	404	404	414	414	424	424	438	0

Note: The data provided in the table is based on the legislation<sup>93</sup>, data provided by the Ministry of Integration (columns 9-12) and own estimates (for the heavy fuel oil for 2005-2006). Excise duties in column (3) are enforced on 1<sup>st</sup> of January 2002, while the one in column (4) are enforced on 1<sup>st</sup> of August 2002. Excises duties in column (5) are enforced on 22<sup>nd</sup> of January 2003 and the one in column (6) are enforced on 1<sup>st</sup> of July 2003. Excise levels in column (7) are enforced on 1<sup>st</sup> of January 2004. Finally, excise levels in column (8) are enforced on 1<sup>st</sup> of July 2004.

\* Minimum excise duties adopted by The Council on 19-10-1992 (Directive 92/82/EEC).

Excise duties on mineral oils have been raised several times, starting with 2000 (see table 7.5). For LPG, methane and kerosene Romania already meets the requirements established for 2006. For the period 2005-2006, it is envisaged that the excise duties on petrol, gas oil and heavy fuel oil will be raised in order to meet the minimum requirements. The schedule for the harmonization of the excise duties on petrol and

<sup>93</sup>OG 27/2000 regarding the excise duties, enforced on 30<sup>th</sup> of January 2000; OUG 158/2001 regarding the excise duties enforced on 1<sup>st</sup> of January 2002; Law 523/2002 regarding the excise duties enforced on 1<sup>st</sup> of August 2002; OUG 3/2003 for the modification of the OUG 158/2001 regarding the excise duties and the enforcement of some measures meant to increase the collection of government revenues, enforced on 22<sup>nd</sup> of January 2003; OUG 57/2003 for the modification and completion of the OUG 158/2001 regarding the excise duties, enforced on 1<sup>st</sup> of July 2003; Law no.571/23 December 2003 regarding the Fiscal Code, enforced on 1<sup>st</sup> of January 2004; HG 977/2004 regarding the increase in the excise duties levels for some products, enforced on 1<sup>st</sup> of July 2004.

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gas oil have been provided by the Ministry of Integration. Although Romania already meets the requirement on kerosene excise duties will be further increased, following the same schedule as for the leaded petrol. For heavy fuel oil, no estimation is available. Therefore, it has been assumed that the excise duties on heavy fuel oil will be gradually raised by December 2006 (see table 7.5).

RoMod is used to simulate the harmonization of the excise duties on mineral oils during 2001-2006 within two scenarios<sup>94</sup>. In the first scenario (the non-neutral excise scenario) the conventional budget deficit is allowed to adjust, while in the second one (the neutral excise scenario) the conventional deficit adjusts during 2001-2002 while, starting with 2003, the additional revenues are recycled through a decrease in social security contributions so as to ensure budget neutrality. In the neutral excise scenario the start of the recycling of the additional revenues has been made to correspond to the moment the Romanian government actually started gradually decreasing social security contributions by a smaller amount. This approach helps to show by how much the social contributions could have been reduced by increasing the excises duties on mineral oils<sup>95</sup>. In this scenario the deficit ratio is kept constant at its 2002 level.

The average effective excise rates are used in RoMod instead of the statutory levels, because it is not possible to distinguish between the prices and the quantities of petroleum products used by the sectors in the production process. Starting with 2002, the changes in the estimated excise revenues, expressed in EUR, have been taken as a proxy for the change in the average effective excise rates. The excise revenues for 2001-2006 have been calculated such that consumption of mineral oils (expressed in tons) is kept unchanged compared to 2000. Total consumption of mineral oils in 2000 and the estimated excise revenues are given in table 7.6.

**Table 7.6. Consumption of mineral oils in 2000 and excise revenues during 2000-2006**

Excise revenues (EUR)	Total consumption 2000 (tons)	Excises 2000 (EUR)	Excises 2001 (EUR)	Excises 2002 (EUR)	Excises 2003 (EUR)	Excises 2004 (EUR)	Excises 2005 (EUR)	Excises 2006 (EUR)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Petrol</b>								
Leaded	911	246063	246063	275529	368183	372739	381853	392789
Unleaded	415	91224	91224	102213	143886	145130	148447	152594
<b>Gas oil</b>	2565	269325	269325	294975	523260	597645	651510	702810
<b>LPG and methane</b>	281			28100	28100	28100	28100	28100
<b>Heavy fuel oil</b>	803						1305	3915
<b>Kerosene</b>	615			185935	248460	251535	257685	265065
<b>Total</b>	<b>5590</b>	<b>606612</b>	<b>606612</b>	<b>886752</b>	<b>1311889</b>	<b>1395149</b>	<b>1468900</b>	<b>1545272</b>
Percentage change in excise revenues	-	-	0.00	46.18	47.94	6.35	5.29	5.20

Source: International Energy Agency and own estimates.

The average effective excise rates paid by producing sectors and consuming households for the use of mineral oils in the baseline are presented in table 7.7. As already explained, the rates used in the policy simulations (see table 7.7, columns

<sup>94</sup>The detailed results of the policy simulations are given in appendix 7.A, tables 7.A.15-7.A.28. Only the results for 2004-2006 are presented in the appendix. The results for 2001-2003 are available on request.

<sup>95</sup>See chapter 2 for a discussion of the changes in the social security contribution rates.

2-7) are estimated by applying the percentage change in excise revenues to the baseline tax rates levels, given that for most of the uses the excise levels are the same.

**Table 7.7. Average effective excise rates (%) on final and intermediate consumption**

Sectors		Baseline (1)	2001 (2)	2002 (3)	2003 (4)	2004 (5)	2005 (6)	2006 (7)
Agriculture, forestry and fishing	sec1	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Coal sector	sec2	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Oil sector	sec3	0.5	0.5	0.7	1.0	1.1	1.2	1.2
Natural gas sector	sec4	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Manufacture of food products and beverages; tobacco	sec5	21.0	21.0	30.8	45.5	48.4	50.9	53.6
Manufacture of textile and leather products	sec6	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Manufacture of wood and products of wood	sec7	21.0	21.0	30.8	45.5	48.4	50.9	53.6
Manufacture of paper and paper products	sec8	21.1	21.1	30.8	45.5	48.4	51.0	53.6
Manufacture of publishing and printing	sec9	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Manufacture of chemicals and chemical products	sec10	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Manufacture of pharmaceutical products and cosmetics	sec11	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Manufacture of rubber and plastic products	sec12	21.1	21.1	30.8	45.5	48.4	51.0	53.7
Manufacture of glass and glass products	sec13	21.1	21.1	30.8	45.5	48.4	51.0	53.7
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	21.1	21.1	30.8	45.5	48.4	51.0	53.6
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Manufacture of domestic appliances	sec17	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Manufacture of electrical and machinery and apparatus	sec18	21.1	21.1	30.8	45.5	48.4	51.0	53.7
Manufacture of transport equipment	sec19	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Electricity, gas and water supply	sec20	1.4	1.4	2.1	3.1	3.3	3.5	3.6
Construction	sec21	21.1	21.1	30.8	45.5	48.4	51.0	53.7
Wholesale and retail trade	sec22	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Hotels and restaurants; activities of travel agencies	sec23	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Transport via railways	sec24	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Other land transport; transport via pipelines	sec25	20.3	20.3	29.7	44.0	46.8	49.3	51.8
Water transport	sec26	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Air transport	sec27	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Post and telecommunications	sec28	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Financial intermediation	sec29	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Real estate activities	sec30	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Other business activities	sec31	20.6	20.6	30.1	44.5	47.3	49.8	52.4
Public administration and defence; compulsory social security	sec32	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Education	sec33	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Health and social work	sec34	21.1	21.1	30.8	45.6	48.4	51.0	53.7
Other community, social and personal service activities	sec35	21.1	21.1	30.8	45.6	48.4	51.0	53.7
<b>Households</b>		21.1	21.1	30.8	45.5	48.4	51.0	53.6

Source: National Institute of Statistics and own estimates.

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### *Non-neutral excise scenario*

The rise in the excise levels for mineral oils has a direct impact on the prices. The consumer price including taxes for petroleum products (sec3) increases by about 25 percent compared to the baseline, exerting downward pressure on the consumer price net of taxes. Private consumption of mineral oils declines triggering a fall in the output price and the profitability of the sector. Consequently, the sectoral gross output diminishes (see table 7.8). Employment, capital and energy demand of the sector also decrease. The strong decline in domestic sales results in a reduction of imports (about 9 percent during 2004-2006 compared to the baseline) and in a reorientation of the oil sector (sec3) towards exports.

Raising mineral oil taxes on intermediate consumption affects firms' input choice. It generates an upward shift in the cost curves of the production sectors and demand for petroleum products falls. The relative increase in the mineral oils price with respect to other factors of production induces a substitution effect in favor of capital and labor. Nevertheless, the decline in output triggers a downwards adjustment in capital and labor demand which outweighs the substitution effects. Thus, the share of capital income in value added declines in most of the sectors. Furthermore, unemployment rises and the real wage rate falls (see table 7.9).

**Table 7.8. Effects of changes in excises on mineral oils on the oil sector**

Sectoral results	Non-neutral scenario			Neutral scenario		
	2004	2005	2006	2004	2005	2006
<b>Oil sector (sec3)</b>						
Consumer price gross of taxes	20.91	22.91	24.98	20.47	22.39	24.37
Consumer price net of taxes	-1.39	-1.46	-1.54	-1.75	-1.88	-2.01
Rental rate of capital net of taxes	-9.46	-10.16	-10.86	-9.24	-9.83	-10.42
Price of gross output	-1.74	-1.83	-1.92	-2.11	-2.26	-2.41
Price of domestic deliveries (including trade and transportation margins)	-1.82	-1.92	-2.02	-2.16	-2.31	-2.46
Price of domestic deliveries (excluding trade and transportation margins)	-2.10	-2.21	-2.32	-2.44	-2.61	-2.78
Private consumption	-6.42	-6.86	-7.29	-5.74	-6.14	-6.53
Domestic sales	-4.86	-5.22	-5.58	-4.58	-4.96	-5.35
Gross output	-1.82	-1.94	-2.06	-1.58	-1.71	-1.85
Employment	-3.52	-3.83	-4.14	-3.21	-3.52	-3.84
Demand for capital-labor bundle	-2.06	-2.24	-2.43	-1.92	-2.15	-2.39
Investments carried out in the sector	-0.19	-0.11	-0.01	-2.29	-2.73	-3.12
Exports	2.44	2.56	2.69	2.30	2.30	2.29
Imports	-8.27	-8.83	-9.39	-7.86	-8.41	-8.97

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

The impact of the adjustment of excise duties on oil concentrates on 2003, when it causes an increase of revenues of 0.63 percent of GDP at current market prices. After 2004, the harmonization of excise duty levels has lower effects on government revenues (0.1 percent of GDP at current market prices in 2005 and 2006). The budget deficit drops by about 32 percent compared to the baseline, which is equivalent to about 1.29 percent of GDP at current market prices during 2004-2006

(see table 7.9). The retrenchment of the government deficit crowds in private investment and the real interest rate declines.

The equivalent variation, in terms of ROL over a one-year period, reflects the loss of households as a result of higher excise duties (see table 7.9). In the long-run, the measure generates welfare losses of 15,588 billions ROL, equivalent to 0.12 percent of the present value of households' income in 2000 prices (the present value of the equivalent variation over a 30 years horizon). The relative low magnitude of welfare losses in the long run are induced in this case by the increase in investments which increases the profitability of the firms in the long-run, and further affects households' capital income.

**Table 7.9. Macroeconomic effects of changes in excises on mineral oils (% changes compared to the baseline)**

Macroeconomic results	Non-neutral scenario			Neutral scenario		
	2004	2005	2006	2004	2005	2006
GDP at constant prices	-0.12	-0.05	0.02	-0.12	-0.11	-0.10
Private consumption	-1.18	-1.22	-1.26	-0.60	-0.61	-0.62
Labor supply	-0.13	-0.13	-0.12	0.06	0.08	0.10
Unemployment	0.35	0.34	0.32	-0.15	-0.21	-0.26
<b>Households</b>						
Households' income	-1.12	-1.16	-1.20	-0.26	-0.22	-0.18
Households' savings	-1.13	-1.17	-1.21	-0.30	-0.26	-0.23
<b>Firms</b>						
Firms income	-1.88	-2.03	-2.18	-1.41	-1.50	-1.61
Firms savings	-2.43	-2.62	-2.82	-1.88	-2.02	-2.16
<b>Government</b>						
Total government revenues	2.44	2.75	3.06	0.83	0.83	0.83
Total government expenditures	-0.38	-0.38	-0.38	-0.19	-0.19	-0.19
Government transfers to households	-0.33	-0.36	-0.40	0.07	0.10	0.13
Interest payments	-2.16	-2.44	-2.73	-1.63	-1.77	-1.91
Primary budget surplus	102.78	113.56	124.72	33.03	32.25	31.49
Conventional budget deficit	-26.24	-29.04	-31.96	-9.58	-9.57	-9.57
Foreign debt	-4.08	-4.48	-4.90	-2.09	-2.16	-2.23
Domestic debt	-5.52	-6.11	-6.72	-2.01	-2.01	-2.01
Total debt	-4.66	-5.14	-5.63	-2.06	-2.10	-2.14
<b>Savings/Investment</b>						
National savings	3.41	3.85	4.32	0.31	0.19	0.07
Total investment	3.30	3.73	4.17	0.91	0.88	0.84
<b>Current account</b>						
Total exports	-0.37	-0.31	-0.24	-0.70	-0.77	-0.83
Total imports	-0.32	-0.27	-0.22	-0.55	-0.60	-0.65
<b>Prices</b>						
Exchange rate	-0.44	-0.45	-0.45	-0.86	-0.94	-1.02
Real interest rate	-2.31	-2.61	-2.92	-1.69	-1.84	-1.98
Average wage rate	-0.81	-0.78	-0.75	0.68	0.86	1.03
Equivalent variation (billions ROL)	-7,836	-8,477	-9,138	-3,895	-4,090	-4,324
Change in the social security contributions rate	0.00	0.00	0.00	-7.88	-9.01	-10.16

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

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### *Neutral excise scenario*

Compared to the non-neutral scenario the recycling of additional government revenues by reducing social security contributions has positive effects in terms of welfare such as the employment and the real wage rate, by reducing the labor tax distortion (see table 7.9). The recycling of government revenues benefits to sectors with special and particular work conditions and to labor intensive sectors like services.

In the model the social security contribution rates decrease by about 9 percent in 2005, from 35 to 31.8 percent for normal work conditions, from 40 to 36.4 percent for particular work conditions and from 45 to 40.9 percent for special work conditions. The social contribution rates envisaged by the government in the 2003 Pre-accession program starting with 2005 are very close to these figures: 30.5 percent for normal work conditions, 35.5 percent for particular work conditions and 40.5 percent for special work conditions. Hence, the rise in excise duties would almost be sufficient to cover the loss in social security contributions revenues.

The households' losses from raising excise duties, in terms of equivalent variation over a one-year period, are more than halved compared to the non-neutral scenario during 2004-2006 (see table 7.9). However, the present value of the welfare losses over a 30 years horizon is higher (42,193 billions ROL, equivalent to 0.34 percent of the present value of households' income). As in the neutral VAT scenario, the higher long-run welfare losses are generated by lower investments which affect firms' profitability and households' capital income.

### **7.3.3. Elimination of direct subsidies on public passenger transport**

The subsidies to state-owned enterprises have either been channeled directly from the budget, or via the energy sector. In 2000 direct subsidies to enterprises represented around 1.3 percent of GDP (National Institute of Statistics, 2003). Roughly half of these subsidies were supporting public passenger transport, of which 85 percent for railways public transport. The problem resulting from the large amount of subsidization is that it allows unstructured and inefficient state owned enterprises (OECD, 2002) to survive. Thus, the elimination of direct subsidies is envisaged by the government in the 2003 Pre-accession program (Romanian Government, 2004).

We evaluate the effects of subsidy elimination to the public transport activities using RoMod. In this case only a non-neutral subsidy scenario is examined, where subsidies on transport activities are removed gradually during 2004-2006 and the conventional budget balance adjusts to account for the fall in expenditures. In reality it is unlikely that direct subsidies supporting public passenger transport would be totally eliminated by the end of 2006. However for the setup of the policy scenario it seems to be a natural benchmark. The average effective subsidy rates on the transport sectors, in the baseline and those used in the policy scenario, are given in table 7.10.

Only the results for railways and water transport are presented in this section as direct subsidies are particularly important for these sectors. The detailed results for

all sectors, including land transport and air transport, are given in appendix 7.A tables 7.A.29-7.A.42.

**Table 7.10. The average effective subsidy rates (%) for the transport activities in the baseline and policy scenario**

Sectors		Average effective subsidy rates			
		Baseline	2004	2005	2006
Transport via railways	sec24	16.7	11.1	3.7	0.0
Other land transport; transport via pipelines	sec25	0.9	0.6	0.2	0.0
Water transport	sec26	2.8	1.9	0.6	0.0
Air transport	sec27	1.4	0.9	0.3	0.0

Source: National Institute of Statistics and own estimates.

### *Non-neutral subsidy scenario*

The initial micro effect of the reduction in the direct subsidies to transport sectors is an upwards shift in the cost curves of these sectors and their output price. As a consequence of the increase in consumer prices for transport services private and public consumption fall. The output supply adjusts to the lower domestic demand triggering a decrease in employment, capital and energy use. Also the profitability rates of the railways transport (sec24) and water transport (sec26) sectors decline (see table 7.11).

On the one hand, the export supply diminishes due to the relative increase in the domestic prices compared to the world prices. On the other hand, foreign services become more interesting price-wise relative to domestic products so imports will rise. For the railways transport imports increase by about 15 percent in 2006 compared to the baseline (see table 7.11). Investments carried out in railways transport (sec24) and water transport (sec26) sectors fall due to the relative decline in the profit rate of these sectors compared to the other activities.

Cutting the subsidies has a negative impact on many activities by raising transport costs. Most affected are the manufacturing sectors due to their high share of transport services used in the production process (between 3 and 8 percent of their gross output). The increase in the production costs are reflected in higher consumer prices, which generate a contraction of the private consumption and a decline in the overall employment (see table 7.12).

Households' income and savings drop due to the fall in the real wage rate and the employment rate. As expected, the equivalent variation, in terms of ROL over a one-year period, shows households' welfare losses as a result of the elimination of direct subsidies supporting public passenger transport (see table 7.12). However, the present value of equivalent variation over a 30 years horizon indicates a gain in welfare of 9,915 billions ROL, equivalent to 0.08 percent of the present value of households' income. A rise in investments is the source of these long-run welfare gains (see below).

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**Table 7.11. Effects of subsidies elimination on railways transport and water transport sectors**

Sectoral results	Non-neutral scenario		
	2004	2005	2006
<b>Transport via railways (sec24)</b>			
Consumer price net of taxes	3.55	8.94	12.06
Rental rate of capital net of taxes	-4.26	-9.71	-12.08
Price of gross output	3.74	9.45	12.78
Price of domestic deliveries (including trade and transportation margins)	3.90	9.84	13.30
Price of domestic deliveries (excluding trade and transportation margins)	3.90	9.84	13.30
Private consumption	-1.14	-2.70	-3.50
Public consumption	-3.44	-8.22	-10.75
Domestic sales	-0.48	-1.14	-1.47
Gross output	-1.03	-2.48	-3.25
Employment	-2.08	-4.87	-6.22
Demand for capital-energy bundle	-0.48	-1.21	-1.65
Investments carried out in the sector	0.00	-1.27	-2.87
Exports	-3.14	-7.51	-9.83
Imports	4.38	11.13	15.10
<b>Water transport (sec26)</b>			
Consumer price net of taxes	0.13	0.33	0.45
Rental rate of capital net of taxes	-2.67	-6.20	-7.92
Price of gross output	0.13	0.33	0.45
Price of domestic deliveries (including trade and transportation margins)	0.20	0.49	0.67
Price of domestic deliveries (excluding trade and transportation margins)	0.20	0.49	0.67
Private consumption	-0.20	-0.49	-0.62
Public consumption	-0.14	-0.34	-0.44
Domestic sales	-0.06	-0.14	-0.17
Gross output	-0.41	-0.99	-1.33
Employment	-1.30	-3.08	-4.01
Demand for capital-energy bundle	-0.23	-0.58	-0.80
Investments carried out in the sector	0.00	-0.54	-1.22
Exports	-0.51	-1.25	-1.69
Imports	0.09	0.22	0.33

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

Government finances benefit from the cut in subsidies to the tune of 0.19 percent of GDP in 2004, 0.47 percent in 2005, and 0.61 percent of GDP in 2006 compared to the baseline. The reduction in the subsidies has a positive impact on the primary and conventional balance, causing a reduction in the total government debt (see table 7.12). Deficit retrenchment crowds in private investment and the real interest rate falls. Thus, investments in all sectors tend to go up except for the railways transport (sec24) and water transport (sec26).

**Table 7.12. Macroeconomic effects of subsidies elimination (% changes compared to the baseline)**

Macroeconomic results	Non-neutral scenario		
	2004	2005	2006
GDP at constant prices	-0.01	-0.01	0.01
Private consumption	-0.15	-0.35	-0.43
Labor supply	-0.01	-0.02	-0.03
Unemployment	0.03	0.07	0.07
<b>Households</b>			
Households' income	-0.18	-0.43	-0.54
Households' savings	-0.18	-0.43	-0.55
<b>Firms</b>			
Firms income	-0.31	-0.74	-0.97
Firms savings	-0.39	-0.94	-1.22
<b>Government</b>			
Total government revenues	-0.10	-0.22	-0.26
Total government expenditures	-0.53	-1.27	-1.65
Government transfers to households	-0.08	-0.20	-0.27
Interest payments	-0.32	-0.79	-1.06
Primary budget surplus	17.81	43.13	57.10
Conventional budget deficit	-4.48	-10.86	-14.40
Foreign debt	-0.56	-1.36	-1.79
Domestic debt	-0.94	-2.28	-3.03
Total debt	-0.71	-1.73	-2.29
<b>Savings/Investment</b>			
National savings	0.64	1.55	2.09
Total investment	0.51	1.25	1.68
<b>Current account</b>			
Total exports	0.01	0.04	0.08
Total imports	0.01	0.03	0.06
<b>Prices</b>			
Exchange rate	0.08	0.20	0.28
Real interest rate	-0.36	-0.87	-1.18
Average wage rate	-0.11	-0.25	-0.29
Equivalent variation (billions ROL)	-1,017	-2,498	-3,242

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

#### 7.3.4. Shifting public expenditures from current to capital expenditures

One of the main priorities stated by the government in the 2003 Pre-accession program is the restructuring of the public expenditures. Public investments growth plays a key role in the restructuring process (Romanian Government, 2004). Therefore, we assess the effects of a shift away from current expenditures (government purchases of goods and services) towards capital expenditures using RoMod. In this non-neutral scenario the public budget balance is allowed to adjust, to account for the change in the public expenditures structure. As explained below (and shown in table 7.15) the shift in the public expenditure structure has positive effects in terms of government revenues and thus on the public budget balance. This illustrates how useful the CGE approach is in analyzing the possible outcomes of a

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policy measure. The shares of the current and capital expenditures in the total public expenditures in the baseline and in the policy simulation are given in table 7.13.

The change in the share of capital expenditures during 2004-2006 corresponds with an increase of 0.2 percent of GDP at current market prices in 2004, and an additional rise of 0.3 percent of GDP at current market prices in 2006, in line with the provisional consolidated budget published in the 2003 Pre-accession program (Romanian Government, 2004). The current expenditures on public administration services (sec32), education (sec33), health and social work (sec34) and other community, social and personal services (sec35) have been kept unchanged not to affect the social safety net.

**Table 7.13. Shares of current and capital expenditures in total public expenditures**

Current and capital expenditures		Baseline	2004	2005	2006
<b>Goods and services</b>					
Agriculture, forestry and fishing	sec1	1.33	1.18	1.18	0.94
Manufacture of publishing and printing	sec9	0.02	0.02	0.02	0.01
Electricity, gas and water supply	sec20	3.10	2.75	2.75	2.20
Construction	sec21	2.58	2.29	2.29	1.83
Transport via railways	sec24	0.75	0.67	0.67	0.54
Other land transport; transport via pipelines	sec25	0.64	0.56	0.56	0.45
Water transport	sec26	0.07	0.06	0.06	0.05
Air transport	sec27	0.28	0.24	0.24	0.20
Post and telecommunications	sec28	0.09	0.08	0.08	0.06
Real estate activities	sec30	0.22	0.19	0.19	0.16
Other business activities	sec31	0.20	0.18	0.18	0.14
Public administration and defence; compulsory social security	sec32	34.56	34.56	34.56	34.56
Education	sec33	17.21	17.21	17.21	17.21
Health and social work	sec34	21.01	21.01	21.01	21.01
Other community, social and personal service activities	sec35	5.43	5.43	5.43	5.43
<b>Capital</b>		12.50	13.56	13.56	15.19
<b>Total</b>		100.00	100.00	100.00	100.00

Source: National Institute of Statistics and own calculations.

### *Non-neutral capital expenditures scenario*

The primary result of this policy measure is that current purchases of goods and services (except for public administration services, education, health and community services) decline by about 11 percent in 2004-2005 and 28 percent in 2006, compared to the baseline (see table 7.14). Overall, the fall in public purchases of goods and services is equivalent to 0.2 percent of GDP at current market prices in 2004 and an additional 0.3 percent in 2006.

The decline in the public consumption results in a fall of domestic sales of agriculture products (sec1), electricity, gas and water supply (sec20) and transport services (sec24-sec27). Consequently, it triggers a downwards adjustment in the

gross output of these sectors and depresses output and consumer prices. The demand for labor, capital and energy inputs in the sectors also diminishes.

The reduction in the output of the electricity, gas and water supply sector (sec20) reduces substantially the demand for coal and natural gas. Consumption of coal and natural gas by the electricity sector represents 46 and 80 percent, respectively, of total demand for these products. Therefore the output of the coal (sec2) and natural gas (sec4) sectors goes down.

**Table 7.14. Government purchases of goods and services (% changes compared to the baseline)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-11.22	-11.19	-28.48
Manufacture of publishing and printing	sec9	-11.43	-11.42	-28.92
Electricity, gas and water supply	sec20	-11.28	-11.27	-28.62
Construction	sec21	-11.55	-11.54	-29.17
Transport via railways	sec24	-11.09	-11.09	-28.25
Other land transport; transport via pipelines	sec25	-11.35	-11.34	-28.76
Water transport	sec26	-11.41	-11.40	-28.89
Air transport	sec27	-11.35	-11.34	-28.76
Post and telecommunications	sec28	-11.43	-11.42	-28.93
Real estate activities	sec30	-11.41	-11.35	-28.81
Other business activities	sec31	-11.47	-11.46	-29.01
Public administration and defence; compulsory social security	sec32	0.02	0.10	0.20
Education	sec33	0.03	0.03	0.07
Health and social work	sec34	0.02	0.03	0.07
Other community, social and personal service activities	sec35	0.02	0.03	0.07

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

In this scenario the reduced outlays on current government consumption are assumed to be used for public investments. The shift towards public capital expenditures has a positive impact on the output of capital goods producing activities, like manufacturing sectors and construction. It further stimulates job-creation and increases the profitability of these sectors.

The policy measure examined here results in minor changes in the income distribution. The negative effects on the profitability of the agricultural, electricity, the gas and water supply and transport services sectors outweigh the effects on the capital goods producing activities and generate a fall in firms' income and savings. On the other hand, households' income and savings increase due to the drop in unemployment and the rise in the real average wage rate. It further causes an upwards adjustment in the private consumption. The equivalent variation in income expressed in terms of billions ROL over a one-year period, shows that households' register a small gain during 2004-2006 (see table 7.15). In the long-run, the policy measure leads to an efficiency gain of 77,126 billions in 2000 ROL (equivalent to 0.61 percent of the present value of households' income).

The government revenues slightly improve due to the positive effects on employment and the rise in social security contributions (equivalent to 0.01 percent of GDP at current market prices in 2004 and an additional 0.02 percent of GDP at

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current market prices in 2006). Thus, the primary budget surplus improves, positively influencing the conventional budget deficit and total debt (see table 7.15). The deficit reduction crowds in private investment and the real interest rate declines.

**Table 7.15. Macroeconomic effects of raising government capital expenditures (% changes compared to the baseline)**

Macroeconomic results	Non-neutral scenario		
	2004	2005	2006
GDP at constant prices	0.04	0.06	0.15
Private consumption	0.05	0.07	0.16
Labor supply	0.00	0.01	0.02
Unemployment	-0.01	-0.03	-0.06
<b>Households</b>			
Households' income	0.02	0.04	0.10
Households' savings	0.02	0.04	0.09
<b>Firms</b>			
Firms income	-0.02	-0.02	-0.04
Firms savings	-0.01	-0.02	-0.04
<b>Government</b>			
Total government revenues	0.05	0.08	0.18
Total government expenditures	0.00	0.01	0.02
Government transfers to the households	-0.02	-0.03	-0.06
Interest payments	-0.01	-0.05	-0.11
Primary budget surplus	1.79	2.54	6.01
Conventional budget deficit	-0.43	-0.65	-1.52
Foreign debt	-0.03	-0.05	-0.12
Domestic debt	-0.09	-0.14	-0.32
Total debt	-0.06	-0.08	-0.20
<b>Savings/Investment</b>			
National savings	1.10	1.15	2.89
Total investment	1.04	1.08	2.70
<b>Current account</b>			
Total exports	0.19	0.22	0.54
Total imports	0.15	0.17	0.43
<b>Prices</b>			
Exchange rate	0.03	0.05	0.11
Real interest rate	-0.02	-0.06	-0.13
Average wage rate	0.01	0.05	0.09
Equivalent variation (billions ROL)	313	478	1,191

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

### 7.3.5. Combined measure of tax harmonization and public expenditures restructuring

The last policy simulation combines all the measures already presented in this chapter: the elimination of the VAT exemptions and the application of EU oriented VAT rates to certain goods and services; the increase in the excise duties on mineral oils; the elimination of direct subsidies on public passenger transport; and the switch of public expenditures from current to capital expenditures. This policy simulation

(neutral combined scenario) is set up such that the conventional budget balance adjusts during 2001-2002 and remains constant afterwards (at 3.6 percent) as a share of GDP at current market prices. The additional revenues are recycled through a decrease in social security contributions. There are two reasons for analyzing this combined measure. First, it presents an overall picture of the possible effects induced by the tax harmonization and public expenditures restructuring scenarios discussed in this chapter. More important, it estimates by how much the social security contributions rate can be reduced during 2004-2006 while keeping the deficit ratio constant. The Romanian government started diminishing the social contributions rates in 2003<sup>96</sup>. That is why in this scenario the additional government revenues are recycled beginning with 2003. In 2004 social security contributions have been reduced with another 3 percentage points. Further cuts in the social contributions of at least 1 percentage point per year were envisaged in the 2003 Pre-accession program for 2005-2006 (Romanian Government, 2004).

The outcomes of the combined measure of tax harmonization and public expenditures restructuring are not equal to the sum of effects induced by the previous policy scenarios. The difference resides in the additional government revenues that are recycled through the decrease in the social security contributions. Due to the measures aiming at the elimination of direct subsidies on public passenger transport and the switch of public expenditures from current to capital expenditures, these revenues are higher in the combined scenario than the sum of additional revenues in the neutral VAT and excise scenarios. Subsequently the combined measure results in a larger reduction of the social security contributions rates. Thus, the change in gross wages relative to other factors (i.e. capital and energy) is higher, inducing substitution effects and leading to effects of different magnitudes at the sectoral level.

### *Neutral combined scenario*

The combined measure of tax harmonization and public expenditures restructuring has a negative impact on the profitability of all production sectors (except for public administration, education and health services) due to the upwards shift in their cost curves. However, the reduction of the labor tax distortions generates substitution effects between energy inputs and labor, given the relative price changes. Consequently, unemployment declines and the real wage rate goes up (see table 7.16).

Households' income and savings rise starting with 2005 and 2006, respectively, causing a lower decline in private consumption beginning with 2006 and lower welfare losses, expressed in terms of equivalent variation over a one-year period (see table 7.16). In the long-run, the efficiency gains of 26,317 billions ROL in 2000 prices (equivalent to about 0.21 percent of the present value of households' income) are caused by the rise in investments and the reduction of the labor tax distortions.

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<sup>96</sup> See chapter 2 for a discussion of the social security contributions.

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**Table 7.16. Macroeconomic effects of the combined measure (% changes compared to the baseline)**

Macroeconomic results	Neutral scenario		
	2004	2005	2006
GDP at constant prices	-0.10	-0.07	0.01
Private consumption	-0.49	-0.45	-0.34
Labor supply	0.15	0.23	0.30
Unemployment	-0.41	-0.63	-0.82
<b>Households</b>			
Households' income	-0.12	0.03	0.21
Households' savings	-0.18	-0.05	0.10
<b>Firms</b>			
Firms income	-1.75	-2.09	-2.32
Firms savings	-2.32	-2.78	-3.09
<b>Government</b>			
Total government revenues	0.29	-0.43	-0.79
Total government expenditures	-0.68	-1.33	-1.64
Government transfers to households	0.07	0.14	0.17
Interest payments	-2.00	-2.43	-2.73
Primary budget surplus	30.95	28.54	26.64
Conventional budget deficit	-9.56	-9.53	-9.46
Foreign debt	-2.24	-2.32	-2.35
Domestic debt	-2.01	-2.00	-1.99
Total debt	-2.15	-2.20	-2.21
<b>Savings/Investment</b>			
National savings	0.94	0.57	1.87
Total investment	1.75	1.53	2.89
<b>Current account</b>			
Total exports	-0.57	-0.71	-0.54
Total imports	-0.43	-0.53	-0.39
<b>Prices</b>			
Exchange rate	-1.04	-1.14	-1.18
Real interest rate	-2.08	-2.54	-2.86
Average wage rate	1.31	1.97	2.46
Equivalent variation (billions ROL)	-3,141	-2,962	-2,223
Change in the social security contributions rate	-12.29	-16.35	-19.27

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

Because the conventional budget deficit is kept at a level of 3.6 percent of GDP during 2005-2006, contributions rates can be reduced by as much as 16.4 percent in 2005 and 19.3 percent in 2006, compared to the baseline. For the normal work conditions this would imply a rate of 29.3 percent in 2005 and 28.2 percent in 2006, for the particular work conditions the rate would be 33.4 percent in 2005 and 32.3 percent in 2006, and for the special work conditions it would be 37.6 percent in 2005 and 36.3 percent in 2006. In budgetary terms, the cut in social contributions revenues is equivalent to 0.36 percent of GDP in 2005 and an additional 0.25 percent of GDP in 2006. The combination of policies has positive effects on the primary budget surplus (even though the conventional deficit to GDP ratio is kept constant)

due to the faster decline in public expenditures compared to tax revenues (see table 7.16).

The impact on growth is positive starting with 2006 although small, due to the higher supply of loanable funds. The deficit reduction until 2003 crowds in private investment and the real interest rate declines.

### 7.4. Uncertainty and sensitivity analysis

The results of the policy simulations discussed in the previous section are conditional on a range of assumptions built into the model. As already explained in chapter 6, one of the most debated issues in the CGE literature concerns the reliability of the exogenous parameters used in the calibration process, mainly the elasticity values. Thus, Harrison et al. (1993) argue that CGE models should be subject to systematic sensitivity analysis, in order to capture, to some extent, the uncertainties involved in calibrating such models.

Although sensitivity analysis is applied in all kinds of disciplines involving the use of mathematical models, its definition varies over and within these disciplines. As Kleijnen (1995) points out, the roles of uncertainty analysis and sensitivity analysis seem especially unclear. Thus, before going further we briefly explain the use of the two concepts within the present study.

Formally, uncertainty analysis assesses the uncertainties in the model's output due to the uncertainties in the model parameters (Kleijnen, 1995). In our case, the model parameters which are considered to be a source of uncertainty are mainly the elasticities of substitution. Sensitivity analysis goes one step further aiming to evaluate the relative importance of each model parameter considered to be a source of uncertainty in determining the value of an output variable (Homma and Saltelli, 1996)<sup>97</sup>.

One of the main issues regarding the use of uncertainty and sensitivity analysis relates to the computational burden involved by models entailing a large number of parameters. Thus, many CGE modelers focus on a reduced number of parameters (elasticities of substitution), which are believed to have a higher influence on the model results<sup>98</sup> or undertake a conditional analysis to assess the uncertainties in models' output<sup>99</sup> (Harrison et al., 1993).

In section 7.4.1 we propose the use of a screening method (the Morris method) in order to identify the parameters driving most of the variation in the model's output.

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<sup>97</sup> So far, in the CGE modeling literature the concept of sensitivity analysis has been associated to what we identify in this study as uncertainty analysis.

<sup>98</sup> Harrison provides examples, found in the literature, of parameters identified as "critical" with respect to a certain policy simulation in conducting uncertainty analysis. The choice of "critical" parameters (mainly elasticities of substitution) is based on the modeler's judgment regarding the relative importance of the model's inputs (elasticities of substitution) in driving the model's results (Harrison et al., 1993).

<sup>99</sup> According to Harrison et al. (1993) the conditional analysis consists in perturbing each parameter at a time from its initial value (point estimate value), conditional on all the other parameters being set to their point estimate values.

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Although the method has been widely applied in the fields of environmental modeling and chemical engineering (Campolongo and Saltelli, 1997; Campolongo and Braddock, 1999; Campolongo, Tarantola and Saltelli, 1999; Duarte et al., 2003; Francos et al., 2003; Kioutsioukis, Tarantola, Saltelli and Gatelli, 2004), this is the first time that it is being applied in the CGE modeling field. The great advantage of the method is its reduced computational cost compared to uncertainty and sensitivity analysis methods when dealing with complex models, involving a large number of parameters. The Morris method is also able to identify the parameters with nonlinear and interaction effects. Although a ranking of the most influential parameters can be obtained, the method does not allow either an uncertainty analysis or a decomposition of model's output variance in terms of contributing parameters. Furthermore, it only provides a qualitative indication of the interactions of each parameter with the rest of parameters which are considered to be a source of uncertainty.

Therefore, a variance-based method (the Sobol' variance decomposition method) is subsequently used (section 7.4.2) for uncertainty and sensitivity analysis. Given the high computation cost involved by the method, only the most influential parameters, selected according to Morris method, are examined. The use of a variance-based method for uncertainty and sensitivity analysis, proposed in this study, is another novelty in the field of computable general equilibrium modeling<sup>100</sup>. The great advantage of the method is that it allows a decomposition of the model's output variance according to the contributing parameters, without *a priori* assuming a linear relationship between these parameters and the model's response. All the methods used so far in the CGE modeling field to identify the most influential parameters driving the model's results are mainly *ad hoc*. Arndt (1996) proposes a careful examination of the individual simulations to determine the different responses in the model's output to the changes in underlying parameters. Harrison et al. (1993) build an index of the elasticity-sensitivity of results based on the difference between the model's output evaluated with the elasticity at +1.4 standard errors and at -1.4 standard errors from its initial value and use it to rank the elasticities in terms of their effect on model's results<sup>101</sup>. None of these methods is able to provide a rigorous decomposition of model's output variance. The Sobol' method not only provides more insights with regard to the most important parameters driving the model's results but also allows a prioritization of future research in terms of parameters' estimation.

A starting point for the analysis, in order to reduce the dimensionality of the computation and reporting problem, is to identify a subset of endogenous variables of the model that could be regarded as the most informative for the model results

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<sup>100</sup> The variance-based methods (including the Sobol' method) for uncertainty and sensitivity analysis have been widely applied in the fields of environmental modeling and chemical engineering (Homma and Saltelli, 1996; Campolongo and Saltelli, 1997; Saltelli, Tarantola and Campolongo, 2000; Duarte et al., 2003; Kioutsioukis, Tarantola, Saltelli and Gatelli, 2004).

<sup>101</sup> Although, an exploration of the mapping between the parameters which are considered a source of uncertainty and the model's response would be possible in these cases by employing scatter plots, regression analysis or correlation analysis, all these methods assume a linear relationship between the parameters and the model's output.

(Harrison et al., 1993). We choose the equivalent variation in income expressed in billions ROL over a one-year period (for 2004-2006) which provides the households' welfare gains/losses due to the policy measures undertaken or envisaged by the government and the GDP at constant prices 2000 in billions ROL (for 2004-2006).

Subsequently, the parameters which are considered to be a source of uncertainty are identified and an *a priori* distribution is provided for each of them. The choice of an appropriate *a priori* distribution for each of the elasticities of substitution depends on the available information. If an elasticity estimate has been obtained from an econometric study, then the *t* distribution or the normal distribution would be appropriate. Otherwise, the uniform distribution could be used when the only information available is on the possible boundary values within which the parameter may lie (Harrison and Vinod, 1992).

A number of 229 parameters have been identified that are considered a source of uncertainty in the present study (elasticity of substitution between labor and the capital-energy bundle for the *c* sectors<sup>102</sup>, elasticity of substitution between capital and the energy bundle for the *c* sectors, elasticity of substitution between electricity and other non-electric energy inputs for the *c* sectors, elasticity of substitution between non-electric energy inputs for the *c* sectors, elasticity of substitution between labor and capital for the *l*<sup>103</sup> sectors, elasticity of substitution between domestically produced goods and imports, elasticity of substitution between the domestically produced goods and exports, the income elasticities of demand for commodities, the Frisch parameter, the wage curve parameter and the real wage elasticity of labor supply). As already explained in chapter 6, no econometric estimates for the elasticity values are available for Romania. Furthermore, even for other countries it is difficult to find econometric studies which provide the elasticity estimates and their corresponding standard errors or *t* values at such a detailed sectoral level. Thus, the uniform distribution is chosen *a priori* for each of the elasticities. The range of variation for each of the selected parameters is provided in appendix 7.B., tables 7.B.1-7.B.9.

### 7.4.1. Screening: applying Morris method

The Morris method allows the identification of parameters which are considered to be a source of uncertainty, which exhibit a negligible effect on output variance, a linear and additive effect or a nonlinear and interaction effect (Morris, 1991)<sup>104</sup>. The less influential parameters could be subsequently fixed to any value over their range of uncertainty without significantly affecting the output variance. The method also

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<sup>102</sup> As already mentioned in chapter 4, *c* sectors include all the production sectors except for coal sector, oil sector and extraction of natural gas sector.

<sup>103</sup> As already discussed in chapter 4, *l* sectors include coal sector, oil sector and extraction of natural gas sector.

<sup>104</sup> Compared to other screening methods the great advantage of the Morris method is its wider applicability. The method does not rely on restrictive assumptions, thus, being model independent (Saltelli, Tarantola, Campolongo and Ratto, 2004).

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allows a ranking of parameters according to their decreasing impact on the model's output (Saltelli, Tarantola, Campolongo and Ratto, 2004).

The Morris method assumes a discrete number of values for each parameter within its range of variation. The number of discrete values is called levels and is denoted by  $p$ . Each parameter takes integer values in the set  $\{0, 1/(p-1), 2/(p-1), \dots, 1\}$ , which are subsequently rescaled to correspond to its range of variation. The method is based on randomized experiments which vary one parameter at a time and evaluate its elementary effect. The elementary effect corresponding to the  $i$ th parameter ( $E_i(\theta)$ ) is derived by using two points in an  $h$ -dimensional  $p$ -level grid:

$$E_i(\theta) = [y(\theta_1, \dots, \theta_{i-1}, \theta_i + \Delta, \theta_{i+1}, \dots, \theta_h) - y(\theta)] / \Delta \quad (7.1)$$

where  $h$  is the total number of parameters considered to be a source of uncertainty,  $\theta$  is a given value of the  $h$ -dimensional vector of exogenous parameters (specified elasticity values) and  $\Delta$  is a predetermined multiple of  $1/(p-1)$ .  $\theta = (\theta_1, \theta_2, \dots, \theta_h)$  can take any value in the  $h$ -dimensional  $p$ -level grid, provided that  $(\theta + a_i \cdot \Delta)$ <sup>105</sup> is still in the  $h$ -dimensional  $p$ -level grid for each  $i=1, \dots, h$ . By randomly sampling different  $\theta$  from the  $h$ -dimensional  $p$ -level grid we derive the finite distribution of elementary effects associated with the  $i$ th parameter (Saltelli, Tarantola, Campolongo and Ratto, 2004).

The mean ( $\mu$ ) and the standard deviation ( $\sigma$ ) of the distribution of the values of elementary effects represent two sensitivity measures proposed by Morris (1991) which estimate the overall effect of the parameter on output and the higher order effects in which the parameter is involved (including interaction effects), respectively. In order to estimate the distribution's statistics (the mean and the standard deviation) a random sample of  $r$  elementary effects is drawn from each distribution of elementary effects (Saltelli, Tarantola, Campolongo and Ratto, 2004).

To interpret the results of the screening method a graphical representation of the mean and standard deviation for each sample of elementary effects is useful. Thus, a measure of importance could be defined, based on the Euclidian distance from the origin in the  $(\mu, \sigma)$  plane (Campolongo and Saltelli, 1997). Further normalizing this measure of importance:

$$e_i = \sqrt{\mu_i^2 + \sigma_i^2} \cdot 100 / \sum_{j=1}^h \sqrt{\mu_j^2 + \sigma_j^2} \quad (7.2)$$

we could determine the most influential parameters, by defining a threshold (Duarte et al., 2003).

In order to screen the most influential parameters among the total of 229 parameters which are considered a source of uncertainty in RoMod, the SIMLAB software (Saltelli, Tarantola, Campolongo and Ratto, 2004) developed at the Joint Research

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<sup>105</sup>  $a_i$  is a vector of zeros, where a unit corresponds to its  $i$ th component.

Centre of the European Commission (Ispra-Italy) has been used together with GAMS. First, the SIMLAB software has been used for sample generation. A number of 4 levels ( $p$ ) has been selected for each parameter within the range of variation, while the size ( $r$ ) of the random sample of the elementary effects has been set to 10. The choice of  $p=4$  and  $r=10$  is based on previous experiments. Campolongo and Saltelli (1997) and Campolongo, Tarantola and Saltelli (1999) have demonstrated that this specific combination has produced valuable results. Then, the model has been recalibrated and solved for each sample point<sup>106</sup>, using the GAMS software. In total this procedure amounted to solving the model 2300 times<sup>107</sup> for each policy scenario and each year. In the final stage, SIMLAB software has been used again to derive the mean and the standard deviation of the distribution of the values of elementary effects.

The graphical representation of the mean and standard deviation of the distribution of the values of elementary effects corresponding to the equivalent variation in income over a one-year period (for 2004-2006) and GDP at constant prices 2000 (for 2004-2006) for all policy scenarios presented in section 7.3 (non-neutral VAT scenario, neutral VAT scenario, non-neutral excise scenario, neutral excise scenario, non-neutral subsidy scenario, non-neutral capital expenditures scenario and neutral combined scenario) is provided in figures 7.1-7.7.

A measure of relative importance in percentage terms, based on the normalized Euclidian distance from the origin in the  $(\mu, \sigma)$  plane, has also been derived according to the equation (7.2)<sup>108</sup>. A threshold of 5 percent has been set, such that only parameters with a percentage of relative importance higher or equal to 5 percent are selected as influential (Duarte et al., 2003). The results for the measure of importance in percentages corresponding to all policy scenarios are provided in tables 7.17-7.23.

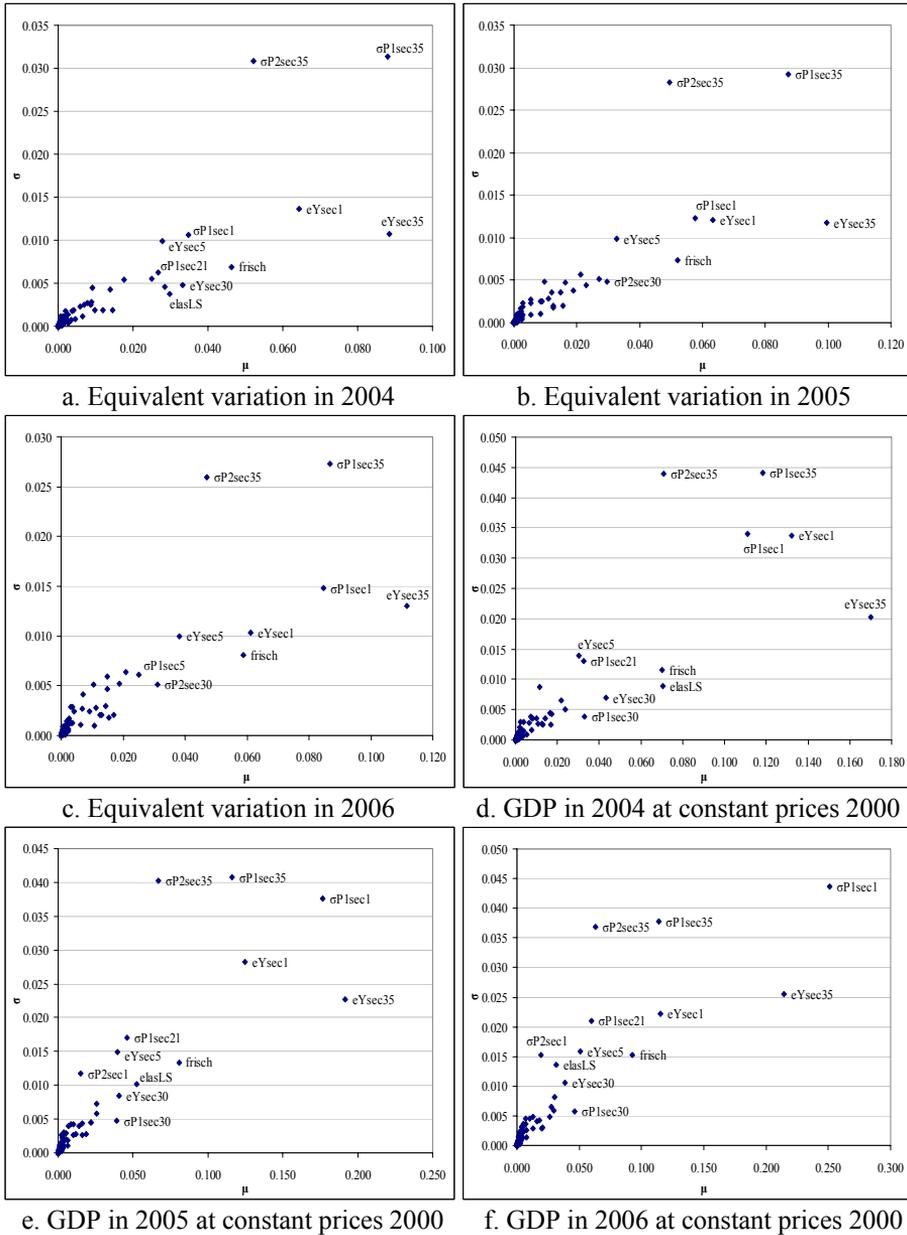
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<sup>106</sup> The sample point represents in this case one set of values corresponding to the 229 parameters.

<sup>107</sup> The total number of simulations is equal to the sample size ( $r$ ) multiplied by the total number of parameters plus one ( $h+1$ ).

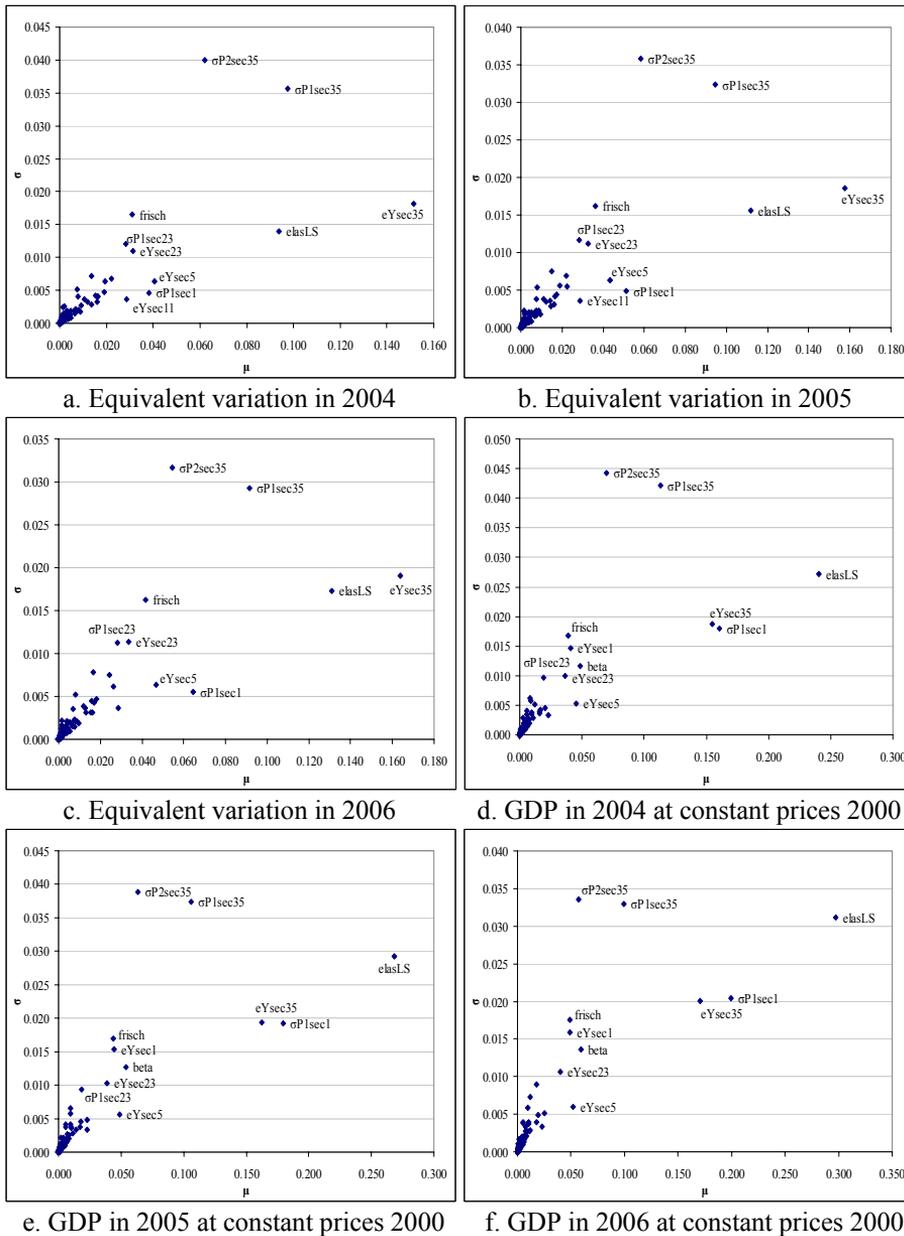
<sup>108</sup> The detailed results for the mean and the standard deviation of the distribution of the values of elementary effects corresponding to the first 25 parameters, in each policy scenario, are provided in appendix 7.B, tables 7.B.10, 7.B.12, 7.B.14, 7.B.16, 7.B.18, 7.B.20, 7.B.22, 7.B.24, 7.B.26, 7.B.28, 7.B.30, 7.B.32, 7.B.34, 7.B.36. The results are available for both the equivalent variation in income over a one-year period (for 2004-2006) and GDP at constant prices 2000 (for 2004-2006).

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Note:  $\mu$  stands for the mean and  $\sigma$  for the standard deviation of the distribution of the values of elementary effects. The notations used for the parameters in the graphical representations are explained in appendix 7.B, tables 7.B.1-7.B.9.

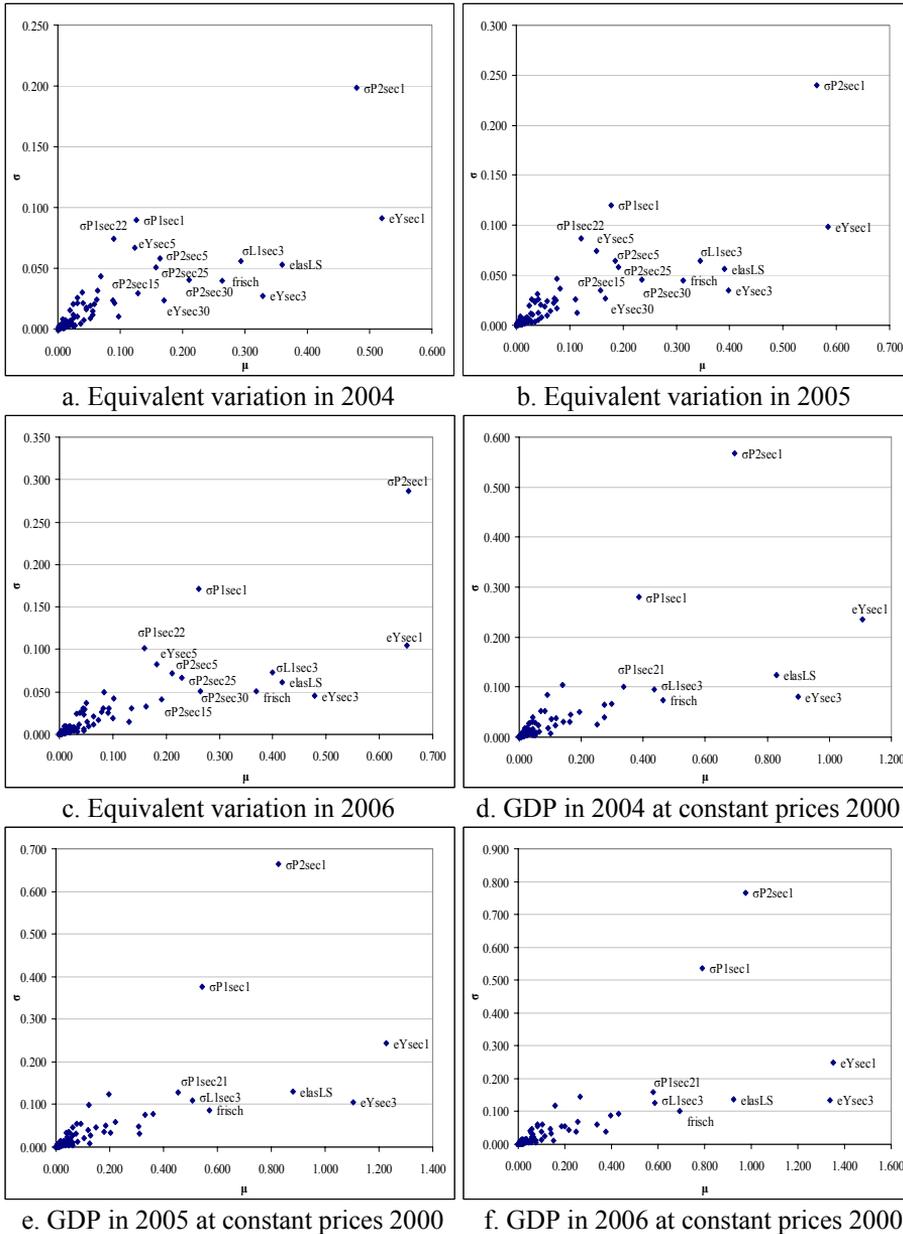
**Figure 7.1. Morris sensitivity measures for the non-neutral VAT scenario**



Note:  $\mu$  stands for the mean and  $\sigma$  for the standard deviation of the distribution of the values of elementary effects. The notations used for the parameters in the graphical representations are explained in appendix 7.B, tables 7.B.1-7.B.9.

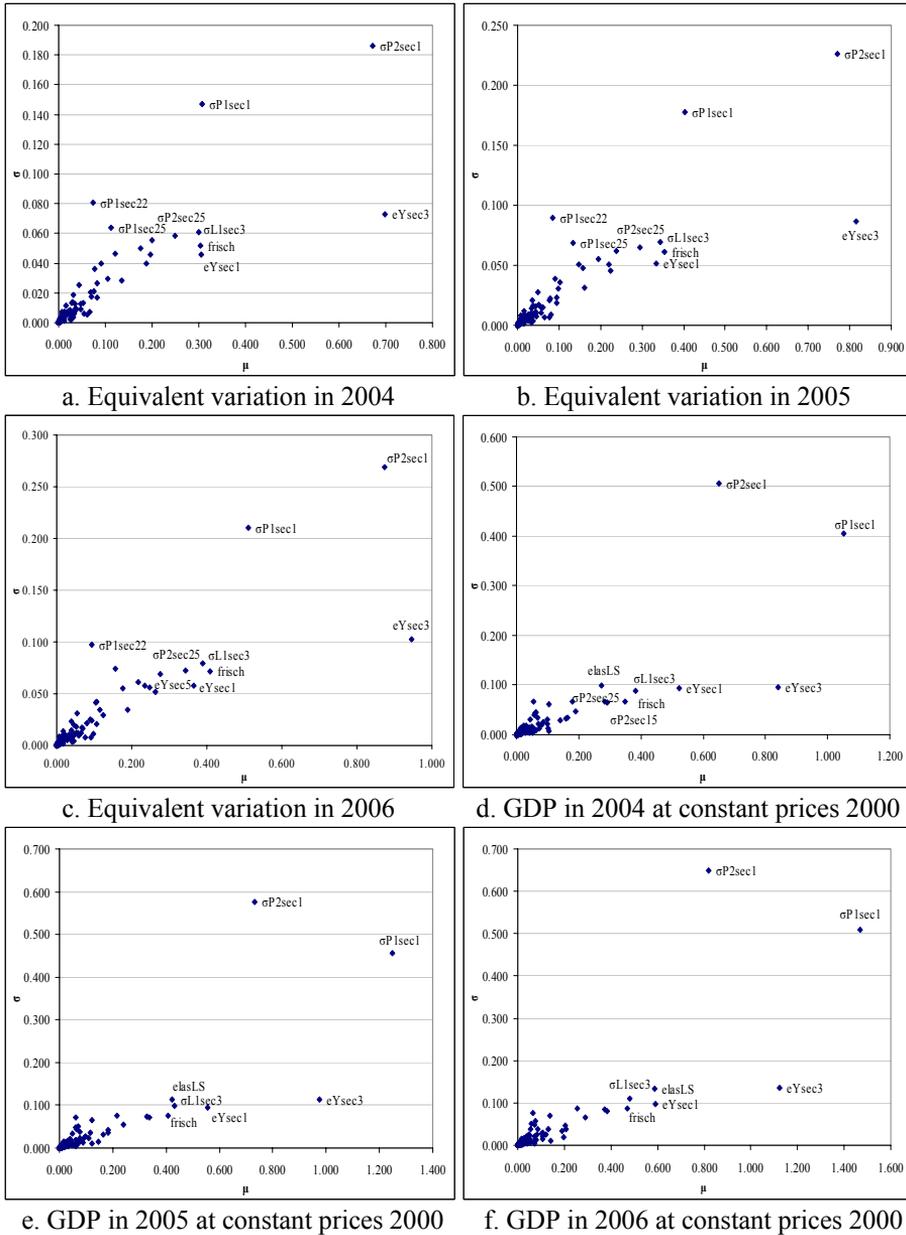
Figure 7.2. Morris sensitivity measures for the neutral VAT scenario

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Note:  $\mu$  stands for the mean and  $\sigma$  for the standard deviation of the distribution of the values of elementary effects. The notations used for the parameters in the graphical representations are explained in appendix 7.B, tables 7.B.1-7.B.9.

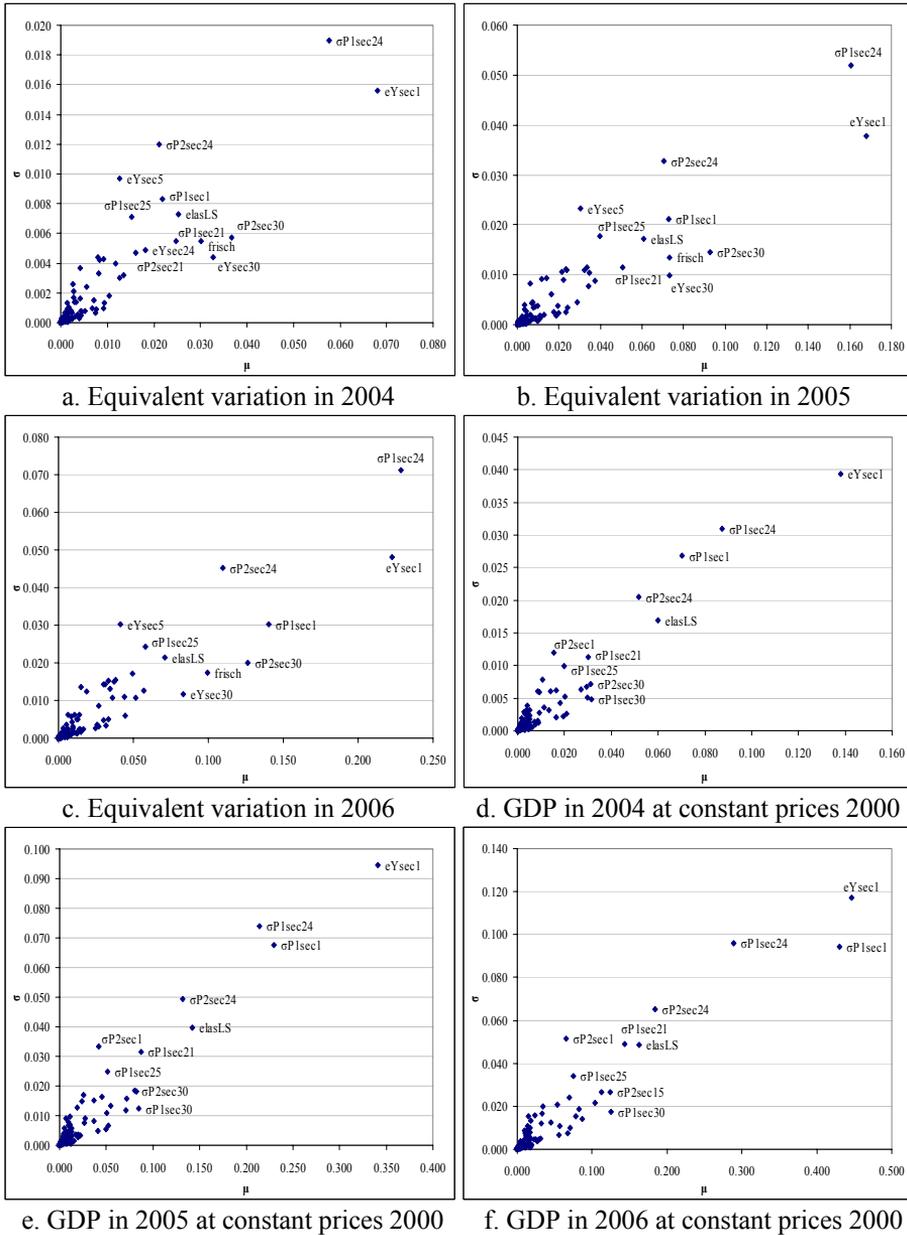
**Figure 7.3. Morris sensitivity measures for the non-neutral excise scenario**



Note:  $\mu$  stands for the mean and  $\sigma$  for the standard deviation of the distribution of the values of elementary effects. The notations used for the parameters in the graphical representations are explained in appendix 7.B, tables 7.B.1-7.B.9.

Figure 7.4. Morris sensitivity measures for the neutral excise scenario

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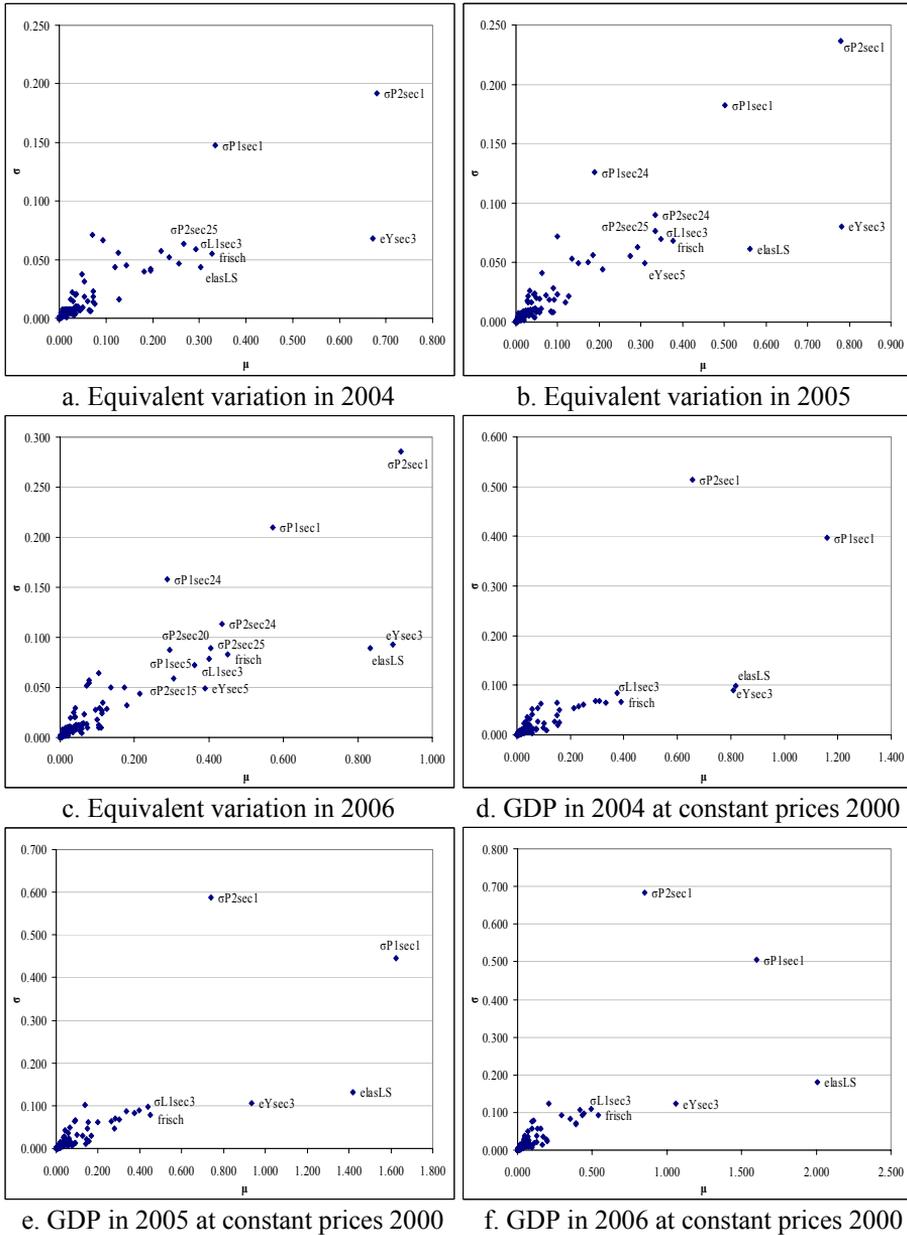


Note:  $\mu$  stands for the mean and  $\sigma$  for the standard deviation of the distribution of the values of elementary effects. The notations used for the parameters in the graphical representations are explained in appendix 7.B, tables 7.B.1-7.B.9.

**Figure 7.5. Morris sensitivity measures for the non-neutral subsidy scenario**



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Note:  $\mu$  stands for the mean and  $\sigma$  for the standard deviation of the distribution of the values of elementary effects. The notations used for the parameters in the graphical representations are explained in appendix 7.B, tables 7.B.1-7.B.9.

**Figure 7.7. Morris sensitivity measures for the neutral combined scenario**

**Table 7.17. Morris sensitivity measures for the non-neutral VAT scenario**

Equivalent variation					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
$\sigma P1sec35$	11.76	$eYsec35$	12.14	$eYsec35$	12.82
$eYsec35$	11.20	$\sigma P1sec35$	11.16	$\sigma P1sec35$	10.37
$eYsec1$	8.28	$eYsec1$	7.82	$\sigma P1sec1$	9.80
$\sigma P2sec35$	7.61	$\sigma P1sec1$	7.15	$eYsec1$	7.07
frisch	5.88	$\sigma P2sec35$	6.91	frisch	6.75
		frisch	6.38	$\sigma P2sec35$	6.13
GDP at constant prices					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
$eYsec35$	13.53	$eYsec35$	13.76	$\sigma P1sec1$	16.29
$eYsec1$	10.77	$\sigma P1sec1$	12.89	$eYsec35$	13.81
$\sigma P1sec35$	9.97	$eYsec1$	9.13	$\sigma P1sec35$	7.69
$\sigma P1sec1$	9.19	$\sigma P1sec35$	8.78	$eYsec1$	7.51
$\sigma P2sec35$	6.60	frisch	5.85	frisch	6.01
elasLS	5.61	$\sigma P2sec35$	5.58		
frisch	5.61				

Note:  $\sigma P1sec1$  stands for the elasticity of substitution between labor and the capital-energy bundle for agricultural sector;  $\sigma P1sec35$  stands for the elasticity of substitution between labor and the capital-energy bundle for other community, social and personal service activities;  $\sigma P2sec35$  stands for the elasticity of substitution between capital and the energy bundle for other community, social and personal service activities;  $eYsec1$  stands for the income elasticity of demand for agricultural goods;  $eYsec35$  stands for the income elasticity of demand for other community, social and personal services; *elasLS* stands for the real wage elasticity of labor supply; *frisch* stands for the Frisch parameter.

**Table 7.18. Morris sensitivity measures for the neutral VAT scenario**

Equivalent variation					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
$eYsec35$	15.04	$eYsec35$	14.90	$eYsec35$	14.76
$\sigma P1sec35$	10.25	<i>elasLS</i>	10.62	<i>elasLS</i>	11.81
<i>elasLS</i>	9.35	$\sigma P1sec35$	9.40	$\sigma P1sec35$	8.59
$\sigma P2sec35$	7.27	$\sigma P2sec35$	6.43	$\sigma P1sec1$	5.79
				$\sigma P2sec35$	5.64
GDP at constant prices					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
<i>elasLS</i>	17.88	<i>elasLS</i>	19.02	<i>elasLS</i>	20.08
$\sigma P1sec1$	11.93	$\sigma P1sec1$	12.74	$\sigma P1sec1$	13.49
$eYsec35$	11.51	$eYsec35$	11.52	$eYsec35$	11.53
$\sigma P1sec35$	8.91	$\sigma P1sec35$	7.94	$\sigma P1sec35$	7.04
$\sigma P2sec35$	6.11	$\sigma P2sec35$	5.23		

Note:  $\sigma P1sec1$  stands for the elasticity of substitution between labor and the capital-energy bundle for agricultural sector;  $\sigma P1sec35$  stands for the elasticity of substitution between labor and the capital-energy bundle for other community, social and personal service activities;  $\sigma P2sec35$  stands for the elasticity of substitution between capital and the energy bundle for other community, social and personal service activities;  $eYsec35$  stands for the income elasticity of demand for other community, social and personal services; *elasLS* stands for the real wage elasticity of labor supply.

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**Table 7.19. Morris sensitivity measures for the non-neutral excise scenario**

Equivalent variation					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
eYsec1	9.21	σP2sec1	9.28	σP2sec1	9.32
σP2sec1	9.06	eYsec1	8.99	eYsec1	8.60
elasLS	6.34	eYsec3	6.06	eYsec3	6.26
eYsec3	5.75	elasLS	5.98	elasLS	5.50
σL1sec3	5.21	σL1sec3	5.31	σL1sec3	5.31
GDP at constant prices					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
eYsec1	10.82	eYsec1	10.04	eYsec1	9.28
eYsec3	8.64	eYsec3	8.89	eYsec3	9.07
σP2sec1	8.59	σP2sec1	8.51	σP2sec1	8.37
elasLS	8.02	elasLS	7.13	σP1sec1	6.43
		σP1sec1	5.30	elasLS	6.30

Note:  $\sigma P1sec1$  stands for the elasticity of substitution between labor and the capital-energy bundle for agricultural sector;  $\sigma P2sec1$  stands for the elasticity of substitution between capital and the energy bundle for agricultural sector;  $\sigma L1sec3$  stands for the elasticity of substitution between labor and capital for the oil sector;  $eYsec1$  stands for the income elasticity of demand for agricultural goods;  $eYsec3$  stands for the income elasticity of demand for mineral oils;  $elasLS$  stands for the real wage elasticity of labor supply.

**Table 7.20. Morris sensitivity measures for the neutral excise scenario**

Equivalent variation					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
eYsec3	10.65	eYsec3	10.52	eYsec3	10.40
σP2sec1	10.59	σP2sec1	10.30	σP2sec1	10.01
σP1sec1	5.18	σP1sec1	5.66	σP1sec1	6.05
GDP at constant prices					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
σP1sec1	12.59	σP1sec1	12.71	σP1sec1	12.84
eYsec3	9.44	eYsec3	9.38	eYsec3	9.33
σP2sec1	9.20	σP2sec1	8.91	σP2sec1	8.62
eYsec1	5.93	eYsec1	5.38	elasLS	4.99

Note:  $\sigma P1sec1$  stands for the elasticity of substitution between labor and the capital-energy bundle for agricultural sector;  $\sigma P2sec1$  stands for the elasticity of substitution between capital and the energy bundle for agricultural sector;  $eYsec1$  stands for the income elasticity of demand for agricultural goods;  $eYsec3$  stands for the income elasticity of demand for mineral oils;  $elasLS$  stands for the real wage elasticity of labor supply.

**Table 7.21. Morris sensitivity measures for the non-neutral subsidy scenario**

Equivalent variation					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
eYsec1	10.30	eYsec1	9.86	σP1sec24	9.84
σP1sec24	8.97	σP1sec24	9.66	eYsec1	9.37
σP2sec30	5.48	σP2sec30	5.38	σP1sec1	5.90
				σP2sec30	5.26
GDP at constant prices					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
eYsec1	13.36	eYsec1	12.68	eYsec1	11.59
σP1sec24	8.61	σP1sec1	8.57	σP1sec1	11.06
σP1sec1	6.99	σP1sec24	8.13	σP1sec24	7.65
elasLS	5.79	elasLS	5.28		
σP2sec24	5.16	σP2sec24	5.05		

Note: *σP1sec1* stands for the elasticity of substitution between labor and the capital-energy bundle for agricultural sector; *σP1sec24* stands for the elasticity of substitution between labor and the capital-energy bundle for transport via railways sector; *σP2sec24* stands for the elasticity of substitution between capital and the energy bundle for transport via railways sector; *σP2sec30* stands for the elasticity of substitution between capital and the energy bundle for real estate activities; *eYsec1* stands for the income elasticity of demand for agricultural goods; *elasLS* stands for the real wage elasticity of labor supply.

**Table 7.22. Morris sensitivity measures for the non-neutral capital expenditures scenario**

Equivalent variation					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
σP1sec1	17.38	σP1sec1	18.88	σP1sec1	18.74
eYsec1	8.94	eYsec1	9.52	eYsec1	9.47
σP1sec22	5.68	elasLS	5.63	elasLS	5.27
GDP at constant prices					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
σP1sec1	29.65	σP1sec1	29.68	σP1sec1	29.88
eYsec1	11.01	eYsec1	11.27	eYsec1	11.30
		elasLS	6.77	elasLS	6.38

Note: *σP1sec1* stands for the elasticity of substitution between labor and the capital-energy bundle for agricultural sector; *σP1sec22* stands for the elasticity of substitution between labor and the capital-energy bundle for wholesale and retail trade sector; *eYsec1* stands for the income elasticity of demand for agricultural goods; *elasLS* stands for the real wage elasticity of labor supply.

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**Table 7.23. Morris sensitivity measures for the neutral combined scenario**

Equivalent variation					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
$\sigma P2sec1$	9.55	$\sigma P2sec1$	8.60	$\sigma P2sec1$	8.38
$eYsec3$	9.14	$eYsec3$	8.31	$eYsec3$	7.86
		$elasLS$	5.97	$elasLS$	7.32
		$\sigma P1sec1$	5.65	$\sigma P1sec1$	5.32
GDP at constant prices					
2004		2005		2006	
Parameters	<i>e</i>	Parameters	<i>e</i>	Parameters	<i>e</i>
$\sigma P1sec1$	12.11	$\sigma P1sec1$	13.06	$elasLS$	13.35
$\sigma P2sec1$	8.24	$elasLS$	11.03	$\sigma P1sec1$	11.11
$elasLS$	8.12	$\sigma P2sec1$	7.33	$\sigma P2sec1$	7.22
$eYsec3$	8.05	$eYsec3$	7.29	$eYsec3$	7.06

Note:  $\sigma P1sec1$  stands for the elasticity of substitution between labor and the capital-energy bundle for agricultural sector;  $\sigma P2sec1$  stands for the elasticity of substitution between capital and the energy bundle for agricultural sector;  $eYsec3$  stands for the income elasticity of demand for mineral oils;  $elasLS$  stands for the real wage elasticity of labor supply.

In the graphical representations, figures 7.1-7.7, the Morris sensitivity measures are to be interpreted as follows: if the mean ( $\mu$ ) of the distribution of the values of elementary effects corresponding to the parameter  $\theta_i$  is high, the parameter has a large effect on output and the sign of the effect is always the same; if the standard deviation ( $\sigma$ ) of the distribution of the values of elementary effects corresponding to the parameter  $\theta_i$  is high, it means that the elementary effects relative to this parameter are significantly different from each other, depending on the choice of other parameter's values. However, a high value of ( $\sigma$ ) could also reflect a nonlinear effect (curvature effect) on the model's output. In cases where  $\mu > \sigma$  (zone of the plane  $(\mu, \sigma)$ ), we can conclude that the parameter is less involved in curvature and/or interaction effects, while the contrary stands for parameters where  $\mu < \sigma$  (zone of the plane  $(\mu, \sigma)$ ) (Saltelli, Tarantola, Campolongo and Ratto, 2004).

The graphical representations with respect to both equivalent variation in income and GDP at constant prices (see figures 7.1-7.7) suggest that in all policy scenarios none of the parameters that are well separated from the others has a purely linear effect on output. In the following, we will only discuss the parameters that are identified as influential based on the relative measure of importance with a threshold of 5 percent (see tables 7.17-7.23).

In the *non-neutral VAT scenario*, the elasticity of substitution between labor and the capital-energy bundle for other community, social and personal services activities ( $\sigma P1sec35$ ) and the income elasticity of demand for other community, social and personal services ( $eYsec35$ ) are well separated from the rest of parameters,

indicating their large influence on the equivalent variation in income in all three years (see figure 7.1.a-7.1.c and table 7.17), in accordance with *a priori* expectations. However, the income elasticity ( $eY_{sec35}$ ) is less involved in curvature and/or interaction effects, compared to the elasticity of substitution between labor and the capital-energy bundle ( $\sigma P1_{sec35}$ ). Both parameters are scenario specific, as indicated in section 7.3.1.

The large influence of the income elasticity of demand for other community, social and personal services ( $eY_{sec35}$ ) on the equivalent variation can be explained by the relatively high share of these services in the household's consumption budget, 3.7 percent, compared to other commodities subject to a change in the VAT rates (0.4 percent for the publishing and printing products, 2.0 percent for the pharmaceutical products and cosmetics and 5.4 percent for the hotel and restaurants services), and by the larger change in the average effective VAT rates corresponding to these services (see table 7.1, section 7.3.1), which induces a greater adjustment of consumer prices.

Subsequently, the high importance of the elasticity of substitution between labor and the capital-energy bundle ( $\sigma P1_{sec35}$ ) on the equivalent variation derives from the above mentioned effect of the policy measure on the production of other community services. The decline in other community services leads to an adjustment in employment by the sector (see table 7.2, section 7.3.1). Consequently, households' income and consumption budgets fall, affecting the equivalent variation in income. This adjustment is particularly large because of the relatively large share of employment in the sector (1.1 percent of domestic labor demand, compared to publishing and printing, 0.2 percent, manufacture of pharmaceutical products and cosmetics, 0.2 percent, and hotels and restaurants services, 1.0 percent).

The second group of parameters with an important effect on the equivalent variation includes: the income elasticity of demand for agricultural goods ( $eY_{sec1}$ ), the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma P1_{sec1}$ ), the elasticity of substitution between capital and the energy bundle for other community, social and personal services ( $\sigma P2_{sec35}$ ) and the Frisch parameter (*frisch*). The elasticity of substitution between capital and the energy bundle for other community services ( $\sigma P2_{sec35}$ ) meets the *a priori* expectations, being scenario specific. Again, the higher adjustment in community services production (see table 7.2, section 7.3.1) together with the relatively large share of capital income originating from the sector (1.6 percent of total capital income, compared to publishing and printing, 0.5 percent, manufacture of pharmaceutical products and cosmetics, 0.6 percent, and hotels and restaurants services, 2.8 percent) explains the importance of the parameter with respect to equivalent variation. Here should also be considered that capital income represents about 33.9 percent of the households' income. Further, the importance of the Frisch parameter (*frisch*) on the equivalent variation has to do with its direct impact on the minimum (subsistence) level of consumption of commodities used by the household sector.

Less evident is the substantial effect of the income elasticity of demand for the agricultural goods ( $eY_{sec1}$ ) and the elasticity of substitution between labor and the

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capital-energy bundle for the agricultural sector ( $\sigma_{P1sec1}$ ) on the equivalent variation, in the non-neutral VAT scenario. Nevertheless, the large share of agricultural products in the households' consumption budget, 13.7 percent, and the high share of employment in the agricultural sector, 38.4 percent of the domestic labor demand, could provide a reasonable explanation for such a result. The income elasticity of demand for agricultural goods ( $e_{Ysec1}$ ) has a direct effect on the equivalent variation through the price of the agricultural products. The elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma_{P1sec1}$ ) influences employment in the sector, which further affects the households' consumption budget, and thus equivalent variation through the labor income originating from the sector.

The parameters with the largest influence on the real GDP in the non-neutral VAT scenario are the income elasticity of demand for other community, social and personal services ( $e_{Ysec35}$ ), the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma_{P1sec1}$ ), the income elasticity of demand for agricultural goods ( $e_{Ysec1}$ ) and the elasticity of substitution between labor and the capital-energy bundle for other community services ( $\sigma_{P1sec35}$ ), which are well separated from the rest (see figure 7.1.d-7.1.f.), followed by a second group including the remaining parameters in table 7.17. Again, the income elasticity ( $e_{Ysec35}$ ) is less involved in curvature and/or interaction effects, compared to the rest of parameters. The importance of the parameters in table 7.17 with respect to the real GDP can be explained by two different mechanisms, both leading to an adjustment in private consumption: the income elasticity of demand for other community services ( $e_{Ysec35}$ ), the income elasticity of demand for agricultural goods ( $e_{Ysec1}$ ) and the Frisch parameter (*frisch*) have a direct effect on private consumption, while the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma_{P1sec1}$ ), the elasticity of substitution between labor and the capital-energy bundle for other community services ( $\sigma_{P1sec35}$ ) and the elasticity of substitution between capital and the energy bundle for other community services ( $\sigma_{P2sec35}$ ) generate an adjustment in households' capital or labor income and further affect the households' consumption budget. An additional parameter, the real wage elasticity of labor supply (*elasLS*), appears to have a large influence on the real GDP due to its direct effect on labor supply, which subsequently affects the households' income and consumption budget.

In the *neutral VAT scenario*, all the parameters that are identified as important with respect to the equivalent variation and the GDP at constant prices (see figure 7.2 and table 7.18) have already been discussed for the non-neutral VAT scenario. It is interesting to note that the reduction in the labor tax distortion changes the ranking of the parameters such that the real wage elasticity of labor supply (*elasLS*) becomes the most significant parameter with regard to the real GDP and also appears to be influential with respect to the equivalent variation. Some other parameters become less influential due to the recycling scheme: the income elasticity of demand for agricultural goods ( $e_{Ysec1}$ ) and the Frisch parameter (*frisch*).

In the *non-neutral excise scenario*, the elasticity of substitution between capital and the energy bundle for the agricultural sector ( $\sigma_{P2sec1}$ ) and the income elasticity of

demand for agricultural goods ( $eY_{sec1}$ ) have a large influence on the equivalent variation in income (see figure 7.3.a-7.3.c. and table 7.19), followed by a second group including: the income elasticity of demand for mineral oils ( $eY_{sec3}$ ), the real wage elasticity of labor supply ( $elasLS$ ) and the elasticity of substitution between labor and capital for the oil sector ( $\sigma_{L1sec3}$ ).

The income elasticity of demand for mineral oils ( $eY_{sec3}$ ) and the elasticity of substitution between labor and capital for the oil sector ( $\sigma_{L1sec3}$ ) meet the *a priori* expectations, being scenario specific. As already explained in section 7.3.2, the rise in excise levels for mineral oils has a direct impact on consumer prices, inducing a reduction in the private consumption of mineral oils. The large effect on consumer prices including taxes for these products (see table 7.8, section 7.3.2) and the high share of mineral oils in the households' consumption budget, 5.3 percent, explain the importance of the income elasticity of demand for mineral oils ( $eY_{sec3}$ ) with regard to the equivalent variation. Consequently, the relatively large decline in mineral oils production compared to other sectors and the share of capital income originating from this sector, 1.8 percent of the total capital income, can explain the impact of the elasticity of substitution between labor and capital for the oil sector ( $\sigma_{L1sec3}$ ) through the households' income and consumption budget on the equivalent variation.

The relative large size of the agricultural sector, which contributes 11 percent of domestic production, together with the high mineral oils consumption by the sector in the production process, 3.7 percent of intermediate consumption, may well explain the high significance of the elasticity of substitution between capital and the energy bundle for the agricultural sector ( $\sigma_{P2sec1}$ ). The upward shift in the cost curves of the agriculture sector due to the rise in the mineral oil prices induces a decline in the sector's profitability, despite the substitution effect in favor of capital (given by the elasticity of substitution between capital and the energy bundle), and results in an adjustment in households' income and consumption budget, and thus on the equivalent variation. However, the elasticity of substitution between capital and the energy bundle ( $\sigma_{P2sec1}$ ) plays a crucial role in this case due to the large share of households' capital income originating from this sector<sup>109</sup>. As in the non-neutral VAT scenario, the large share of agricultural products in the households' consumption budget further explains the importance of the income elasticity of demand for agricultural goods ( $eY_{sec1}$ ) with respect to equivalent variation, while the real wage elasticity of labor supply ( $elasLS$ ) derives its importance from its direct effects on labor supply, and thus on households' income and consumption.

An additional parameter, the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma_{P1sec1}$ ), is identified as influential with regard to the real GDP in the non-neutral excise scenario (see figure 7.3.d-7.3.f. and table 7.19), while the elasticity of substitution between labor and capital for the oil sector ( $\sigma_{L1sec3}$ ) becomes less influential, probably due to the relatively small share

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<sup>109</sup> A high share of households' capital income originates from the agricultural sector due to the unincorporated enterprises as explained in chapter 5, section 5.3.2.

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of capital and labor income originating from the sector, compared to the agricultural sector.

In the *neutral excise scenario*, the ranking of the most influential parameters on the equivalent variation and the real GDP slightly changes due to the reduction in the labor tax distortion (see figure 7.4 and table 7.20). The income elasticity of demand for mineral oils ( $eY_{sec3}$ ) appears to be the most influential parameter for equivalent variation this time, while the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma P1_{sec1}$ ) also becomes important. Some other parameters, including the elasticity of substitution between labor and capital for the oil sector ( $\sigma L1_{sec3}$ ), the income elasticity of demand for agricultural goods ( $eY_{sec1}$ ) and the real wage elasticity of labor supply ( $elasLS$ ) prove to be less influential. The parameters identified as important with respect to the real GDP are the same as in the non-neutral excise scenario although their ranking slightly changes. It can be noticed that the recycling scheme, which favors employment and further affects households' income and consumption, brings to the forefront the parameters corresponding to the agricultural sector because of its substantial contribution to total employment.

In the *non-neutral subsidy scenario*, the income elasticity of demand for agricultural goods ( $eY_{sec1}$ ) and the elasticity of substitution between labor and the capital-energy bundle for the transport via railways sector ( $\sigma P1_{sec24}$ ) are well separated from the others, indicating a large influence on equivalent variation, followed by a second group including (see figure 7.5.a-7.5.c. and table 7.21) the elasticity of substitution between capital and the energy bundle for real estate activities ( $\sigma P2_{sec30}$ ) and the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma P1_{sec1}$ ).

The elasticity of substitution between labor and the capital-energy bundle for railway transport ( $\sigma P1_{sec24}$ ) meets the *a priori* expectations, being policy scenario specific (see section 7.3.3). First of all, a large share of direct subsidies is directed towards railways public transport, 85 percent of the total subsidies supporting public passenger transport. Together with the high share of labor outlays (19 percent), and capital outlays (36.6 percent) in railways transport production this clarifies the importance of the elasticity of substitution between labor and the capital-energy bundle for the railways sector ( $\sigma P1_{sec24}$ ), through the consumer prices of these services and the households' capital and labor income originating from the sector, on the equivalent variation.

As explained above, the impact of the income elasticity of demand for agricultural goods ( $eY_{sec1}$ ) on equivalent variation is due to the high share of agricultural products in households' consumption budgets, while the importance of the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma P1_{sec1}$ ) can be explained by the large share of employment by the sector.

Less evident is the importance of the elasticity of substitution between capital and the energy bundle for real estate activities ( $\sigma P2_{sec30}$ ) with regard to equivalent variation. However, it must be kept in mind that the policy measure indirectly affects the real estate activities through the upwards adjustment in the energy prices. The

energy consumption represents about 9.4 percent of the intermediate consumption of the sector. Further, the high share of capital income originating from the sector, 16.5 percent of total capital income, coupled with the fall in the sector's profitability can provide a reasonable explanation why the parameter exerts an influence on equivalent variation through the effects on households' income and consumption budget.

Two additional parameters, the elasticity of substitution between capital and the energy bundle for the railways sector ( $\sigma_{P2sec24}$ ) and the real wage elasticity of labor supply ( $elasLS$ ), are identified as influential with regard to GDP at constant prices, while the elasticity of substitution between capital and the energy bundle for real estate activities ( $\sigma_{P2sec30}$ ) proves to be less influential in this case (see figure 7.5.d-7.5.f. and table 7.21). The elasticity of substitution between capital and the energy bundle for the transport via railways sector ( $\sigma_{P2sec24}$ ) meets the *a priori* expectations, being scenario specific. The large share of capital outlays in the railways transport production costs could further clarify such a result.

In the *non-neutral capital expenditures scenario*, the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma_{P1sec1}$ ) is well separated from the rest, showing the high importance of the parameter with regard to both equivalent variation and GDP at constant prices (see figure 7.6 and table 7.22). Again, the large size of the sector and the high share of employment in the sector could provide an explanation for this result. Two other parameters, the income elasticity of demand for agricultural goods ( $eYsec1$ ) and the real wage elasticity of labor supply ( $elasLS$ ), are identified as influential for both equivalent variation and GDP at constant prices, due to their effect on households' consumption and households' income, respectively.

The importance of the elasticity of substitution between labor and the capital-energy bundle for the wholesale and retail trade sector ( $\sigma_{P1sec22}$ ) with regard to equivalent variation is less apparent in this policy scenario. A possible explanation could be the relative large share of employment in the sector, 8.4 percent of total labor supply. The rise in private consumption of wholesale and retail trade services generates an adjustment in sectoral production and an increase in employment by the sector, with positive effects on households' income and consumption.

In the *neutral combined scenario*, the elasticity of substitution between capital and the energy bundle for the agricultural sector ( $\sigma_{P2sec1}$ ), the income elasticity of demand for mineral oils ( $eYsec3$ ), the real wage elasticity of labor supply ( $elasLS$ ) and the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma_{P1sec1}$ ) are identified as important with respect to both the equivalent variation and GDP at constant prices (see figure 7.7 and table 7.23). The income elasticity of demand for mineral oils ( $eYsec3$ ) could be connected to the relatively large rise in consumer prices including taxes for the mineral oils in this policy scenario compared to other commodities, and the high share of these products in the households' consumption budget, 5.3 percent. The other parameters identified as influential in this policy scenario are related to the effects induced through capital and labor income on the equivalent variation and GDP at constant prices.

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Table 7.24 provides a summary of the most influential parameters as identified with the help of the Morris method. These parameters will subsequently be examined in more detail using uncertainty and sensitivity analysis.

**Table 7.24. Parameters selected for applying the Sobol' method**

Parameters	VAT	VATN	EXC	EXCN	SUB	CAP	COMB
$\sigma P1sec1$	$\sigma P1sec1$	$\sigma P1sec1$	$\sigma P1sec1$	$\sigma P1sec1$	$\sigma P1sec1$	$\sigma P1sec1$	$\sigma P1sec1$
$\sigma P1sec22$						$\sigma P1sec22$	
$\sigma P1sec24$					$\sigma P1sec24$		
$\sigma P1sec35$	$\sigma P1sec35$	$\sigma P1sec35$					
$\sigma P2sec1$			$\sigma P2sec1$	$\sigma P2sec1$			$\sigma P2sec1$
$\sigma P2sec24$					$\sigma P2sec24$		
$\sigma P2sec30$					$\sigma P2sec30$		
$\sigma P2sec35$	$\sigma P2sec35$	$\sigma P2sec35$					
$\sigma L1sec3$			$\sigma L1sec3$				
$eYsec1$	$eYsec1$		$eYsec1$	$eYsec1$	$eYsec1$	$eYsec1$	
$eYsec3$			$eYsec3$	$eYsec3$			$eYsec3$
$eYsec35$	$eYsec35$	$eYsec35$					
elasLS	elasLS	elasLS	elasLS	elasLS	elasLS	elasLS	elasLS
frisch	frisch						

Note: VAT stands for the non-neutral VAT scenario; VATN stands for the neutral VAT scenario; EXC stands for the non-neutral excise scenario; EXCN stands for the neutral excise scenario; SUB stands for the non-neutral subsidy scenario; CAP stands for the non-neutral capital expenditures scenario; COMB stands for the neutral combined scenario. The notations used for the parameters in the table are explained in the previous tables (7.17-7.23) and in appendix 7.B, tables 7.B.1-7.B.9.

### 7.4.2. Uncertainty and sensitivity analysis: applying the Sobol' method

Uncertainty analysis is used to assess the uncertainty in the model's results (for example, the equivalent variation in income over a one-year period and the GDP at constant prices) due to the uncertainties in the model's parameters. To illustrate the basic idea of the uncertainty analysis, let's denote  $Y$  as any output variable from a specified policy simulation,  $\theta = (\theta_1, \theta_2, \dots, \theta_i, \dots, \theta_h)$  as the vector of exogenously specified elasticity values and other parameters which are considered a possible source of uncertainty that affect the output, and  $X$  the vector of policy parameters.  $G$  reflects the given structure of the model which maps the  $h$ -dimensional space of parameters ( $\theta$ ) and the vector of policy parameters to that of the output variable  $Y$ <sup>110</sup>:

$$Y = G(X; \theta_1, \theta_2, \dots, \theta_h) \quad (7.3)$$

<sup>110</sup> For convenience, in the following we drop the vector of policy parameters ( $X$ ) from the notation used for  $G$ .

Once an *a priori* distribution is assigned to each parameter  $\theta_i$  and a sample of size  $N$  is generated from the *a priori* distributions according to an appropriate design<sup>111</sup>, the model is evaluated at each sample point. The purpose of the uncertainty analysis then is the estimation of the probability density function of the model's output, which is obtained in this manner. The expected value and variance for the output variable can then be estimated, while a histogram can be used to describe the stochastic features of the model's results (Crosetto, Tarantola and Saltelli, 2000).

Uncertainty analysis methods based on a numerical integration procedure have been already used in the CGE modeling field to explore the mapping from the uncertainty in the model's inputs to the uncertainty in the model's results (Harrison and Vinod, 1992; Harrison et al., 1993; Arndt, 1996; DeVuyst and Preckel, 1997; Rutherford, Rutstrom and Tarr, 1997; Arndt and Pearson, 1998; Böhringer and Vogt, 2003). Most of them are sampling-based procedures (*i.e.* applying the Monte Carlo method). For example, Harrison and Vinod (1992) define a set of equiprobable values for each parameter considered to be a source of uncertainty, based on the *a priori* parameter's distribution. The parameters are assumed to be independently distributed. Then, they form the Cartesian product of these values and employ a stratified sampling design to estimate the mean of the population. Similar approaches have been applied by Harrison et al. (1993), Rutherford, Rutstrom and Tarr (1997) and Böhringer and Vogt (2003). Given that an approximation distribution for the model's parameters built in this manner understates the parameters variability and biases the results of uncertainty analysis, some other authors applied a method based on the Gaussian Quadrature procedure for numerical integration (Arndt, 1996; DeVuyst and Preckel, 1997; Arndt and Pearson, 1998). Their procedure also starts by defining an *a priori* joint distribution for the parameters considered to be a source of uncertainty. However, in order to propagate the uncertainty through the model, the parameters' values and the associated weights (probabilities) are selected such that they have the same lower-order moments as the joint parameter distribution. The method has the advantage of reducing greatly the computational burden, while more accurately reflecting the variability in the parameters distribution and thus in the distribution of the model's results. Furthermore, it is not necessary to assume that the parameters are independently distributed (DeVuyst and Preckel, 1997). However, neither of the methods applied so far in the CGE modeling field is able to evaluate in a straightforward manner how the variance of the model's results can be apportioned to the different sources of uncertainties in the parameters without *a priori* assuming a linear relationship between these parameters and the model's response.

In the following, we propose the use of a variance-based method (the Sobol' variance decomposition method), which is suitable for conducting both uncertainty and sensitivity analysis at no extra cost.

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<sup>111</sup> For example, the sample could be generated using Monte Carlo methods such as random sampling, stratified sampling, Latin Hypercube sampling (Helton and Davis, 2003) or quasi-random sampling (Sobol', 1990).

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Variance-based methods for sensitivity analysis are based on the so-called “sensitivity indices”, which estimate the fractional contribution of each parameter  $\theta_i$  to the variance of output  $Y$  (Archer, Saltelli and Sobol’, 1997). To derive the sensitivity indices for a set of orthogonal parameters ( $\theta$ ), the total unconditional variance of the model’s output ( $V$ ) is apportioned as:

$$V = \sum_i V_i + \sum_i \sum_{j>i} V_{ij} + \sum_i \sum_{j>i} \sum_{k>j} V_{ijk} + \dots + V_{12\dots h} \quad (7.4)$$

where

$$V_i = V(E(Y|\theta_i)) \quad (7.5)$$

$$V_{ij} = V(E(Y|\theta_i, \theta_j)) - V_i - V_j \quad (7.6)$$

$$V_{ijk} = V(E(Y|\theta_i, \theta_j, \theta_k)) - V_{ij} - V_{ik} - V_{jk} - V_i - V_j - V_k \quad (7.7)$$

and so on for a total of  $2^h - 1$  terms.  $V_i$ ,  $V_j$  and  $V_k$  represent the first-order effects of the parameters  $\theta_i$ ,  $\theta_j$  and  $\theta_k$ , respectively, on output ( $Y$ ).  $V_{ij}$  measures the joint effect  $V(E(Y|\theta_i, \theta_j))$  of the pair  $(\theta_i, \theta_j)$  on output minus the first-order effects for the parameters  $\theta_i$  and  $\theta_j$ . Thus,  $V_{ij}$  can be interpreted as the interaction effect<sup>112</sup> between the two independent parameters,  $\theta_i$  and  $\theta_j$ , on output ( $Y$ ).  $V_{ijk}$  further gives the interaction effect between  $\theta_i$ ,  $\theta_j$  and  $\theta_k$  on output. Finally  $V_{12\dots h}$  measures the joint effect of the set  $(\theta_1, \theta_2, \dots, \theta_h)$  on the output minus the first-order effects for the parameters  $\theta_1, \theta_2, \dots, \theta_h$  (Saltelli, Tarantola, Campolongo and Ratto, 2004). The other terms in (7.4) will be clarified subsequently (see equations (7.15) and (7.18)).

First-order effect indices ( $S_i$ ) could then be defined as:

$$S_i = \frac{V_i}{V} \quad (7.8)$$

which gives the fraction of the total variance of output  $Y$  which is due to individual parameters  $\theta_i$ <sup>113</sup>. It follows that if there are no interaction effects between the parameters:

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<sup>112</sup> Two parameters,  $\theta_i$  and  $\theta_j$ , are assumed to interact when their joint effect on output  $V(E(Y|\theta_i, \theta_j))$  is not equal to the sum of their single effects ( $V_i$  and  $V_j$ ) on output.

<sup>113</sup> In reality, we would like to rank the parameters  $\theta$  according to the reduction in output variance  $V(Y|\theta_i = \theta_i^*)$  that is attained when fixing  $\theta_i$  to its true value  $\theta_i^*$ . However, not knowing the true value

$$\sum_i S_i = I \quad (7.9)$$

The Sobol' method for the variance decomposition in (7.4) is based on the decomposition of a square integrable function  $g(\theta_1, \theta_2, \dots, \theta_h)$  defined in the  $h$ -dimensional unit hypercube<sup>114</sup> (Sobol', 1990):

$$g(\theta_1, \theta_2, \dots, \theta_h) = g_0 + \sum_i g_i(\theta_i) + \sum_{j>i} g_{ij}(\theta_i, \theta_j) + \dots + g_{12\dots h}(\theta_1, \theta_2, \dots, \theta_h) \quad (7.10)$$

Relation (7.10) is often called a high dimensional model representation (HDMR). Furthermore, if the following requirement (see equation (7.11)) is satisfied<sup>115</sup>, relation (7.10) is called an ANOVA<sup>116</sup> HDMR (Sobol', 2003):

$$\int_0^1 g_{i_1\dots i_s}(\theta_{i_1}, \dots, \theta_{i_s}) d\theta_k = 0 \quad \text{for } k = i_1, \dots, i_s \quad (7.11)$$

where  $1 \leq i_1 < \dots < i_s \leq h$ .

It follows from equation (7.11) that all members in the decomposition (7.10) are orthogonal, such that if  $(i_1, \dots, i_s)$  is not identical with  $(i_1, \dots, i_t)$  then:

$$\int g_{i_1\dots i_s} g_{i_1\dots i_t} d\theta = 0 \quad (7.12)$$

and can be expressed as integrals of  $g(\theta)$  (Sobol', 2003). Thus, integrating (7.10) over the  $h$ -dimensional unit hypercube results in:

$$\int g(\theta) d\theta = g_0 \quad (7.13)$$

integrating over all parameters except for  $\theta_i$  results in:

$$\int g(\theta) \prod_{k \neq i} d\theta_k = g_0 + g_i(\theta_i) \quad (7.14)$$

integrating over all parameters except for  $\theta_i$  and  $\theta_j$  results in:

$$\int g(\theta) \prod_{k \neq i, j} d\theta_k = g_0 + g_i(\theta_i) + g_j(\theta_j) + g_{ij}(\theta_i, \theta_j) \quad (7.15)$$

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corresponding to each  $\theta_i$ , it seems reasonable to average the above measure over all possible values  $\theta_i^*$  of  $\theta_i$ , which is given by  $E(V(Y|\theta_i))$ . Given that  $V = V(E(Y|\theta_i)) + E(V(Y|\theta_i))$ , the first-order effect index for  $\theta_i$  could be written as:  $S_i = (V - E(V(Y|\theta_i)))/V$  which is further equivalent to  $S_i = V(E(Y|\theta_i))/V$  (Saltelli, Tarantola, Campolongo and Ratto, 2004).

<sup>114</sup> Assuming that  $I$  is the unit interval  $[0, 1]$ ,  $I^h$  is the  $h$ -dimensional hypercube.

<sup>115</sup> The integrals below are defined from 0 to 1 for each variable and  $d\theta = d\theta_1 \dots d\theta_h$ .

<sup>116</sup> ANOVA comes from the analysis of variance (Archer, Saltelli and Sobol', 1997).

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and so on (Sobol', 2003) until all  $(h-1)$  dimensional members in (7.10) are defined. The last member  $g_{12\dots h}(\theta_1, \theta_2, \dots, \theta_h)$  is then derived from relation (7.10).

Given the assumption that  $g(\theta_1, \theta_2, \dots, \theta_h)$  is square integrable, all members  $g_{i_1, \dots, i_s}(\theta_{i_1}, \theta_{i_2}, \dots, \theta_{i_s})$  in (7.10) are square integrable. Thus, squaring (7.10) and integrating over the  $h$ -dimensional unit hypercube yields:

$$\int g^2(\theta) d\theta - g_0^2 = \sum_{s=1}^h \sum_{i_1 < \dots < i_s} \int g_{i_1, \dots, i_s}^2(\theta_{i_1}, \dots, \theta_{i_s}) d\theta_{i_1} \dots d\theta_{i_s} \quad (7.16)$$

where the total unconditional variance ( $V$ ) corresponding to  $g(\theta)$  can be defined as:

$$V = \int g^2(\theta) d\theta - g_0^2 \quad (7.17)$$

and the variances ( $V_{i_1, \dots, i_s}$ ) corresponding to  $g_{i_1, \dots, i_s}(\theta_{i_1}, \dots, \theta_{i_s})$  are given by:

$$V_{i_1, \dots, i_s} = \int g_{i_1, \dots, i_s}^2(\theta_{i_1}, \dots, \theta_{i_s}) d\theta_{i_1} \dots d\theta_{i_s} \quad (7.18)$$

such that we arrive at (7.4).

The Sobol' decomposition method can be summarized as follows: given  $\theta$ , a random point uniformly distributed in the  $h$ -dimensional unit hypercube, then  $g(\theta)$  and all members  $g_{i_1, \dots, i_s}(\theta_{i_1}, \dots, \theta_{i_s})$  of (7.10) would be random variables and their variances are  $V$  and  $V_{i_1, \dots, i_s}$ , respectively (Sobol', 2003).

The variances  $V$  and  $V_{i_1, \dots, i_s}$ , and thus the sensitivity indices  $S_{i_1, \dots, i_s}$ , can be computed directly by multidimensional Monte Carlo integration. However, there are as many as  $2^h - 1$  terms in the variance decomposition (7.4), and a separate sample would be needed to compute each of these terms which makes the approach unpractical even for a moderate number of parameters ( $h$ ) (Homma and Saltelli, 1996). To avoid the "curse of dimensionality", the total effect sensitivity index ( $S_{T_i}$ ) can be computed instead for each of the  $h$  parameters. This total effect index gives the fraction of the total output variance due to any individual parameter  $\theta_i$  and the interactions between the parameter  $\theta_i$  and any other  $(h-1)$  parameters.  $S_{T_i}$  can be derived by first defining the conditional variance  $V(E(Y|\theta_{-i}))$ , which represents the contribution to the variance of output  $Y$  due to the non- $\theta_i$  (the  $h-1$  remaining parameters). The total effect index for parameter  $\theta_i$  can then be computed as:

$$S_{T_i} = \frac{V - V(E(Y|\theta_{-i}))}{V} \quad (7.19)$$

where the difference:  $V - V(E(Y|\theta_{-i}))$  reflects all terms in the variance decomposition (7.4) that include  $\theta_i$ <sup>117</sup>. For details on the numerical integration procedure, see Saltelli (2002).

The computation of the first-order effect indices and total effect indices provides a good description of the model's output sensitivity at a relatively low cost. To summarize, the first-order effect indices give us the contribution of each individual parameter to the output variance and the total order effects indices provide the contribution of each individual parameter and its interaction effects with the remaining parameters to the output variance. Thus, by comparing the first-order effect index with the total order effect index for each parameter  $\theta_i$ , we could get an idea of the interaction effects of parameter  $\theta_i$ . If  $S_{T_i}$  is significantly different from  $S_i$  it means that for parameter  $\theta_i$  interactions play an important role in the variance of  $Y$  (Saltelli, Tarantola, Campolongo and Ratto, 2004).

In order to assess the uncertainty in the model's results (uncertainty analysis) and to derive the first-order effect indices and the total effect indices (sensitivity analysis) corresponding to the parameters which are considered to be a source of uncertainty in RoMod, the SIMLAB software has been used together with GAMS. SIMLAB has been used in the initial stage to generate the random samples for the orthogonal parameters  $\theta_i$ . Then, GAMS has been applied to solve the model at each sample point and then SIMLAB again in the final stage to calculate the first-order effect indices and the total effect indices. Only the truly influential parameters, selected with the help of the Morris method (see table 7.24), have been tested for each of the policy scenarios presented in section 7.3. A sample size ( $N$ ) of 256 has been adopted for this purpose. This amounts to 4096 model evaluations for each year for the non-neutral VAT scenario, 3072 evaluations for the neutral VAT scenario, 3584 for the non-neutral excise scenario, 3072 for the neutral excise scenario, 3584 for the non-neutral subsidy scenario, 2560 for the non-neutral capital expenditures scenario and 2560 for the neutral combined scenario<sup>118</sup>.

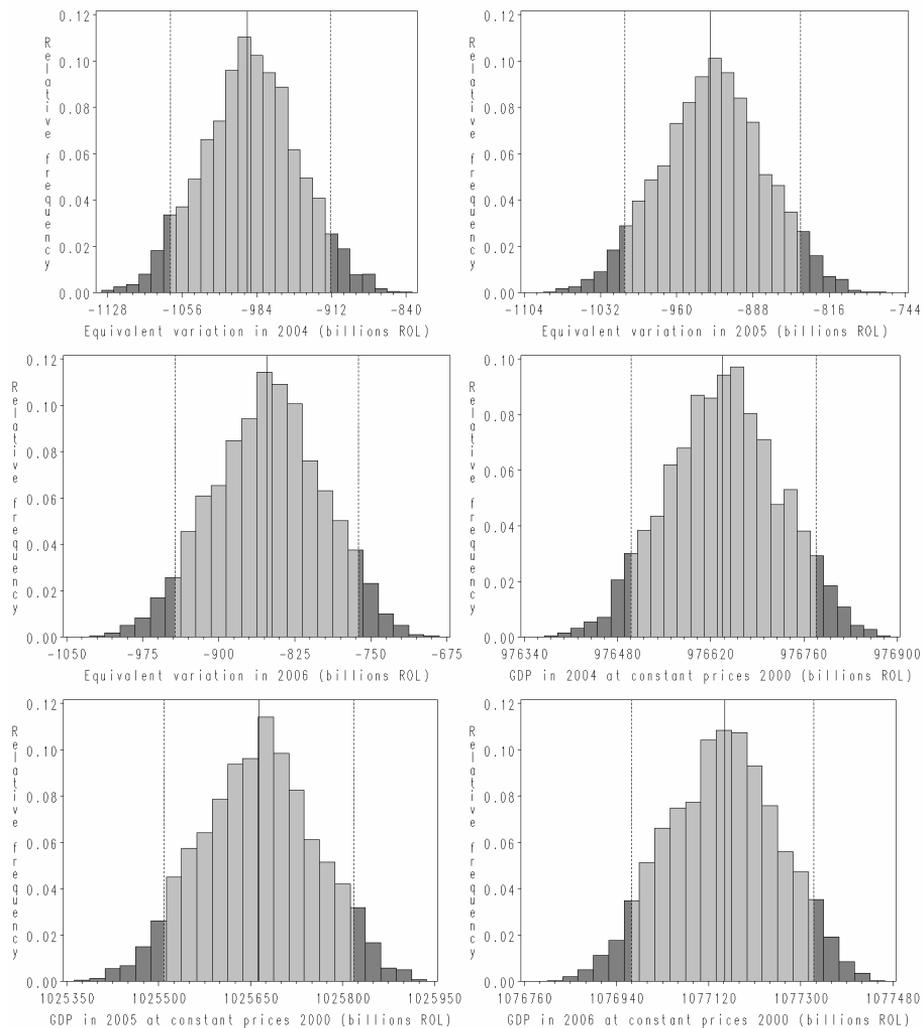
The results of the uncertainty analysis corresponding to each policy scenario are presented in tables 7.25-7.31 and figures 7.8-7.14.

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<sup>117</sup> The computation of the total effect indices, using the Sobol' method, is very handy given that decomposition (7.4) could be written by grouping parameters into subsets. Thus, if we partition the  $h$  parameters into two subsets  $u$  and  $v$ , the decomposition (7.4) yields:  $V = V_u + V_v + V_{uv}$ . Assuming that subset  $u$  contains only the parameter  $\theta_i$  while the subset  $v$  contains the rest of  $h-1$  parameters, we could subsequently write:  $I = S_i + S_v + S_{iv}$ , where  $S_i$  and  $S_v$  give the first order effects and  $S_{iv}$  gives the interaction effect between  $\theta_i$  and the rest of the parameters of the subset  $v$ . Subsequently, the total order effect for parameter  $\theta_i$  is given by:  $S_{T_i} = S_i + S_{iv} = I - S_v$ . (Campolongo and Saltelli, 1997).

<sup>118</sup> The number of model evaluations is given by  $N(2h+2)$ , where  $N$  gives the sample size and  $h$  the number of parameters under study. For a discussion on the Monte Carlo integration procedure and the number of model evaluations needed to compute the first-order effects indices and total order effect indices using the Sobol' method, see Saltelli (2002).

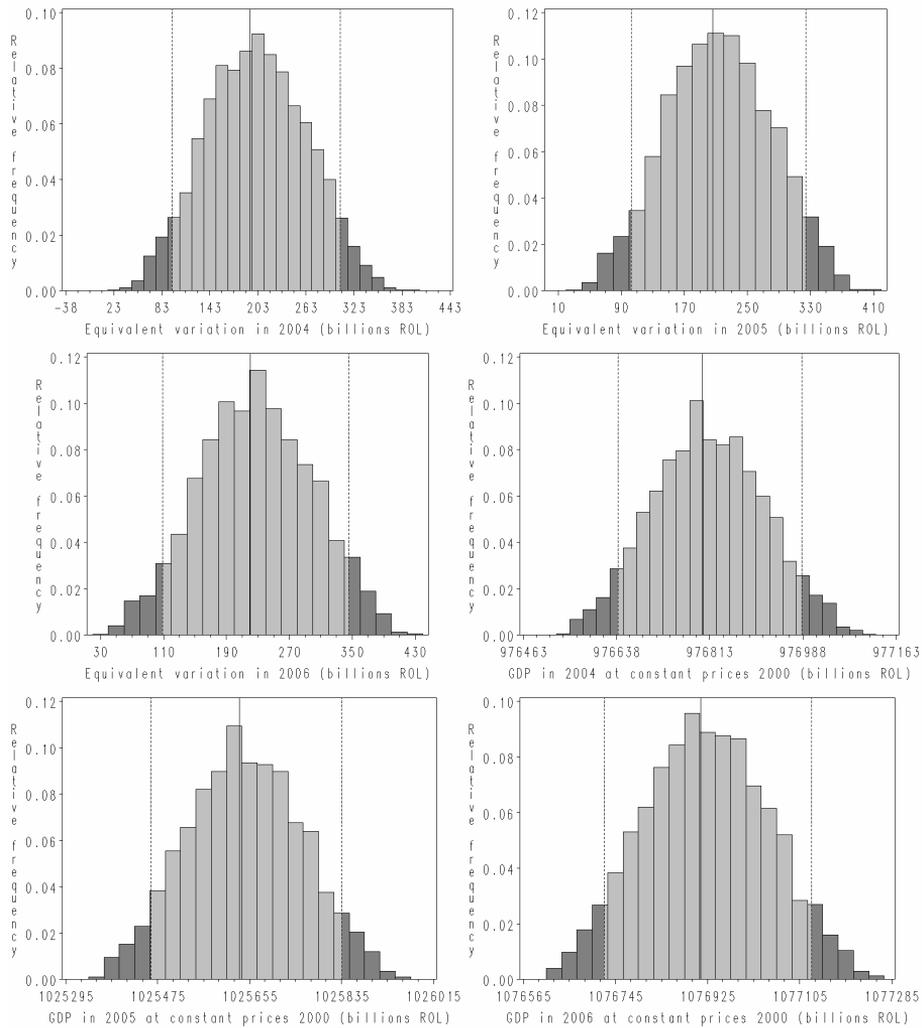
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**Figure 7.8. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (non-neutral VAT scenario)**

**Table 7.25. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (non-neutral VAT scenario)**

Uncertainty analysis results	Point estimate	Mean	Median	Standard deviation	5% quantile	95% quantile
	(1)	(2)	(3)	(4)	(5)	(6)
EV 2004	-993	-990	-990	46	-1,067	-913
EV 2005	-928	-926	-925	49	-1,009	-843
EV 2006	-853	-852	-851	54	-943	-762
GDP 2004	976,638	976,639	976,640	84	976,500	976,779
GDP 2005	1,025,664	1,025,663	1,025,664	94	1,025,509	1,025,819
GDP 2006	1,077,152	1,077,148	1,077,150	109	1,076,970	1,077,326

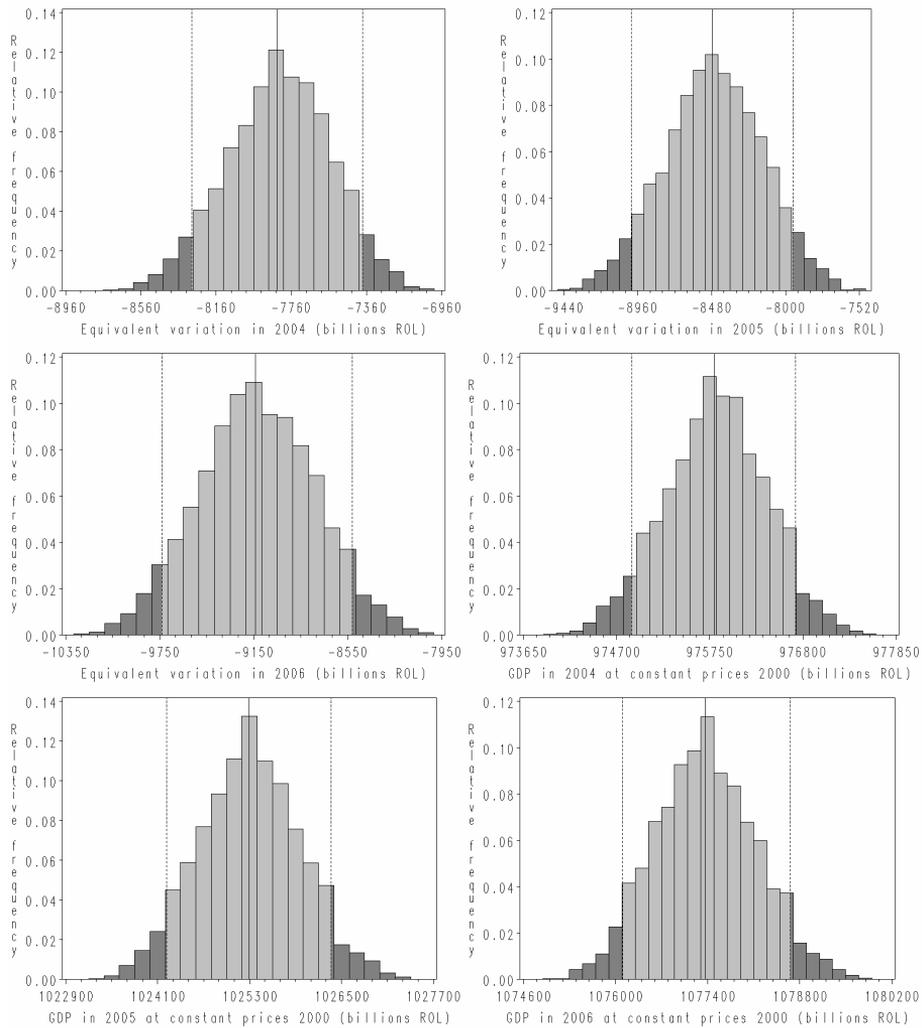


**Figure 7.9. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (neutral VAT scenario)**

**Table 7.26. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (neutral VAT scenario)**

Uncertainty analysis results	Point estimate	Mean	Median	Standard deviation	5% quantile	95% quantile
	(1)	(2)	(3)	(4)	(5)	(6)
EV 2004	193	201	200	62	96	305
EV 2005	207	214	214	66	103	324
EV 2006	220	227	226	71	109	346
GDP 2004	976,799	976,810	976,808	104	976,640	976,986
GDP 2005	1,025,635	1,025,646	1,025,644	112	1,025,462	1,025,836
GDP 2006	1,076,912	1,076,922	1,076,920	121	1,076,723	1,077,128

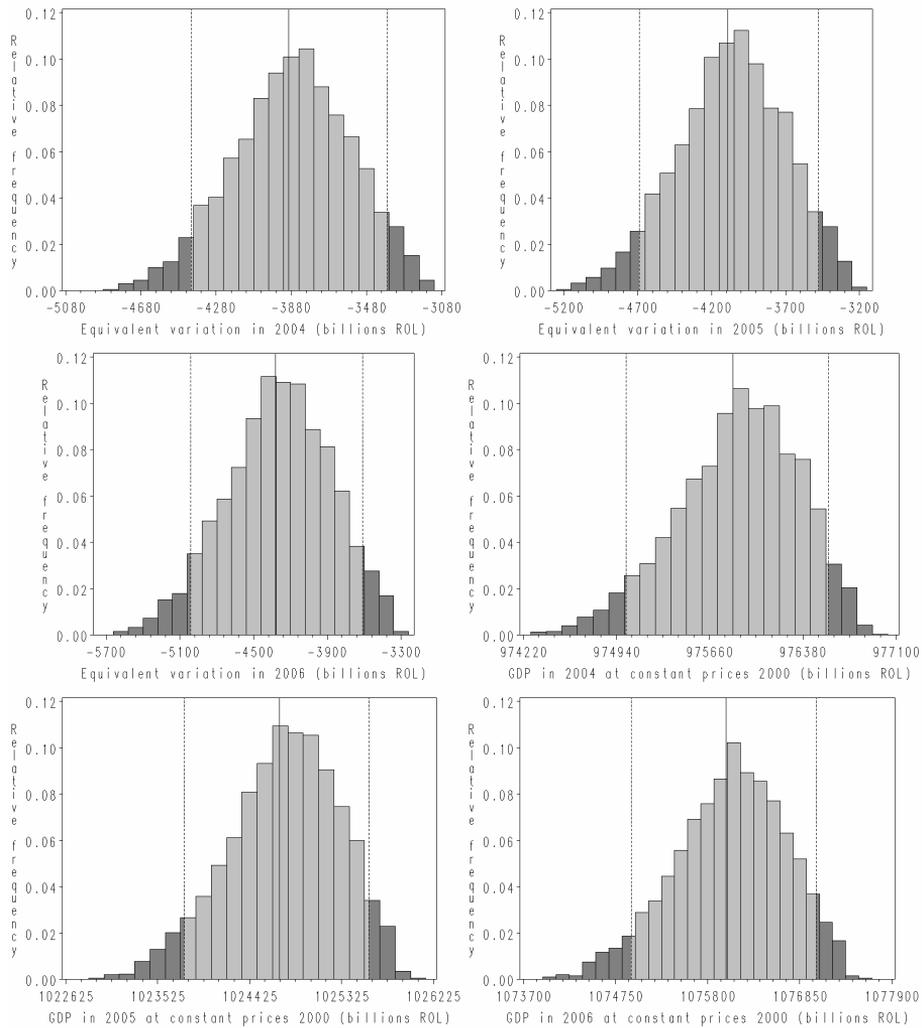
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**Figure 7.10. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (non-neutral excise scenario)**

**Table 7.27. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (non-neutral excise scenario)**

Uncertainty analysis results	Point estimate	Mean	Median	Standard deviation	5% quantile	95% quantile
	(1)	(2)	(3)	(4)	(5)	(6)
EV 2004	-7,836	-7,825	-7,817	274	-8,290	-7,384
EV 2005	-8,477	-8,467	-8,464	318	-9,002	-7,951
EV 2006	-9,138	-9,128	-9,136	368	-9,735	-8,522
GDP 2004	975,808	975,819	975,826	568	974,876	976,715
GDP 2005	1,025,298	1,025,302	1,025,298	661	1,024,219	1,026,364
GDP 2006	1,077,371	1,077,368	1,077,364	774	1,076,115	1,078,659

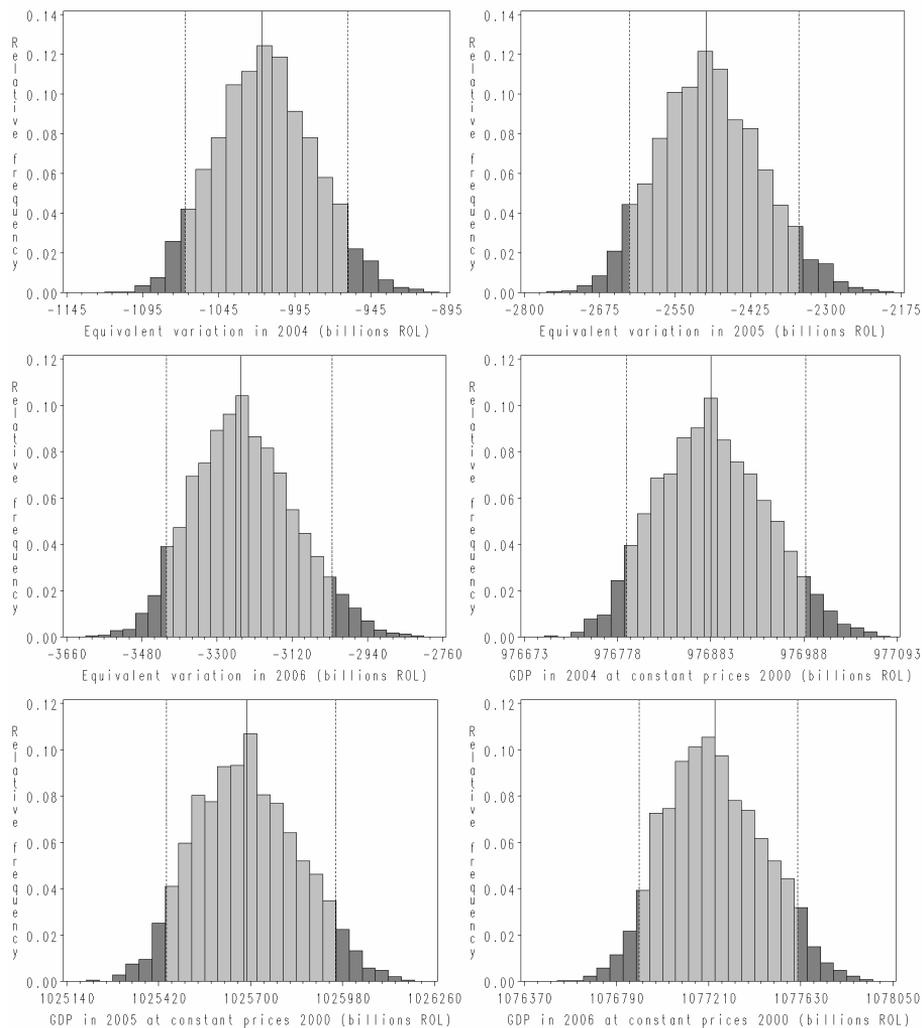


**Figure 7.11. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (neutral excise scenario)**

**Table 7.28. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (neutral excise scenario)**

Uncertainty analysis results	Point estimate	Mean	Median	Standard deviation	5% quantile	95% quantile
	(1)	(2)	(3)	(4)	(5)	(6)
EV 2004	-3,895	-3,875	-3,865	312	-4,413	-3,371
EV 2005	-4,090	-4,067	-4,053	364	-4,688	-3,476
EV 2006	-4,324	-4,296	-4,283	423	-5,015	-3,614
GDP 2004	975,842	975,879	975,907	467	975,014	976,579
GDP 2005	1,024,720	1,024,761	1,024,799	545	1,023,785	1,025,592
GDP 2006	1,076,011	1,076,058	1,076,093	633	1,074,934	1,077,039

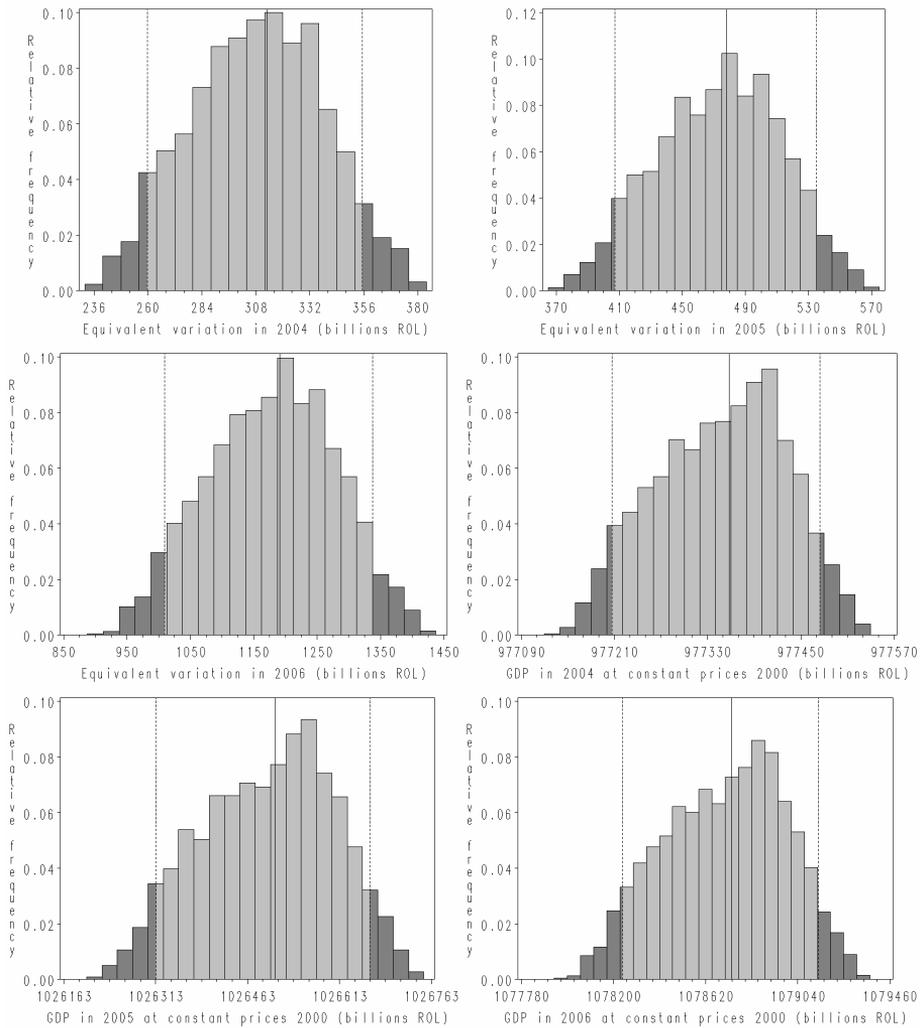
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**Figure 7.12. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (non-neutral subsidy scenario)**

**Table 7.29. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (non-neutral subsidy scenario)**

Uncertainty analysis results	Point estimate	Mean	Median	Standard deviation	5% quantile	95% quantile
	(1)	(2)	(3)	(4)	(5)	(6)
EV 2004	-1,017	-1,014	-1,015	32	-1,067	-960
EV 2005	-2,498	-2,492	-2,494	86	-2,626	-2,345
EV 2006	-3,242	-3,235	-3,241	121	-3,421	-3,025
GDP 2004	976,883	976,884	976,883	62	976,788	976,989
GDP 2005	1,025,688	1,025,689	1,025,683	158	1,025,445	1,025,958
GDP 2006	1,077,240	1,077,238	1,077,224	224	1,076,894	1,077,617

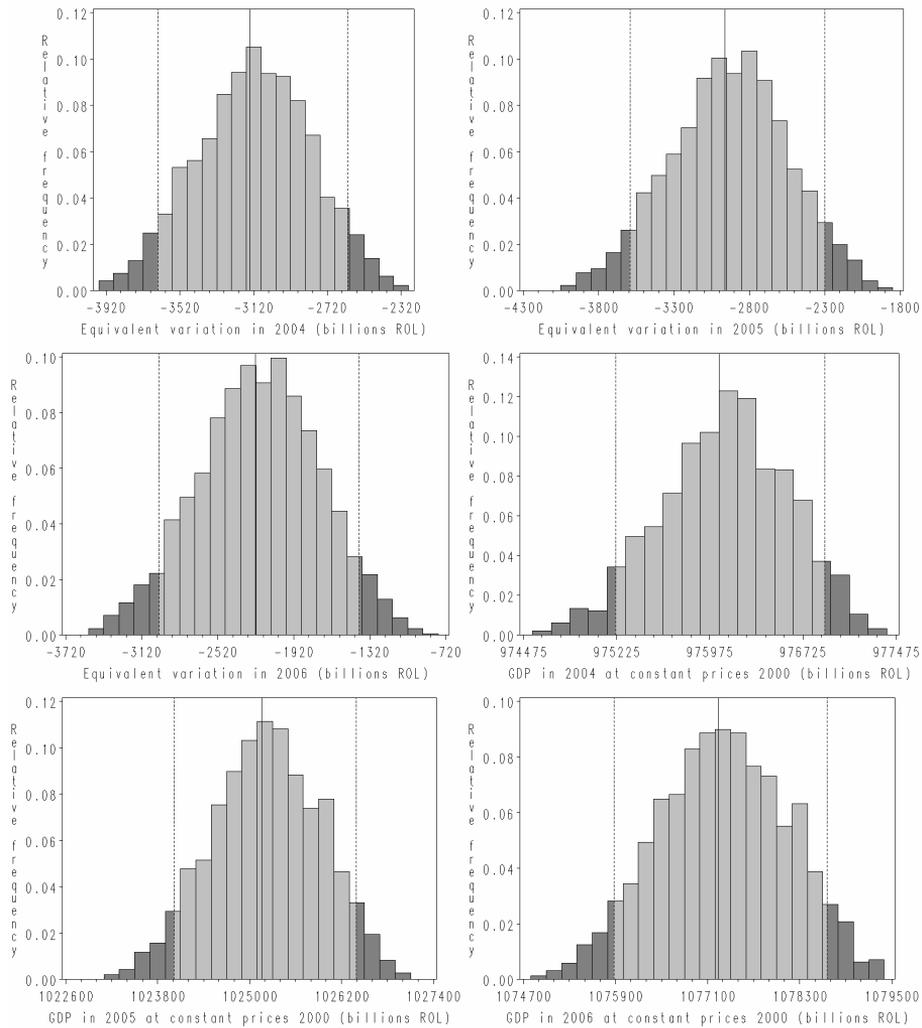


**Figure 7.13. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (non-neutral capital expenditures scenario)**

**Table 7.30. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (non-neutral capital expenditures scenario)**

Uncertainty analysis results	Point estimate	Mean	Median	Standard deviation	5% quantile	95% quantile
	(1)	(2)	(3)	(4)	(5)	(6)
EV 2004	313	309	310	29	260	355
EV 2005	478	473	476	39	407	535
EV 2006	1,191	1,178	1,184	100	1,009	1,337
GDP 2004	977,358	977,348	977,356	83	977,207	977,475
GDP 2005	1,026,507	1,026,496	1,026,504	108	1,026,313	1,026,661
GDP 2006	1,078,739	1,078,709	1,078,732	277	1,078,242	1,079,133

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**Figure 7.14. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (neutral combined scenario)**

**Table 7.31. Uncertainty analysis of the equivalent variation and real GDP in billions of ROL (neutral combined scenario)**

Uncertainty analysis results	Point estimate	Mean	Median	Standard deviation	5% quantile	95% quantile
	(1)	(2)	(3)	(4)	(5)	(6)
EV 2004	-3,141	-3,117	-3,111	308	-3,638	-2,611
EV 2005	-2,962	-2,933	-2,925	390	-3,590	-2,299
EV 2006	-2,223	-2,193	-2,187	475	-2,980	-1,406
GDP 2004	976,050	976,097	976,117	509	975,220	976,904
GDP 2005	1,025,160	1,025,218	1,025,227	711	1,024,015	1,026,395
GDP 2006	1,077,247	1,077,297	1,077,296	844	1,075,885	1,078,661

The tables contain the results corresponding to the point estimate<sup>119</sup> of the selected parameters in terms of the equivalent variation in income in billions ROL (for 2004-2006) and of the real GDP in billions ROL (for 2004-2006) together with the mean, median, standard deviation and the 5% and 95% quantiles.

Further, histograms corresponding to the equivalent variation and the real GDP (given in figures 7.8-7.14) provide more information on the stochastic features of the model's results. The welfare effect or the change in the real GDP resulting from the point estimate is indicated by a vertical line in each one of the histograms, while dashed vertical lines indicate the 5% and 95% quantiles.

Examination of tables 7.25-7.31 reveals that the results corresponding to the point estimate are close to the mean and the median values in the uncertainty analysis for each policy scenario. Furthermore, we note that the standard deviations of the distributions for the real GDP are very small in all scenarios. This is not always the case, however, for the distributions relating to the equivalent variation. Some considerable spread can be observed in the neutral VAT (table 7.26) and the neutral combined (table 7.31) scenarios and fairly considerable spread in the neutral excise (table 7.28) and in the non-neutral capital expenditures (table 7.30) scenarios. The results will be examined in more detail using the sensitivity analysis.

Saltelli, Tarantola, Campolongo and Ratto (2004) suggest the use of cumulative area plots for the presentation of sensitivity indices for time-dependent model results. Thus, the first-order effect indices and the total effect indices corresponding to the equivalent variation and the real GDP in each policy scenario are presented in figures 7.15-7.28 in this fashion<sup>120</sup>. The notations used for the parameters have already been described in section 7.4.1.

In the *non-neutral VAT scenario*, the income elasticity of demand for other community services (eYsec35) accounts for more than 31 percent of the variance of the equivalent variation and more than 33 percent of the variance of real GDP in all three years (see figures 7.15-7.16). This parameter is scenario specific and is also identified as most influential by the Morris method. The interaction effect plays a marginal role with respect to all parameters. The largest interaction effects could be attributed to the elasticity of substitution between labor and the capital-energy bundle ( $\sigma P1sec35$ ) and the elasticity of substitution between capital and the energy bundle ( $\sigma P2sec35$ ) for other community services. However, they only represent between 2 and 4 percent of the variance of the equivalent variation and real GDP in all three years (see figures 7.15-7.16 and appendix 7.B, tables 7.B.11 and 7.B.13). It appears that the Morris method correctly identifies the interaction effects in which the two parameters are involved (see figure 7.1, section 7.4.1).

In the *neutral VAT scenario*, only two parameters, the income elasticity of demand for other community, social and personal services (eYsec35) and the real wage

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<sup>119</sup> The point estimate corresponds to the initial values of the parameters (presented in chapter 6) used to run the policy scenarios in section 7.3.

<sup>120</sup> The detailed results for the first-order effect indices and total effect indices are provided in appendix 7.B, tables 7.B.11, 7.B.13, 7.B.15, 7.B.17, 7.B.19, 7.B.21, 7.B.23, 7.B.25, 7.B.27, 7.B.29, 7.B.31, 7.B.33, 7.B.35, 7.B.37.

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elasticity of labor supply ( $\text{elasLS}$ ) drive more than 70 percent of the equivalent variation and the real GDP variance in all three years (see figures 7.17-7.18). Both parameters are scenario specific (see section 7.4.1). An additional 15 percent of the variance of the equivalent variation is explained by the elasticity of substitution between labor and the capital-energy bundle for other community services ( $\sigma_{P1sec35}$ ), and an additional 20 percent of the variance of the real GDP by the elasticity of substitution between labor and the capital-energy bundle for agricultural sector ( $\sigma_{P1sec1}$ ). Again, the interaction effects are marginal, accounting for less than one percent of real GDP variance in all three years. Furthermore, the interaction effects in which the elasticity of substitution between labor and the capital-energy bundle for other community services ( $\sigma_{P1sec35}$ ) and the elasticity of substitution between capital and the energy bundle for other community services ( $\sigma_{P2sec35}$ ) are involved only account for about 1 percent of the variance of the equivalent variation in this case (see figures 7.17-7.18 and appendix 7.B, tables 7.B.15 and 7.B.17). Over time the contribution to the variance in the equivalent variation and real GDP changes (see figures 7.15-7.18). The most notable adjustment could be observed with regard to the elasticity of substitution between labor and the capital-energy bundle for agricultural sector ( $\sigma_{P1sec1}$ ), probably due to the high share of labor income originating from the sector and the change in the real wage rate over time.

In the *non-neutral excise scenario*, more than 55 percent of the variance of the equivalent variation is driven by the income elasticity of demand for agricultural goods ( $eYsec1$ ) and the elasticity of substitution between capital and the energy bundle for the agricultural sector ( $\sigma_{P2sec1}$ ), due to the indirect effects of the policy measure (see section 7.4.1 for details). With regard to the real GDP the highest importance is attributed to the income elasticity of demand for agricultural goods ( $eYsec1$ ), about 30 percent of the real GDP variance, followed by a scenario specific parameter, the income elasticity of demand for mineral oils ( $eYsec3$ ) which contributes another 20 percent of the variance of real GDP (see figures 7.19-7.20). The interaction effects appear to be more important in this policy scenario. About 4 percent of the variance of the equivalent variation and about 7 percent of that of the real GDP originate from the interaction effects of the elasticity of substitution between labor and the capital-energy bundle for agricultural sector ( $\sigma_{P1sec1}$ ) with other parameters. Another 4 percent of the variance of the equivalent variation and 6 percent of real GDP originates from the interaction effects in which the elasticity of substitution between capital and the energy bundle for agricultural sector ( $\sigma_{P2sec1}$ ) is involved (see appendix 7.B, tables 7.B.19 and 7.B.21).

In the *neutral excise scenario*, almost equal importance is attributed to the elasticity of substitution between capital and the energy bundle for agricultural sector ( $\sigma_{P2sec1}$ ) and the income elasticity of demand for mineral oils ( $eYsec3$ ) with respect to equivalent variation. Together, they give rise to more than 80 percent of the variance of the equivalent variation (see figure 7.21). Using the Morris method the same two parameters are identified as most influential. The interaction effects in which the elasticity of substitution between capital and the energy bundle for agricultural sector ( $\sigma_{P2sec1}$ ) and the elasticity of substitution between labor and the capital-energy bundle for agricultural sector ( $\sigma_{P1sec1}$ ) are involved account each for 2 percent of the variance of the equivalent variation (see figure 7.21 and appendix

7.B, table 7.B.23). Thus, the interaction effects are correctly identified by the Morris method, given that both parameters lie in the  $\mu < \sigma$  zone of the plane  $(\mu, \sigma)$  (see figure 7.4.a-7.4.c, section 7.4.1). The elasticity of substitution between labor and the capital-energy bundle for the agricultural sector ( $\sigma P1sec1$ ) contributes most to the variance of real GDP, about 35 percent, followed by the income elasticity of demand for mineral oils ( $eYsec3$ ) with another 25 percent. The parameters involved in interaction effects in this case are the same ones as for the equivalent variation. However their interaction effects account for about 6 percent of the variance of real GDP, each (see figure 7.22 and appendix 7.B, table 7.B.25).

In the *non-neutral subsidy scenario*, the income elasticity of demand for agricultural goods ( $eYsec1$ ) and the elasticity of substitution between labor and the capital-energy bundle for the railways sector ( $\sigma P1sec24$ ) provide more than 63 percent of the variance of the equivalent variation and more than 52 percent of the variance of the real GDP. The ranking of the parameters with respect to the real GDP is slightly changed compared to the Morris method. In general, the Sobol' method is regarded as more accurate than the Morris method. Therefore, the slight differences in the ranking of the parameters are not surprising. It is important to note that again one of the parameters accounting for most of the variance in the model's results is policy scenario specific (the elasticity of substitution between labor and the capital-energy bundle for the railways sector ( $\sigma P1sec24$ )) while the importance of the other (the income elasticity of demand for agricultural goods ( $eYsec1$ )) is driven by the indirect effects of the policy measure and its weight in the structure of the database.

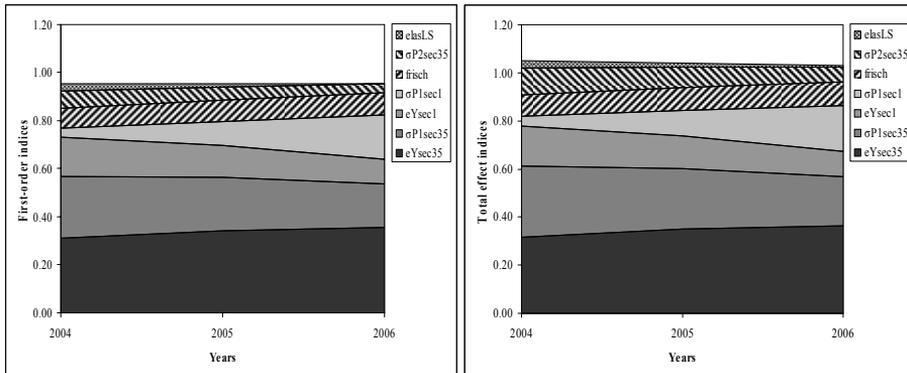
Interaction effects are identified for most parameters, although more important seem to be the ones in which the elasticity of substitution between labor and the capital-energy bundle for transport via railways sector ( $\sigma P1sec24$ ) and the elasticity of substitution between capital and the energy bundle for railways transportation ( $\sigma P2sec24$ ) are involved (see figures 7.23-7.24 and appendix 7.B, tables 7.B.27 and 7.B.29). Again, the interaction effects are correctly identified by the Morris method (see figure 7.5, section 7.4.1).

In the *non-neutral capital expenditures scenario*, the elasticity of substitution between labor and the capital-energy bundle for agriculture ( $\sigma P1sec1$ ) alone causes more than 72 percent of the variance of the equivalent variation and more than 83 percent of the variance of the real GDP (see figures 7.25-7.26 and appendix 7.B, tables 7.B.31 and 7.B.33). Also this parameter is identified as influential due to its part in indirect effects of the policy measure and the structure of the database (see section 7.4.1 for more details). The parameter is also involved in interaction effects, but they only account for about 1 percent of the variance of the equivalent variation and of the real GDP.

In the *neutral combined scenario*, almost equal contributions to the variance of the equivalent variation are generated by the elasticity of substitution between capital and the energy bundle for agriculture ( $\sigma P2sec1$ ) and the income elasticity of demand for mineral oils ( $eYsec3$ ), with more than 33 percent each (see figure 7.27). The most influential parameters with regard to the real GDP are the elasticity of substitution between labor and the capital-energy bundle for the agricultural sector

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( $\sigma P1sec1$ ) and the real wage elasticity of labor supply ( $elasLS$ ), which account together for more than 60 percent of its variance (see figure 7.28). Hence, it seems that the most influential parameters in this scenario derive their impact from the indirect effects of the policy measures and from the weight of certain sectors in the structure of the database. Given the comprehensive nature of the scenario, this will not come as a surprise. The importance of the real wage elasticity of labor supply ( $elasLS$ ) can be explained by the reduction in the labor tax distortion. In fact the parameter is identified as influential in all policy scenarios due to its direct effect on labor supply and thus on households' income and consumption budgets. The elasticity of substitution between capital and the energy bundle for agriculture ( $\sigma P2sec1$ ) and the elasticity of substitution between labor and the capital-energy bundle for the same sector ( $\sigma P1sec1$ ) are further involved in interaction effects as also suggested by the Morris method (see figure 7.7, section 7.4.1). The steep decline in the influence of the elasticity of substitution between labor and the capital-energy bundle ( $\sigma P1sec1$ ) and the elasticity of substitution between capital and the energy bundle ( $\sigma P2sec1$ ) for agriculture on the real GDP during time may be attributed to the recycling scheme, which favors employment in labor intensive sectors and reduces the negative effects on the households' income and consumption. The highest reduction in social security contributions, which leads to the largest adjustment in the real wage rate, is achieved in 2006. This can also explain the increasing importance of the real wage elasticity of labor supply over time.



**Figure 7.15. Sobol' first-order indices and total effect indices with respect to the equivalent variation (EV) (non-neutral VAT scenario)**

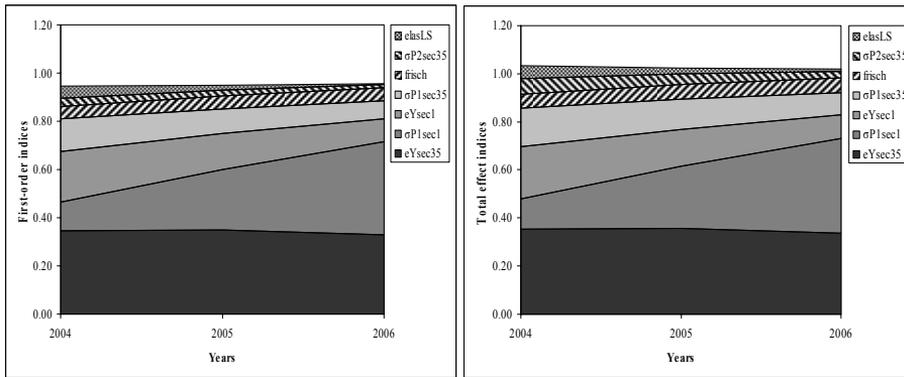


Figure 7.16. Sobol' first-order indices and total effect indices with respect to the real GDP (non-neutral VAT scenario)

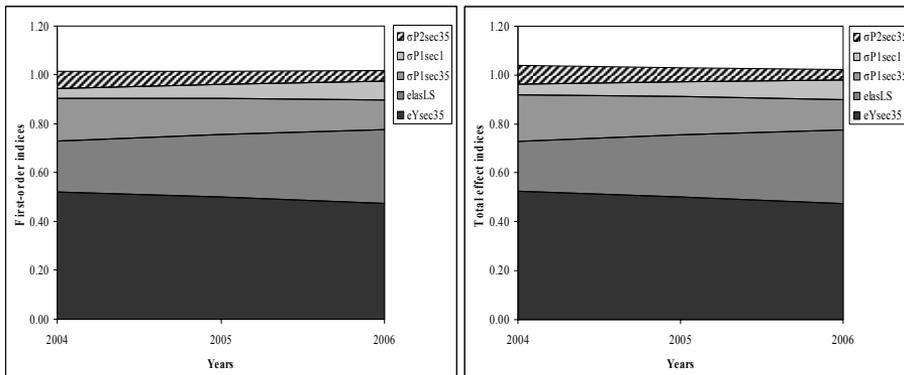


Figure 7.17. Sobol' first-order indices and total effect indices with respect to the equivalent variation (EV) (neutral VAT scenario)

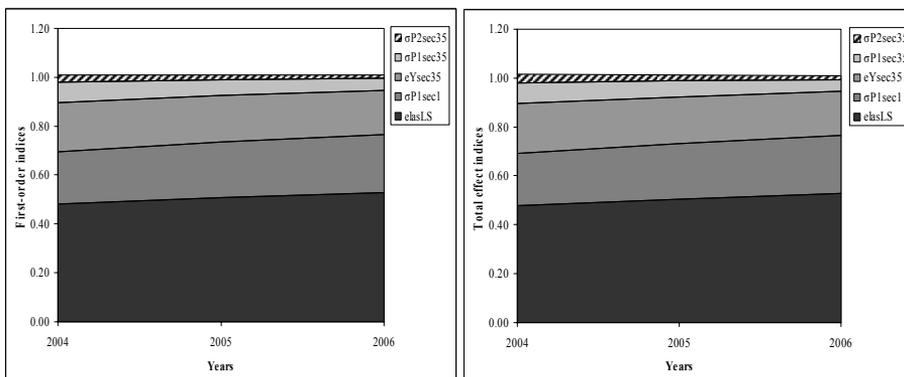
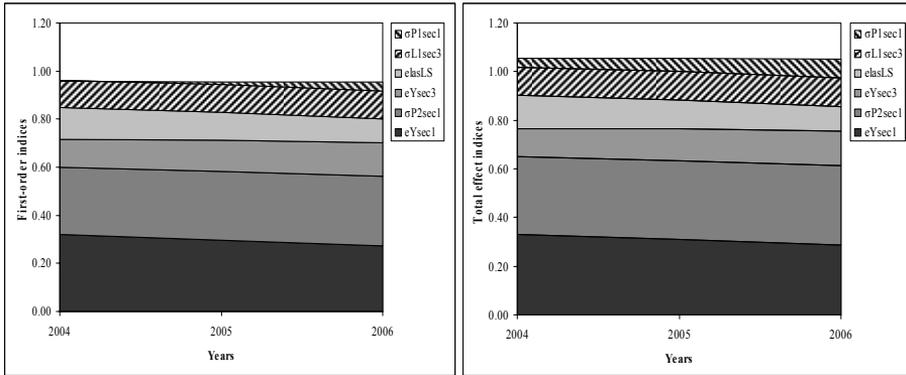
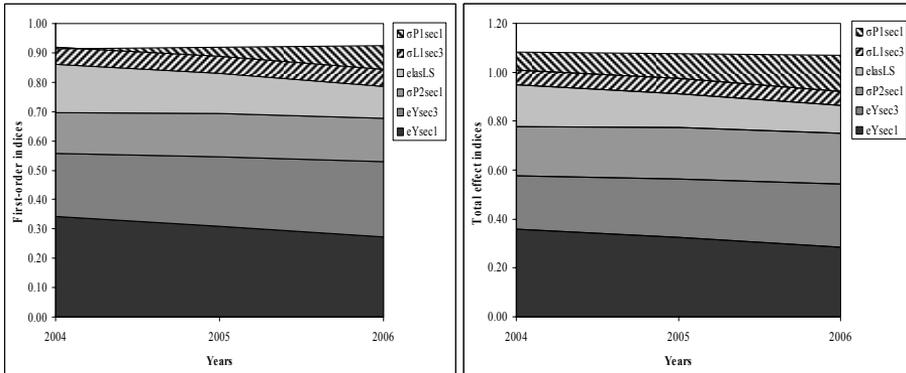


Figure 7.18. Sobol' first-order indices and total effect indices with respect to the real GDP (neutral VAT scenario)

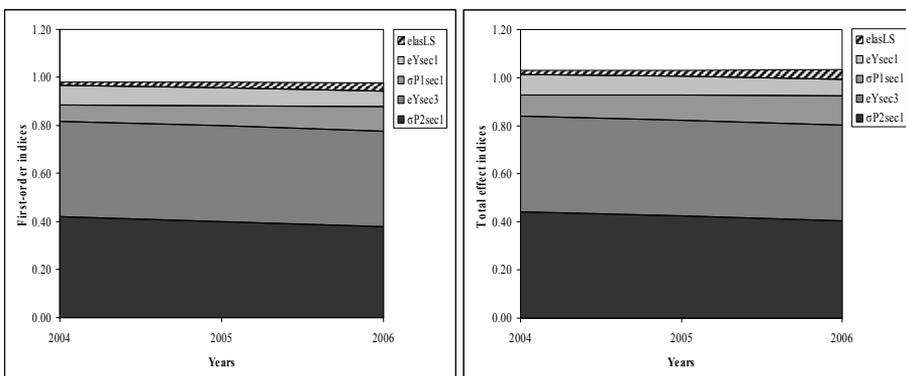
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**Figure 7.19. Sobol' first-order indices and total effect indices with respect to the equivalent variation (EV) (non-neutral excise scenario)**



**Figure 7.20. Sobol' first-order indices and total effect indices with respect to the real GDP (non-neutral excise scenario)**



**Figure 7.21. Sobol' first-order indices and total effect indices with respect to the equivalent variation (EV) (neutral excise scenario)**

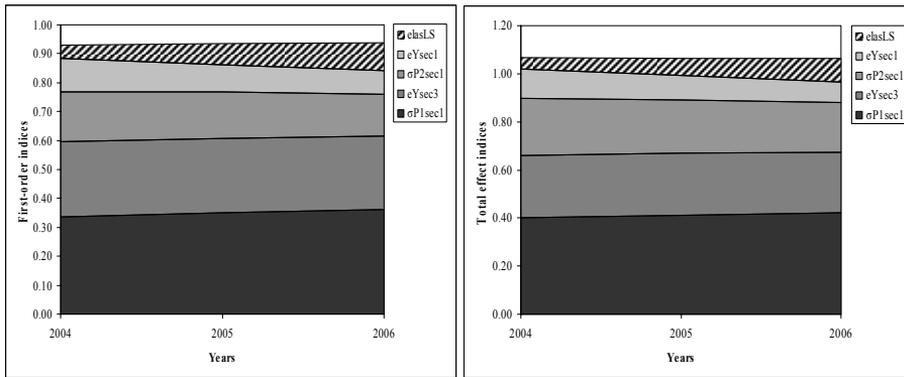


Figure 7.22. Sobol' first-order indices and total effect indices with respect to the real GDP (neutral excise scenario)

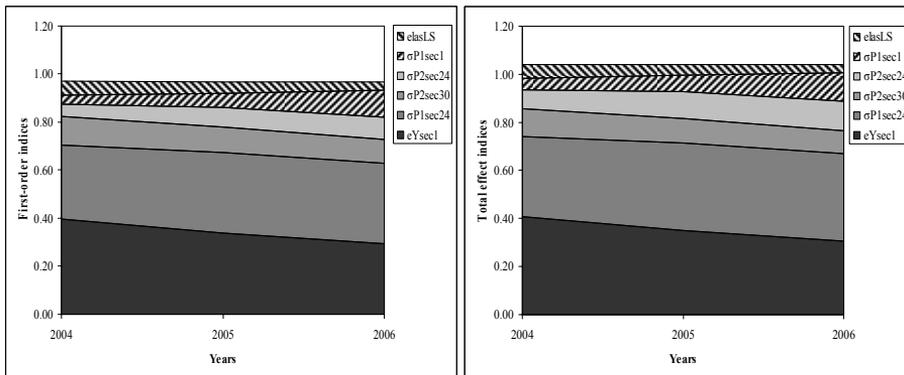


Figure 7.23. Sobol' first-order indices and total effect indices with respect to the equivalent variation (EV) (non-neutral subsidy scenario)

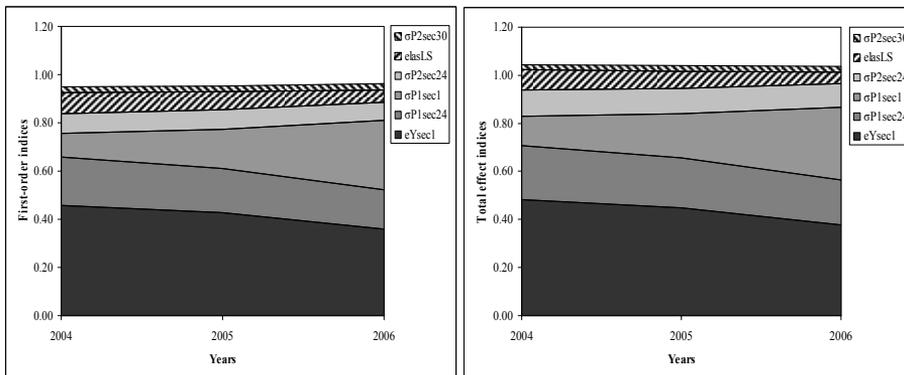
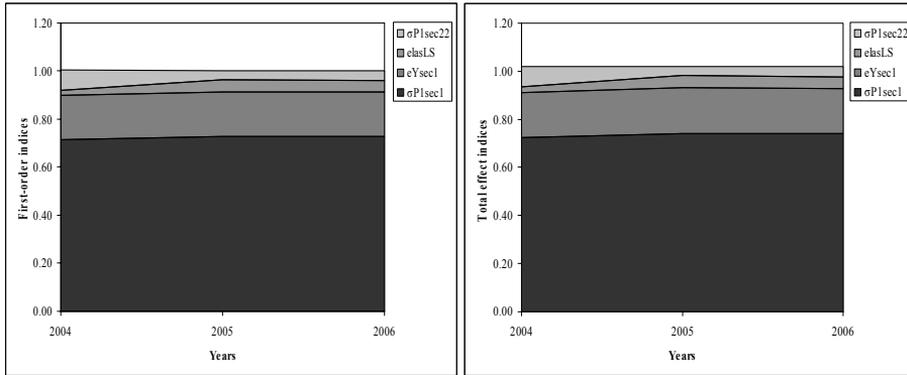
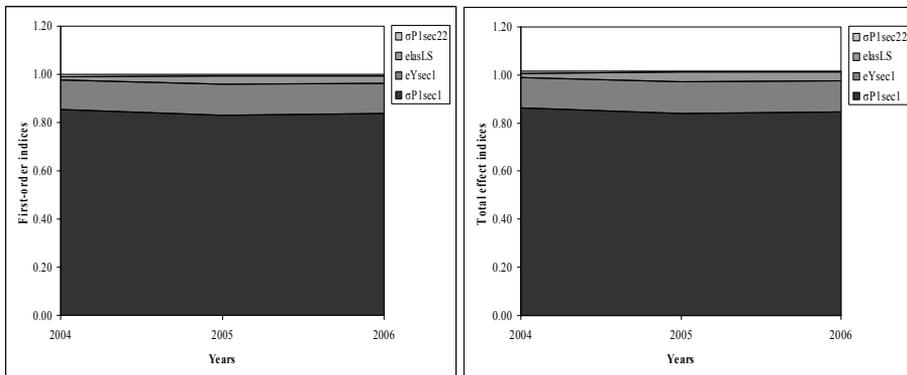


Figure 7.24. Sobol' first-order indices and total effect indices with respect to the real GDP (non-neutral subsidy scenario)

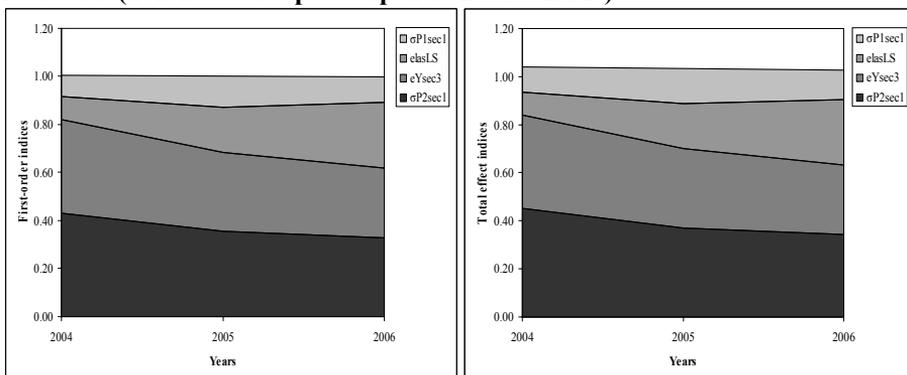
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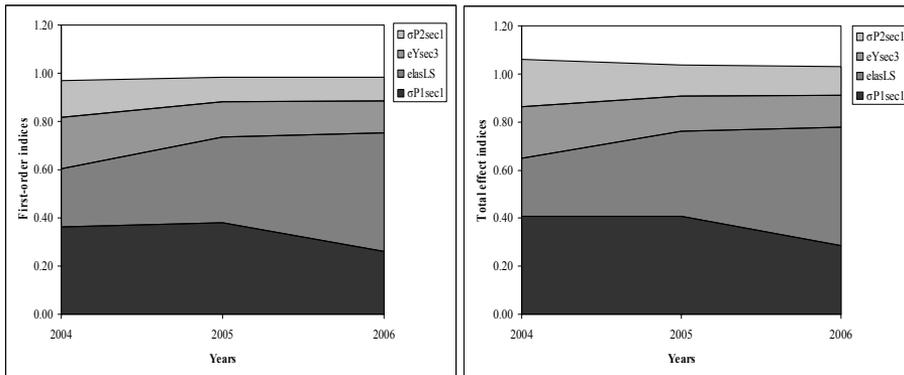
**Figure 7.25. Sobol' first-order indices and total effect indices with respect to the equivalent variation (EV) (non-neutral capital expenditures scenario)**



**Figure 7.26. Sobol' first-order indices and total effect indices with respect to the real GDP (non-neutral capital expenditures scenario)**



**Figure 7.27. Sobol' first-order indices and total effect indices with respect to the equivalent variation (EV) (neutral combined scenario)**



**Figure 7.28. Sobol' first-order indices and total effect indices with respect to the real GDP (neutral combined scenario)**

## 7.5. Conclusions

In this chapter, the CGE model developed for Romania (RoMod) has been used to evaluate the possible effects of some of the policy measures already implemented or envisaged by the government in the 2003 Pre-accession program (Romanian Government 2004). The five main policy scenarios under study aim for tax harmonization with the EU requirements or public expenditures restructuring.

The policy scenarios have illustrated the varying effects of the individual measures on the sectors directly affected versus the rest of the economy. For example, the elimination of direct subsidies on public passenger transport (non-neutral subsidy scenario) leads to a decline in supply by the transport sectors (directly affected sectors) due to the rise in their production costs and consequently in their output prices. But, the elimination of subsidies affects many other activities (mostly manufacturing sectors) by rising the transport costs, thus, illustrating the effect of a specific measure on the rest of the economy.

As already explained in chapter 4, we use the concept of the equivalent variation in income that is needed to keep households at the same welfare level in the new counter-factual equilibrium<sup>121</sup> (evaluated at benchmark prices) to assess the welfare gains or losses. Thus it can be shown (see table 7.32) that, during 2004-2006, households experience a loss as a result of the elimination of the VAT exemptions and the replacement of the statutory rate of 19 percent by the reduced rate of 9 percent for certain goods and services (non-neutral VAT scenario), from the increase in excise duties on mineral oils (non-neutral and neutral excise scenario), and from the elimination of direct subsidies supporting public passenger transport (non-neutral subsidy scenario).

<sup>121</sup> The counter-factual equilibrium is given by each of the policy scenarios discussed in this chapter.

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**Table 7.32. Equivalent variation (billions ROL) over a one-year period and in the long-run**

Scenarios	Equivalent variation (billions ROL)			
	2004	2005	2006	Long-run
Non-neutral VAT scenario	-993	-928	-853	9,271
Neutral VAT scenario	193	207	220	2,491
Non-neutral excise scenario	-7,836	-8,477	-9,138	-15,588
Neutral excise scenario	-3,895	-4,090	-4,324	-42,193
Non-neutral subsidy scenario	-1,017	-2,498	-3,242	9,915
Non-neutral capital expenditures scenario	313	478	1,191	77,126
Neutral combined scenario	-3,141	-2,962	-2,223	26,317

Source: Results of the policy simulations.

In the neutral VAT scenario however, the recycling of additional government revenues through the social security contributions has positive welfare effects, thanks to the reduction in the labor tax distortions. The highest gain in welfare expressed over a one-year period during 2004-2006 results from the shift from current government expenditures to capital expenditures. Overall, the combined measures of tax harmonization and public expenditures restructuring generate welfare losses during 2004-2006.

The welfare gains/losses in the long-run are expressed as the present value of the equivalent variation in 2000 prices. The welfare gains are mainly achieved through the retrenchment of the conventional budget deficit which crowds in private investment. As a result, the profitability in the production sectors improves in the long-run giving rise to capital income gains for the households. Private consumption recovers due to the higher disposable income. The reduction of the labor tax distortion seems to be less beneficial in the long-run given the lower rise in investments. Even though all policy scenarios, except for non-neutral and neutral excise scenarios, generate welfare gains in the long-run, their size is small. The efficiency gain, achieved by the capital expenditures measures, is equivalent to only 0.61 percent of the present value of households' income in 2000 prices (see table 7.33).

**Table 7.33. Equivalent variation in % of households' income over a one-year period and in the long-run**

Scenarios	Equivalent variation in % of households' income			
	2004	2005	2006	Long-run
Non-neutral VAT scenario	-0.13	-0.12	-0.10	0.07
Neutral VAT scenario	0.03	0.03	0.03	0.02
Non-neutral excise scenario	-1.04	-1.07	-1.10	-0.12
Neutral excise scenario	-0.51	-0.51	-0.52	-0.34
Non-neutral subsidy scenario	-0.13	-0.31	-0.39	0.08
Non-neutral capital expenditures scenario	0.04	0.06	0.14	0.61
Neutral combined scenario	-0.41	-0.37	-0.26	0.21

Source: Results of the policy simulations.

We also observe that all the policy measures considered above yield positive effects on the conventional budget deficit and total debt (in the non-neutral scenarios).

Furthermore, the neutral combined scenario shows that the social contribution rates can be reduced by 16.4 percent in 2005 and by 19.3 percent in 2006 compared to the baseline, when the conventional deficit to GDP ratio is kept unchanged after 2003. The social contribution rates envisaged in the 2003 Pre-accession program (Romanian Government, 2004) were close to the one estimated in the neutral combined scenario (see table 7.34). However, it is worth noting that the deficit ratio is higher in the neutral combined scenario (3.6 percent) than in the forecast published in the 2003 Pre-accession program (3.3 percent). There are two main reasons for this difference. First, the corporate tax rate applied to export-related profits has been increased in 2003, from 6 percent to 12.5 percent, and starting with 2004 to 25 percent. Due to the lack of information on the share of export-related profits in the total profits it was not possible to evaluate the effects of such a policy measure. Furthermore, the harmonization of the excise duties on tobacco and alcoholic beverages has not been taken into account due to the lack of data on their tax base (expressed in quantities). When the positive budgetary effects of these two measures are eliminated from the 2003 Pre-accession program estimates, the conventional deficit would also have been about 3.6 percent of GDP.

**Table 7.34. Social security contribution rates (%)**

Statutory social security contribution rates (%)	2005		2006	
	Neutral combined scenario	Envisaged in the 2003 Pre-accession program	Neutral combined scenario	Envisaged in the 2003 Pre-accession program
Normal work conditions	29.3	30.5	28.2	29.5
Particular work conditions	33.4	35.5	32.3	34.5
Special work conditions	37.6	40.5	36.3	39.5

Source: 2003 Pre-accession program (Romanian Government, 2004) and results of the neutral combined scenario.

The overall effect of the policy measures is small, except for the increase in the excise duties on mineral oils. This does not come as a surprise given the limited size of the policy measures. Thus, while the preparation in terms of tax harmonization and public expenditures restructuring for the EU integration results in positive effects on the government budget, it does not seem to have serious negative effects on GDP and households' welfare.

The policy scenarios discussed in this section take into account only the direct effects and not the closing down or the restructuring effects induced by the policy measures on the unprofitable firms. Therefore, the positive effects of the policy measures may be understated. Given this limitation, RoMod can be better used for policy purpose in the future, when the restructuring of the uncompetitive firms has been finalized.

The Annual Report for 2004, recently published by the National Bank of Romania (National Bank of Romania, 2005) drastically revises the conventional budget deficit for 2004 down to 1.1 percent of GDP. The budget was rectified twice during the year (in June and August) mainly to account for the decline in the interest payments

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for the public debt, the higher than expected revenues<sup>122</sup> and to insure the correlation with the larger than expected end of the year real GDP growth<sup>123</sup>. By the end of the year the real GDP growth turned out to be 8.3 percent, which further exerted a positive influence on the conventional budget deficit to GDP ratio (National Bank of Romania, 2005).

The recently released 2004 Pre-accession economic program (PEP) sets a much more ambitious budget deficit target of 0.7 percent of GDP for 2005 and 0.9 percent of GDP for 2006, compared to the 2003 Pre-accession program, in the context of considerable cuts in income and corporate profit tax<sup>124</sup> rates and further relaxation of the social security contribution rates starting with 2006 (Romanian Government, 2005). However, the European Commission (2005, p.34) notes that:

“For 2005, the programme’s budget deficit target of 0.7% of GDP is considerably lower than the 2005 budget, which was approved before the adoption of the fiscal reform. It is therefore no good yardstick for this year’s likely budgetary outcome, although it is of interest that the original budget on the back of a much more timid relaxation of income and profit taxes projected a significantly larger general government deficit in 2005 than the programme. The PEP is not entirely lucid in explaining the differences to the approved budget and would have benefited from a more extensive analysis of the budgetary effect of various measures, including a heavier reliance on quantified estimates.”

Only the income and profit tax rates reduction is expected to result in revenue losses equivalent to about 1.5 percent of projected 2005 GDP, making the compliance with the deficit target difficult. Although very useful, an evaluation of the income and corporate profit tax reform was not possible in the present study due to the data and time limitations.

Furthermore, while the 2003 Pre-accession program estimated that about 5 percentage point reduction in the social security contributions rate would lead to a revenue loss of 0.8 percent of GDP over the program period (during 2005-2006), the 10 percentage point cut in the social security contributions rate<sup>125</sup> envisaged by the 2004 Pre-accession program starting with 2006 is estimated to lead to a gain of 0.9 percent of GDP over the same period<sup>126</sup> (Romanian Government, 2005). European Commission (2005, p.36) points out that indeed improved administration could lead to increased revenues by strengthen tax collection, but the 2004 Pre-accession program is “not convincing in arguing that these gains would be immediately able to more than compensate for the considerable reduction in the contribution rate, not

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<sup>122</sup> The higher than expected government revenues in 2004 arise due to progress in tax compliance and collection (European Commission, 2005).

<sup>123</sup> The rectified budget has been correlated with an estimated real GDP growth of 6.5 percent compared to the initial estimate of 5.5 percent.

<sup>124</sup> See chapter 2 for a discussion on the income and corporate profit tax rates reduction undertaken starting with 2005.

<sup>125</sup> The 10 percentage points cut in the social security contributions would be distributed as follows: 8 percentage points for the employers and 2 percentage points reduction for employees.

<sup>126</sup> The highest gains would be acquired according to the 2004 Pre-accession program in 2006, 0.8 percent of GDP (Romanian Government, 2005).

least since no forceful steps to improve enforcement are emphasized". In this context, it is interesting to note that the decrease in the social security contributions revenues estimated for 2004 using RoMod, in the neutral combined scenario (0.5 percent of GDP), does not differ much from that published by the National Bank of Romania (0.3 percent of GDP). The difference can be attributed to the fact that the social security contribution rates declined less than was assumed in the neutral combined scenario<sup>127</sup>.

The deficits projected for 2005-2006 in the 2004 Pre-accession program are mainly envisaged to be achieved by restraining current expenditures and subsidies (Romanian Government, 2005). Only reduction in the current expenditures would represent about 1.2 percent of GDP in 2005, while the decline in the subsidies would amount to an additional 0.3 percent of GDP. Interesting enough, in the model, the gradual elimination of direct subsidies on the public passenger transport would generate a decline of subsidy expenditures of about 0.28 percent of GDP in 2005. Thus, the elimination of direct subsidies on public passenger transport would almost be sufficient to cover the reduction in the subsidies envisaged by the 2004 Pre-accession program. However, the present study accounts for a much lower reduction in the current expenditures and thus for a larger budget deficit than the one foreseen in the 2004 Pre-accession program. Thus, the present study is in line with the European Commission (2005, p.32) appreciations, which notes that the major reduction in current expenditures and subsidies "will be a litmus test for the ability to not letting non-programmed revenue gains translate into extra expenditures". Furthermore, it is interesting to note that although the public investments in infrastructure, environment and rural development are still considered a priority in the 2004 Pre-accession program, the capital expenditures in 2005 are envisaged to decline, according to the same program (Romanian Government, 2005). The tax harmonization with the EU requirements seems to be the only consistent priority in both Pre-accession programs.

The chapter has also provided a new approach in the CGE modeling field by analyzing the robustness of the policy scenarios results for the choice of the exogenous parameters used in the calibration process (mainly elasticity values). First, a screening method (the Morris method) has been applied and several conclusions have been drawn regarding the most influential parameters:

- The screening exercise served to identify those parameters among the large number of parameters considered to be a source of uncertainty in the model. These parameters, also summarized in table 7.24, have been further used to conduct uncertainty and sensitivity analysis. The less influential parameters can be given any value over their uncertainty distribution without affecting the model's output variance (Saltelli, Tarantola, Campolongo and Ratto, 2004). The

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<sup>127</sup> In the neutral combined scenario the social security contributions rates estimated for 2004 are: 30.7 percent for the normal work conditions, 35.1 percent for the particular work conditions and 39.5 percent for the special work conditions, while the rates actually enforced starting with 2004 are: 31.5 percent for the normal work conditions, 36.5 percent for the particular work conditions and 41.5 percent for the special work conditions. See chapter 2 for more details on the change in the social security contribution rates.

## Chapter 7

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exercise also helped to give a better insight in the structure and the functioning of the model;

- Many policy specific parameters appear to exert a significant influence on the outcomes of the corresponding scenarios in accordance with *a priori* expectations. However, there are still many other parameters that could hardly have been identified as important without such an exercise;
- The most important parameters are those that directly transmit the policy shock or that significantly influence the indirect effects generated by the policy shock because of their weight (for example, the share of employment in the agricultural sector in total employment);
- Some differences can be observed between the most influential parameters selected with regard to the equivalent variation and the real GDP, in most of the policy scenarios. Although the mechanisms through which the parameters affect the two output variables are mostly the same, the real GDP seems to be more sensitive to the choice of parameters values. Thus, the most influential parameters which are selected for further examination in the uncertainty and sensitivity analysis comprise the parameters that have a significant influence on equivalent variation in income as well as on the real GDP.

Thereafter, uncertainty analysis has been conducted to examine how the uncertainties in the most influential parameters affect the stochastic features of the RoMod's results. Finally, the sensitivity analysis gave an indication of the contribution each of these parameters made to the variance in the model's results in terms of equivalent variation in income and real GDP. The results of the uncertainty and sensitivity analysis can be summarized as follows:

- The results of the policy scenarios with respect to the real GDP, provided in section 7.3, are remarkably robust considering the substantial uncertainty in the parameters values (mainly elasticities of substitution). However, some considerable spread has been observed with respect to equivalent variation in the neutral VAT and neutral combined scenarios and fairly considerable spread in the neutral excise scenario and the non-neutral capital expenditures scenario;
- In some policy scenarios, a large share of the output (equivalent variation and real GDP) variance is due to parameters which are policy scenario specific (for example, in the non-neutral and neutral VAT scenarios). These are the parameters which meet the *a priori* expectations. However, in most policy scenarios the parameters that contribute most to output variance are driven by the indirect effects of the policy measures and the structure of the database (see section 7.4.1 for more details). This proves how useful such an approach is in better understanding the model's mechanisms;
- The greatest reduction in the variance of the equivalent variation in the neutral VAT scenario can be achieved by reducing the range of uncertainty for the income elasticity of demand for other community services (eYsec35) and for the real wage elasticity of labor supply (elasLS), and in the non-neutral capital expenditures scenario by reducing the range of uncertainty for the elasticity of substitution between labor and the capital-energy bundle for the agricultural

sector ( $\sigma_{P1sec1}$ ). In the neutral excise and neutral combined scenarios the greatest reduction in the variance of the equivalent variation can be achieved by reducing the range of uncertainty for the elasticity of substitution between capital and energy bundle for the agricultural sector ( $\sigma_{P2sec1}$ ) and for the income elasticity of demand for mineral oils ( $e_{Ysec3}$ ). Thus, future research could be concentrated on improving the estimation of these parameters to reduce the output variance in the policy scenarios;

- The results of the screening exercise are consistent with the results of the sensitivity analysis in ranking the parameters according to their impact on the output variance. Given that the Sobol' method can be regarded as more accurate than the Morris method in ranking the parameters we can conclude that the results of the screening exercise are satisfactory.



## Chapter 8

### Conclusions and suggestions for future research

#### 8.1. Overview and policy implications

The economic transition process which has been ongoing in parallel with the implementation of the EU *acquis* during the negotiation process and Romania's forthcoming EU membership in January 2007 implies major institutional and economic changes we need consider with great care. The issues raised by the EU membership require a modern and powerful quantitative tool. These issues can only be addressed in a consistent economy-wide framework given that the institutional and economic changes implied by the membership process produce innumerable, dynamic and complex interactions between the economic agents and sectors. The general equilibrium model developed in this study provides the tools necessary to answer several important questions raised by the EU membership.

In response to the research questions formulated in chapter 1, this study provides a consistent framework that can assist the Romanian policymakers in evaluating a wide range of fiscal-budgetary measures and contributes to the discussion on the socio-economic costs of regulatory adjustments in the field of taxation and the restructuring of public expenditures by providing an empirical, general equilibrium assessment, of several pre-accession policy scenarios. It also offers an analysis of the structural relationships among different economic agents, to improve the understanding of the Romanian economy.

An historical perspective on Romania's recent economic evolution has been provided in *chapter 2*, underlining the significant progress recently achieved compared to the beginning of the 1990s and the challenges ahead. The analysis points up to the period of strong economic growth experienced by the economy starting with 2001, accompanied by the steady decline of the inflation and interest rates, the reduction of the government budget deficit and unemployment. It also shows the danger of the domestic demand expansion not sustained by the domestic

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production capacity, which resulted in the rise of imports and the widening of the current account deficit in 2003.

The preparation for the EU accession has been reviewed in terms of the compliance with the 1993 Copenhagen European Council criteria. The recognition of the Romanian economy as a functioning market economy in 2004 illustrated the significant progress achieved. Nevertheless, the accession is still pending on the improvement of the judicial and administrative capacity and further structural economic reforms whilst maintaining the macroeconomic stability. As Romania has been criticized for its weak governance enforcement by both the European Commission and the IMF, the overview regarding growth in transition emphasized the important role played by institution building and governance in restructuring the economy. The state of its institutions probably explains why Romania has been left behind by the other new EU members, as argued in chapter 1. Although the impact of governance improvement is not explicitly quantified in the present study, the adoption of the EU institutions “blueprint” is expected to have positive effects on the economic performance. The adoption of the EU *acquis* in the field of taxation (VAT and excise duties) has been reviewed in terms of legislative harmonization with the EU standards, emphasizing the efforts needed in adopting the EU minimum excise duties levels on mineral oils by December 2006.

The overview of fiscal and budgetary developments also illustrated the significant progress achieved in the field of taxation in 2004, through the adoption of a new Fiscal Code, which includes most of the new legislation in the taxation field<sup>128</sup>. The evolution of each of the main tax categories has been analyzed (personal income tax, social security contributions, corporate income tax, VAT, excise duties and import tariffs), emphasizing the high statutory social security rates enforced by the end of 2003 and the need for a significant reduction in order to lower the incentives for tax evasion. In the public expenditures field, the need for eliminating the subsidies on the public passenger transport has been discussed, together with the difficulties encountered by the social security system, the high government wage bill and interest payments on the public debt. At the same time, the necessity of increasing capital expenditures on infrastructure has been highlighted, given the preparation for the EU accession.

The conceptual framework of computable general equilibrium analysis has been developed in *chapter 3*, showing its ability to assist policymakers in evaluating the effects of different fiscal-budgetary measures. A classification of prevailing CGE models according to their theoretical background, the incorporation of dynamics and the techniques used to determine its parameters has been presented to illustrate the large variety of CGE models and their wide range of application. The survey of CGE models for Eastern European countries showed that the disaggregated model presented in *chapter 4* is the first of its type developed for the Romanian economy. It also demonstrated that the number of CGE models dealing with transition economies is relative small. Most of these models analyze the Polish economy and evaluate a

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<sup>128</sup> The Fiscal Code includes the legislation on the VAT, excise duties, personal income tax, corporate tax and local taxes.

## Conclusions and suggestions for future research

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variety of policy questions ranging from industrial policies and financial liberalization to environmental policies and the implications of the EU enlargement. However, their very different theoretical backgrounds illustrate the need for better understanding these economies to adequately describe their functioning mechanisms. Due to the short series of data, the calibration of their parameters also raises questions regarding the reliability of the results. Most models are static or incorporate recursive dynamic features, due to the computational problems when accounting for a detailed sectoral disaggregation and the lack of an adequate knowledge of the dynamic behavior of economic agents in transition economies. Last but not least, they usually focus on the real side of the economy because of the lack of data related to the financial sector. The CGE model for the Romanian economy suffers from the same limitations, although efforts have been made to assess the reliability of the results through the uncertainty and sensitivity analysis.

The theoretical foundations of the CGE model for the Romanian economy (RoMod) have been discussed in *chapter 4*, where we present all the behavioral equations as well as the accounting identities for each institutional sector (the firms sector, the households sector, the government sector and the external sector), investment demand, prices, labor market and other macroeconomic indicators. The analytical description started with the static version of the model, underlining its focus on the real side of the economy. Although the model and its database have been presented separately, they have been constructed in tandem to account for the country specific characteristics and the data limitations. A short description of the main characteristics of the institutional sectors and markets, using the model's database, has been added.

Thirty-five types of production sectors have been distinguished in RoMod, each producing one type of commodity. This set-up has been dictated by the limitations of the input-output table, the main source of data for the model's database. The technical characteristics of each sector have been taken into account through nested production structures, explicitly incorporating the demand for capital, labor and four types of energy inputs (coal, oil, natural gas and electricity). With regard to the household sector, the main sources of income have been specified. Consumption has been disaggregated into 35 types of commodities. The gains or losses of households due to fiscal policy measures have been evaluated using the concept of equivalent variation in income.

The tax and subsidy structure has been modeled in detail, at the sectoral and commodity levels. Government behavior was specified at two levels. First, the public sector produces public services, employing capital, labor, energy and other material inputs. Secondly, the government sector collects taxes (value added taxes, excise duties, import tariffs, social security contributions, taxes on production, personal income taxes and corporate taxes), and spends on transfers to firms and households (including the interest payments on public debt), subsidies on consumption and production, purchases of goods and services and capital expenditures. The purchases of public services by the government sector from the public administration sector provide the link between the two.

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The presentation of the external sector expounded the main elements of the balance of payments, where limited substitution possibilities are assumed between the domestically produced goods and the imports. We also assume imperfect transformation possibilities between the goods produced for the domestic market and exports. The domestic, import and export prices in national currency include the trade and transport margins for each type of commodity. The labor supply and the unemployment level have also been endogenously specified.

In the discussion of the recursive dynamic version of the model the endogenous determination of investment behavior and the accumulation of capital have been explained, where the equilibrium expected rate of return in all sectors except the public administration sector has been specified as an inverse logistic function of the proportionate growth in each sector's capital stock. Investments in the public administration sector are given by government's capital expenditures. The accumulation of government domestic and external debt has also been explained.

Two alternative closure rules have been specified for the government behavior. In the first one, primary and conventional deficits are endogenous, while the government budget for the current and capital expenditures is specified as a fixed share of GDP at current market prices. In the second one, the conventional budget deficit is fixed as a share of GDP, while the social security contribution rates are endogenously determined. The current account is considered as given, while the exchange rate is endogenous. With respect to the macro closure rule, the level of investment is assumed to adjust to the available domestic and foreign savings. Thus, the specification of the RoMod incorporates the elements needed to support the policymakers in evaluating a wide range of fiscal-budgetary policy measures, in conformity with one of the research aims stated in chapter 1.

The construction process of the Romanian Social Accounting Matrix (SAM) for 2000 has been described in *chapter 5*. The SAM for 2000 is based on the ESA 95 methodology, adopted by Romania's National Institute of Statistics in 1998, which represents an important step towards harmonization with the EU requirements. The SAM has served two purposes. First, it has enabled an analysis of the structural relationships among the various economic agents in a consistent framework. Secondly, it has been used as the database for RoMod.

The construction of the Romanian SAM has been explained along with the presentation of each of the eleven main accounts: commodity accounts, production sectors accounts, transactions costs accounts, factors of production accounts, households sector account, firms sector account, government sector account, taxes and subsidies accounts, savings/investment account and changes in stocks account and the external sector account.

The commodities accounts showed that the structure of goods supplied to Romania's domestic market is comparable with that in developed economies, to the extent that the services sectors comprise the highest share of supply. Nevertheless the share of agricultural and processed food products remains relatively high, thus underlining the country's agricultural profile. On the demand side, the industrial products represent the main component in households' consumption, while services count

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heavily in the government consumption. The production sectors accounts showed that the low wages in the agricultural sector resulted in relatively low labor costs, even though this sector had the highest share in total employment in 2000. Thus, households' income consists to a large degree of capital income as compared to the labor income. However, the high share of capital income is misleading as it seems to result from the inclusion of the remuneration for work carried out by the owners of the unincorporated enterprises (mixed income). This issue points to the need for separating the mixed income from the capital income in the input-output table published by the National Institute of Statistics.

The government sector has been represented in the SAM by three different entities, each with its own account. First, the public administration account describes the production of public services. Then, there are the main government sector account and the taxes and subsidies accounts. The disaggregation of the taxes and subsidies accounts, by type of tax and subsidy has proved very useful in tracing the main tax contributors by sector or by commodity. Most taxes (value-added taxes, excise duties, import tariffs and social security contributions) have been recorded on an accrual basis, while the tax arrears have been booked as transfers in favor of the defaulting taxpayers (firms and households). This approach illustrated the high tax arrears in the social security contributions, which also represent the highest tax component. The recording of other taxes like corporate taxes, income taxes and taxes on production still needs to be harmonized with the ESA 95 methodology. The SAM also presented the savings of each institutional sector.

Regarding the balance of payments, represented by the external sector account, the high re-export activities of textile and leather products needed special attention. This is due to the large number of firms in the manufacturing of textile and leather that are involved in subcontracting activities for firms in various EU countries. Since exports in this sector were higher than the domestic production in the input-output table, some adjustments were needed. Some other technical problems, data limitations and adjustments have also been discussed in this chapter. All in all, the in-depth analysis of the SAM's accounts has enabled a better understanding of the structural relationships among the economic agents and has put into light some data issues in the input-output table prepared by the National Institute of Statistics.

The calibration of our model has been presented in detail in *chapter 6*. We also pointed out some of its weaknesses: the unreliability of some of the parameters, the dependency of the model's quality on the benchmark year chosen for the calibration and the limitations on the model's structure imposed by the calibration. Still, after a discussion of the pros and cons of other methods for estimating the CGE model's parameters the calibration approach appeared to be the most appropriate when only a very short series of data is available, which is the case for Romania. The calibration of the RoMod parameters were then presented using the data provided in the Romanian SAM and values of the elasticities taken from other sources. The lack of econometric estimates for most of elasticity parameters for Romania forced us to make use of estimates for other countries. This approach necessitates uncertainty and sensitivity analysis to assess the robustness of the model's outcomes to the choice of parameters values.

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The choice of the steady-state growth path of the economy as the baseline scenario for RoMod has been explained in *chapter 7*, followed by a description of five main fiscal-budgetary policy scenarios, giving detailed socio-economic and sectoral effects for each of them. The first scenario, the elimination of the VAT exemptions and the application of EU oriented VAT rates to certain goods and services, in accordance with the Annex H of the Sixth Council Directive (77/388/EEC), produces negative effects in terms of profitability, output and employment in the publishing and printing sector and in other community, social and personal service activities and some positive effects in the manufacture of pharmaceutical products and in the hotels and restaurants sector. The conventional budget deficit fell at the expense of an unemployment expansion and real wage decline, which resulted in households' welfare losses in the short-run. A simultaneous reduction in the social security contribution rates, while keeping the conventional budget deficit unchanged, would not reverse the negative impact on the above-mentioned sectors and activities, but it would have beneficial effects on unemployment and the real wage rate. Still, the magnitude of the households' welfare gains in the short-run would be negligible.

The second policy scenario, an increase in excise duties on mineral oils, also aims at tax harmonization with the EU requirements. This policy would result in a large decline in the private consumption and domestic sales of mineral oils, following a steep rise in their prices. However, the reduction in the domestic sales had a stronger negative impact on imports than on domestic production of mineral oils. Like in the VAT scenario, the adaptation of excise duties led to a reduction of the budget deficit, coupled with a rise in unemployment and a real wage decline. In this case, the reduction of the social security contributions could not reverse the households' welfare losses in the short-run although their magnitude has been almost halved.

The third scenario, the elimination of direct subsidies on public passenger transport, aims at restructuring public expenditures in accordance with the European Commission's recommendations. It appeared that the highest decline in profitability, output and employment is encountered by the railways transport sector, given the high share of subsidies received by this sector at present. The measure has a negative impact on many activities, mostly manufacturing sectors, by raising the transport costs. It also results in an income redistribution from firms and households towards the government. Thus, also this measure results in households' welfare losses in the short-run.

The fourth policy scenario, a shift of public expenditures from current to capital expenditures is imposed by the need of expanding the infrastructure in preparation of the EU accession, as envisaged by the government in the 2003 Pre-accession program (Romanian Government, 2004). The measure has negative effects on the agricultural sector, the electricity, gas and water supply sector and transport services, due to the decline in the public consumption of goods and services and has positive effects on capital goods producing activities, like manufacturing sectors and construction, due to the increase in public capital expenditures. Although the measure results in a deficit reduction accompanied by an unemployment decline and a rise in real wages and households' welfare, their magnitudes are marginal.

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Finally, the fifth scenario captured the overall effect of the tax harmonization and the public expenditure measures (as presented in the first four scenarios). Furthermore, it assessed the sustainability of the reduction in the social security contribution rates, envisaged by the government for 2005-2006 in the 2003 Pre-accession program. In the latter exercise, the budget deficit has been kept at a level of 3.6 percent of GDP after 2003. By discounting the impact of the corporate tax changes and the rise in excise duties on tobacco and alcoholic beverages, not included in this scenario, we end up at the forecast of the budget deficit published in the 2003 Pre-accession program for 2005-2006 of 3.3 percent. The combined scenario generated a decline in profitability of all production sectors (except for public administration, education and health services). However, the decrease in the labor costs when the social security contributions are reduced gave rise to substitution effects towards labor and resulted in higher employment and real wages. Thus, the negative effects on households' welfare and private consumption decline over time. This scenario also illustrated that the targets envisaged by the government in the 2003 Pre-accession program for the social security contributions were well within reach, while maintaining the conventional deficit to 3.3 percent of GDP.

In the long-run most policy scenarios, except for the non-neutral and neutral excise scenarios, showed welfare gains. The welfare gains are mostly achieved through a rise in private investment and households' capital income gains. The reduction in the labor tax distortion which leads to an increase in the wage income appears to be less beneficial in the long-run due to the lower rise in investments. The effects on GDP in the short-run are negligible in all five scenarios.

A brief discussion on the recently published 2004 Pre-accession program (Romanian Government, 2005) and the Annual Report for 2004 (National Bank of Romania, 2005) has also been provided. Although not all the measures accounted for in the 2004 Pre-accession program have been taken into account in the present study, the analysis showed that the results of the policy simulations, especially with regard to the reduction in the social security contribution rates, are consistent with the data published by the National Bank of Romania for 2004 and with the European Commission (2005) appreciations. Furthermore, the elimination of the direct subsidies on the public passenger transport would almost be sufficient to cover the cut in subsidy expenditures envisaged for 2005 in the 2004 Pre-accession program.

CGE models are often criticized for the lack of insight they provide into their sensitivity to parameters of doubtful reliability. In order to address this criticism RoMod has been subjected to a rigorous uncertainty and sensitivity analysis. A new method in the general equilibrium modeling field had been proposed to identify those parameters from a long list, that prove to be the most influential (the Morris method). The screening exercise gave a better insight in the structure and the functioning of the model. It also showed that even though many parameters that exert a significant influence on the model's outcome (identified in this case as equivalent variation in income and GDP at constant prices) meet the *a priori* expectations, there are still many others that could not have been identified without such an exercise. Their impact on the output variance is dictated by the indirect effects generated by the policy shock and their weight in relation to the model's

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database. The Morris method allowed the selection of the most influential parameters for conducting uncertainty and sensitivity analysis. Thus it also helped to contain the high computational cost involved by such an analysis.

The Sobol' method has been used to carry out the uncertainty analysis and also to decompose the variance of the model's output in terms of contributing parameters (sensitivity analysis). This variance-decomposition method also represents a novelty in the CGE modeling field. The uncertainty analysis showed that the results of the policy scenarios are robust with respect to the real GDP, especially when considering the substantial uncertainty in the parameters values. With regard to the equivalent variation in income some considerable spread has been observed in the neutral VAT and neutral combined scenarios and moderate spread in the neutral excise and non-neutral capital expenditures scenarios. The sensitivity analysis highlighted that in most policy scenarios the parameters with the highest impact on the output variance are generated by the indirect effects of the policy shocks and the structure of the database. This finding emphasizes the usefulness of such an approach. Furthermore, the parameters that could produce the greatest reduction in the variance of the equivalent variation, by reducing their range of uncertainty, have been identified for the neutral VAT and neutral combined scenarios and neutral excise and non-neutral capital expenditures scenarios. Thus, future research could concentrate on improving the estimation of these parameters. All in all, the ranking of the parameters by applying the Morris method is fairly consistent with the results provided by applying the Sobol' method, which is regarded as more accurate but at the expense of a higher computational cost.

The development of a CGE model for a typical transition economy like the Romanian one, which undergoes profound structural changes, could be questionable. However, as pointed out in chapter 3, the increased reliance on market mechanisms and price incentives in the economy together with the incorporation of "structuralist" features into RoMod makes it a suitable instrument in evaluating the effects of different fiscal-budgetary policy measures. Furthermore, the recursive dynamic structure of the model which incorporates adaptive expectations could be regarded as well suited for a transition economy.

RoMod in its present form must be regarded as a first step in describing the behavior of the Romanian economy, given that the informal sector is not yet incorporated into the model. Furthermore, like all the other CGE models it assumes stable institutions. Thus, the results of the policy scenarios rather suggest the direction and the extent of the changes resulting from partial shocks. An evaluation of the effects induced by the institutional adjustments would require a different approach.

Still, the evaluation of the fiscal-budgetary measures aiming at tax harmonization with the EU requirements and the restructuring of the public expenditures provides useful, detailed sectoral effects. Some of the results also seem to relate closely to the actual data published by the National Bank of Romania for 2004 (i.e. the change in the social security contributions expenditures due to the cut in the social security contribution rates). Moreover, it offers an analysis of the complex interrelationships among different economic agents and the channels through which these fiscal-budgetary measures affect the economy. Nevertheless, it should be kept in mind that

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RoMod, like all the other models, represents a simplification of the economic reality. While its results should be interpreted with caution, it provides a first framework for a detailed analysis of the Romanian economy which can be developed in the future by introducing additional features that enhance its representation of the actual operation of the economy.

### 8.2. Some limitations and suggestions for future research

In the present situation when so much is still vague and uncertain regarding the Romanian economy, suggestions for further research tend to be somewhat gratuitous. It would not be difficult to present a nearly endless list of recommendations for research that aim at improving the knowledge and understanding of the Romanian economy. But one does not have to write a whole dissertation to come up with this kind of insight. Therefore, we just restrict our discussion to some limitations of RoMod and a few suggestions regarding the further development of the model that seems to be important in the current economic context.

Although institution building and governance proves to be very important both in the transition process and in the accession to the European Union, we do not address directly these issues in the current study. One of the reasons is that the theoretical and empirical literature failed to provide so far a method capable of quantifying institutional building effects on economic performance in the Eastern European economies. Given the time limitation, the incorporation of the governance quality in the Romanian model is left for future research. An update of the present model, say five or ten years from now, would allow an appraisal of the impact that new institutions have had since the base year, 2000.

RoMod focuses on the real side of the economy to evaluate the socio-economic effects of a wide range of fiscal-budgetary measures. The incorporation of the financial sector would have provided useful insights in the financing of the fiscal deficit. However, this could not be done due to the lack of data. Moreover, the disaggregation of households in different income groups could allow an evaluation of the distributional effects of the fiscal policy measures. Unfortunately, the limited availability of data made such an analysis impossible. Both issues could be addressed in the future, depending on the data availability.

The model is based on the assumption of constant returns to scale and perfect competition. Closer attention to the actual state of the sectoral economic structure and more specifically, the incorporation of imperfect competition in the mining, oil and the airline transport sectors may improve the model's predictions.

The need for restructuring the pension system in Romania would require the development of an intertemporal dynamic version of RoMod with overlapping generations and forward-looking expectations. Such a model would allow analyzing the impact of pension policy reforms as well as the intergenerational distributional effects of various policy measures.

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RoMod does not currently account for the informal sector although its size is relatively high in Romania<sup>129</sup>. Its explicit incorporation will probably enrich the prediction power of the model. Further refinements in modeling the payments arrears (currently treated exogenously) are also necessary. These are probably the most important and difficult tasks to pursue in the future.

The effects of the policy scenarios as expressed in real GDP appear to be robust to the choice of elasticities values, as shown by the results of the uncertainty analysis. However, some specific parameters could reduce the variance of the equivalent variation in income in the neutral VAT and neutral combined scenarios and neutral excise and non-neutral capital expenditures scenarios. Econometric estimation of these parameters when more data become available would reduce the range of uncertainty.

In order to keep the computational task within reasonable limits, a subset of endogenous variables of the model that are regarded as the most informative for the model results (equivalent variation in income and GDP at constant prices), have been used to conduct the screening exercise (the Morris method). But a cursory examination of results corresponding to the other endogenous variables of the model proved that some additional parameters have a considerable influence on the variance of these variables. This is especially true for the endogenous variables with a sectoral dimension, i.e. government current consumption by commodity. Thus, in a future exercise, it would be useful to extend the uncertainty and sensitivity analysis to all parameters that appear to significantly affect all endogenous variables of the model.

Given Romania's forthcoming entry into the EU, two main directions appear to be important for future research. One would be the integration of RoMod in a European model to evaluate the complex mutual effects of the foreign trade liberalization process, the financial flows between the budgets and the structural funds interventions. Given the importance of the environmental policies at the EU level and the establishment of the European Emission Trading Scheme, which became operational in January 2005, such a model would also enable the evaluation of different environmental measures. In fact, RoMod already builds in useful features for analyzing the effects of environmental policy measures at the national level. The nesting of the production structure according to the technical specification of the sectors and the disaggregation of energy inputs in coal, oil, natural gas and electricity facilitates the incorporation of the CO<sub>2</sub> emissions and other greenhouse gasses based on fuels combustion. Another important direction for future research would be the regionalization of RoMod at the NUTS-3 level, so as to evaluate the effects of regional policies and transfers from the EU structural funds.

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<sup>129</sup> The share of the informal economy has been estimated by the National Institute of Statistics to 18 percent of GDP in 2001. Information retrieved from: [http://www.traderom.ro/SIT/RO/Jurnalul%20Afacilor/ARHIVA/Nr640/SumarNR640.htm#\\_Economia\\_subterana\\_reprezinta](http://www.traderom.ro/SIT/RO/Jurnalul%20Afacilor/ARHIVA/Nr640/SumarNR640.htm#_Economia_subterana_reprezinta).

## Appendix 4.A

### Some technical aspects

#### 4.A.1. The Linear Expenditure System

The linear expenditure system (LES) can perhaps claim precedence among other demand models, if not historically, certainly in popularity and frequency of use. The linear expenditure system (LES) is a complete set of consumer-demand equations linear in total expenditure. Its main rival is the direct addilog demand system, which is linear in log changes of prices and total expenditure. It is possible to begin the discussion regarding the linear expenditure system (LES) either with the utility function or with the demand functions. Here, we choose the utility function approach.

We start with the assumption that a group of consumers shares a utility function. Each of the consumers maximizes the utility function subject to the budget constraint. The additional LES hypothesis is that some monotonic transformation of the utility function is of the Stone-Geary form:

$$U(C_i) = \prod_{i=1}^n (C_i - \mu H_i)^{\alpha H_i} \quad (4.A.1)$$

where  $C_i$  is the consumption of commodity  $i$  and  $\alpha H_i$  and  $\mu H_i$  are parameters of the utility function with:

$$\begin{aligned} 0 < \alpha H_i < 1 \\ 0 \leq \mu H_i \end{aligned} \quad \text{for } (i = 1, \dots, n) \quad (4.A.2)$$

$$\sum_{i=1}^n \alpha H_i = 1 \quad (4.A.3)$$

The function is defined only for:

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$$(C_i - \mu H_i) > 0 \quad (4.A.4)$$

The function was proved to justify a true cost of living index (Geary, 1949). The demand functions derived from it were developed and applied extensively by Stone (1954).

Maximizing the utility function, equation (4.A.1), subject to the budget constraint:

$$CBUD = \sum_{i=1}^n P_i \cdot C_i \quad (4.A.5)$$

we set up the Lagrangean expression:

$$V = \prod_{i=1}^n (C_i - \mu H_i)^{\alpha H_i} + \lambda \cdot (CBUD - \sum_{i=1}^n P_i \cdot C_i) \quad (4.A.6)$$

where  $\lambda$  is the Lagrange multiplier.

The first-order conditions derived by setting  $\partial V / \partial C_i = 0$  take the form:

$$\alpha H_i \cdot (C_i - \mu H_i)^{-1} \cdot U(C_i) = \lambda \cdot P_i \quad (4.A.7)$$

Imposing the restriction from equation (4.A.3) we get:

$$\begin{aligned} 1 &= \sum_{i=1}^n \alpha H_i = \lambda \cdot U(C_i)^{-1} \cdot \sum_{i=1}^n P_i \cdot (C_i - \mu H_i) \\ &= \lambda \cdot U(C_i)^{-1} \cdot (CBUD - \sum_{i=1}^n P_i \cdot \mu H_i) \end{aligned} \quad (4.A.8)$$

Further, the Lagrange multiplier is given by:

$$\lambda = \frac{U(C_i)}{CBUD - \sum_{i=1}^n P_i \cdot \mu H_i} \quad (4.A.9)$$

Substituting  $\lambda$  in equation (4.A.7), after some rearrangements, yields the demand for commodity  $i$ :

$$C_i = \mu H_i + \frac{\alpha H_i}{P_i} \cdot (CBUD - \sum_{i=1}^n P_i \cdot \mu H_i) \quad (4.A.10)$$

We assume  $\mu H_i$  to be the minimum level of consumption of commodity  $i$ , and consequently  $\sum_{i=1}^n P_i \cdot \mu H_i$  is the cost of the minimum consumption level. Then, any excess of income  $CBUD$  over the cost of the minimum consumption level is divided between the various consumption goods according to the ratios  $\alpha H_i / P_i$ . Further,  $\alpha H_i$  represents the marginal budget shares, which explain how consumers allocate their income above the cost of the minimum consumption level.

By differentiation, we derive the elasticity of  $\lambda$  with respect to income (the marginal utility of income):

$$\phi = \frac{\partial \lambda}{\partial CBUD} \cdot \frac{CBUD}{\lambda} = - \frac{CBUD}{CBUD - \sum_{i=1}^n P_i \cdot \mu H_i} \quad (4.A.11)$$

$\phi$  is also called the Frisch parameter. It may be considered as a measure of consumer welfare derived from additional income.

Further, differentiation of equation (4.A.10) yields the Engel elasticity (income elasticity of demand) for commodity  $i$ :

$$E(C_i, CBUD) = \frac{\partial C_i}{\partial CBUD} \cdot \frac{CBUD}{C_i} = \frac{\alpha H_i \cdot CBUD}{P_i \cdot C_i} \quad (4.A.12)$$

or

$$E(C_i, CBUD) = \alpha H_i \cdot s_i^{-1} > 0 \quad (4.A.13)$$

where  $s_i = P_i \cdot C_i / CBUD$  is the budget share of commodity  $i$ . Knowing the Engel elasticity  $E(C_i, CBUD)$  equation (4.A.13) provides an immediate estimate of the budget share for each commodity.

Substituting the demand equation (4.A.10) into (4.A.12) we get:

$$E(C_i, CBUD) = \frac{\alpha H_i \cdot CBUD}{\mu H_i \cdot P_i + \alpha H_i \cdot (CBUD - \sum_{i=1}^n P_i \cdot \mu H_i)} \quad (4.A.14)$$

which can be rewritten as:

$$\mu H_i = C_i - \alpha H_i \cdot P_i^{-1} \cdot CBUD \cdot \frac{CBUD - \sum_{i=1}^n P_i \cdot \mu H_i}{CBUD} \quad (4.A.15)$$

Now we define:

$$CBUD^s = \frac{CBUD - \sum_{i=1}^n P_i \cdot \mu H_i}{CBUD} = -\frac{1}{\phi} \quad (4.A.16)$$

known as the supernumerary income ratio, which is a ratio of the consumer's income excess over the cost of the minimum consumption level. Then, equation (4.A.15) can be rewritten as:

$$\mu H_i = C_i - \alpha H_i \cdot P_i^{-1} \cdot CBUD \cdot (-1/\phi) \quad (4.A.17)$$

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The stylized fact is that the supernumerary income ratio takes a value of about 0.5 for most consumer groups<sup>130</sup>. This is equivalent with the Frisch parameter taking a value of  $-2$ . It allows us to determine  $\mu H_i$  if we know the marginal budget shares ( $\alpha H_i$ ). Another way of calibrating the parameters of the linear expenditure system is to start with  $\mu H_i$ . For example, if we have the past data on consumer expenditure, we can assume that these expenditures are the subsistence expenditures and the resulting supernumerary income is allocated according to fixed fractions. This means that knowing  $\mu H_i$  we can derive  $\alpha H_i$  as:

$$\alpha H_i = \frac{P_i \cdot C_i - P_i \cdot \mu H_i}{CBUD - \sum_{i=1}^n P_i \cdot \mu H_i} \quad (4.A.18)$$

Differentiating equation (4.A.10) with respect to prices yields the own price and cross price elasticities:

$$E(C_i, P_i) = \frac{\partial C_i}{\partial P_i} \cdot \frac{P_i}{C_i} = -\frac{\alpha H_i \cdot [1 - (P_j \cdot \mu H_j / CBUD)]}{s_i} < 0 \quad (4.A.19)$$

$$E(C_i, P_j) = \frac{\partial C_i}{\partial P_j} \cdot \frac{P_j}{C_i} = -\frac{\alpha H_i \cdot (P_j \cdot \mu H_j / CBUD)}{s_i} < 0 \quad \text{for } i \neq j \quad (4.A.20)$$

Further, equation (4.A.19) and (4.A.20) can be rewritten as:

$$E(C_i, P_i) = -E(C_i, CBUD) \cdot [(P_i \cdot \mu H_i / CBUD) + CBUD^s] \quad (4.A.21)$$

$$E(C_i, P_j) = -E(C_i, CBUD) \cdot (P_j \cdot \mu H_j / CBUD) \quad (4.A.22)$$

The term  $E(C_i, CBUD) \cdot (P_i \cdot \mu H_i / CBUD)$  in equation (4.A.21) represents the income effect of a change in price  $P_i$ . It shows that a change in  $P_i$  reduces real income proportionally to  $P_i \cdot \mu H_i / CBUD$ , which, multiplied by the income elasticity  $E(C_i, CBUD)$ , gives the proportional reduction in consumption  $C_i$ . Further, the term  $CBUD^s \cdot E(C_i, CBUD)$  measures the substitution effect. When  $CBUD^s$  gets smaller, the substitution response in consumer behavior also gets smaller. The supernumerary income ratio can be interpreted in this case as an indicator of the importance of price substitution in demand.

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<sup>130</sup> To justify the use of a supernumerary income ratio of 0.5, most of the studies refer to Taylor (1979), which in turn, refers to earlier estimates of Sato (1972) and Brown and Deaton (1972). However, the value of the same supernumerary income ratio for different countries, irrespective of, for instance, the level of income is at least debatable.

#### 4.A.2. The Armington Approach

International trade flows are usually classified according to three main characteristics: the kind of products involved, the exporting country and the importing country. In the past, the theories of demand for tradable goods frequently assumed that a given kind of product exported by one country is a perfect substitute for the same kind of product supplied by any other country. Armington (1969) proposes a general theory of demand for products that are distinguished not only by category, but also by country of origin. His approach is commonly adopted when modeling international trade in the CGE models.

Armington assumes that products are distinguished according to the place of production. Thus, they are assumed to be imperfect substitutes in demand. This implies that consumers discriminate between imported and domestically produced goods. This distinction between the demand for imported products and domestically produced products is based on a Constant Elasticity of Substitution (CES) function. In the same way, products supplied to the domestic market are distinguished from products for export. This division is based on a Constant Elasticity of Transformation (CET) function. As a consequence the Armington approach allows the same kind of product to be both exported as well as imported.

To specify import demand, it is assumed that domestic consumers demand a composite good ( $X_i$ ) of imported ( $M_i$ ) and domestically produced goods ( $XDD_i$ ), according to a CES function:

$$X_i = (\gamma A_i \cdot M_i^{-\rho A_i} + \gamma A_2 \cdot XDD_i^{-\rho A_i})^{-1/\rho A_i} \quad (4.A.23)$$

Domestic consumers must decide on the specific amounts of imported and domestically produced goods they wish to purchase while minimizing costs:

$$Cost_i(M_i, XDD_i) = PM_i \cdot M_i + PDD_i \cdot XDD_i \quad (4.A.24)$$

The first-order conditions for  $i=1, \dots, n$  read:

$$\gamma A_i \cdot M_i^{-(\rho A_i + 1)} \cdot X_i^{(\rho A_i + 1)} = \lambda^{-1} \cdot PM_i \quad (4.A.25)$$

$$\gamma A_2 \cdot XDD_i^{-(\rho A_i + 1)} \cdot X_i^{(\rho A_i + 1)} = \lambda^{-1} \cdot PDD_i \quad (4.A.26)$$

and the CES function (4.A.23).

From (4.A.25) and (4.A.26) we derive:

$$M_i = \left[ \lambda \cdot \gamma A_i \cdot PM_i^{-1} \cdot X_i^{(1+\rho A_i)} \right]^{1/(1+\rho A_i)} \quad (4.A.27)$$

$$XDD_i = \left[ \lambda \cdot \gamma A_2 \cdot PDD_i^{-1} \cdot X_i^{(1+\rho A_i)} \right]^{1/(1+\rho A_i)} \quad (4.A.28)$$

and further substituting (4.A.27) and (4.A.28) into (4.A.23) and solving for the Lagrange multiplier ( $\lambda$ ) yields:

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$$\lambda = \left[ \gamma A1_i^{1/(1+\rho A_i)} \cdot PM_i^{\rho A_i/(1+\rho A_i)} + \gamma A2_i^{1/(1+\rho A_i)} \cdot PDD_i^{\rho A_i/(1+\rho A_i)} \right]^{(1+\rho A_i)/\rho A_i} \quad (4.A.29)$$

Substitution of (4.A.29) into (4.A.27) and (4.A.28) gives:

$$M_i = X_i \cdot (\gamma A1_i / PM_i)^{1/(1+\rho A_i)} \cdot \left[ \gamma A1_i^{1/(1+\rho A_i)} \cdot PM_i^{\rho A_i/(1+\rho A_i)} + \gamma A2_i^{1/(1+\rho A_i)} \cdot PDD_i^{\rho A_i/(1+\rho A_i)} \right]^{1/\rho A_i} \quad (4.A.30)$$

$$XDD_i = X_i \cdot (\gamma A2_i / PDD_i)^{1/(1+\rho A_i)} \cdot \left[ \gamma A1_i^{1/(1+\rho A_i)} \cdot PM_i^{\rho A_i/(1+\rho A_i)} + \gamma A2_i^{1/(1+\rho A_i)} \cdot PDD_i^{\rho A_i/(1+\rho A_i)} \right]^{1/\rho A_i} \quad (4.A.31)$$

Multiplying (4.A.30) by  $PM_i$  and (4.A.31) by  $PDD_i$  and summing up the resulting equations leads to:

$$PM_i \cdot M_i + PDD_i \cdot XDD_i = X_i \cdot \left[ \gamma A1_i^{1/(1+\rho A_i)} \cdot PM_i^{\rho A_i/(1+\rho A_i)} + \gamma A2_i^{1/(1+\rho A_i)} \cdot PDD_i^{\rho A_i/(1+\rho A_i)} \right]^{(1+\rho A_i)/\rho A_i} \quad (4.A.32)$$

Since profits are zero for a constant returns to scale CES function, the price of domestic demand,  $P_i$  (the dual price of the CES function), is given by:

$$P_i = \left[ \gamma A1_i^{1/(1+\rho A_i)} \cdot PM_i^{\rho A_i/(1+\rho A_i)} + \gamma A2_i^{1/(1+\rho A_i)} \cdot PDD_i^{\rho A_i/(1+\rho A_i)} \right]^{(1+\rho A_i)/\rho A_i} \quad (4.A.33)$$

The demand relations for  $M_i$  and  $XDD_i$ , after substitution of (4.A.33), can be written as:

$$M_i = X_i \cdot (\gamma A1_i / PM_i)^{1/(1+\rho A_i)} \cdot P_i^{1/(1+\rho A_i)} \quad (4.A.34)$$

$$XDD_i = X_i \cdot (\gamma A2_i / PDD_i)^{1/(1+\rho A_i)} \cdot P_i^{1/(1+\rho A_i)} \quad (4.A.35)$$

The demand equations (4.A.34) and (4.A.35), in terms of elasticity of substitution, are further given by:

$$M_i = X_i \cdot (\gamma A1_i / PM_i)^{\sigma A_i} \cdot P_i^{\sigma A_i} \quad (4.A.36)$$

$$XDD_i = X_i \cdot (\gamma A2_i / PDD_i)^{\sigma A_i} \cdot P_i^{\sigma A_i} \quad (4.A.37)$$

It follows that the elasticity of substitution ( $\sigma A_i$ ) between  $M_i$  and  $XDD_i$  is equal to the constant  $1/(1+\rho A_i)$ , where  $0 < \sigma A_i < \infty$ . When  $\sigma A_i$  is getting close to zero, the products are perfect complements, while when  $\sigma A_i$  is getting close to infinite the products are perfect substitutes.

To derive the export supply it is assumed again that domestically produced goods and exported goods are imperfect substitutes. Domestic producers have to find the combination of domestically supplied goods and exported goods that would maximize their revenues, given their production capacity. The distribution of the domestically produced goods over the domestically supplied goods and exports is given by a Constant Elasticity of Transformation (CET) function:

$$XD_i = (\gamma T1_i \cdot E_i^{-\rho T_i} + \gamma T2_i \cdot XDD_i^{-\rho T_i})^{-1/\rho T_i} \quad (4.A.38)$$

Producers maximize total revenues:

$$\text{Revenue}_i(E_i, XDD_i) = PE_i \cdot E_i + PDD_i \cdot XDD_i \quad (4.A.39)$$

subject to the constraint (4.A.38). The maximization process yields the export supply function:

$$E_i = XD_i \cdot (\gamma T1_i / PE_i)^{\sigma T_i} \cdot PD_i^{\sigma T_i} \quad (4.A.40)$$

and the domestic production supplied on the domestic market:

$$XDD_i = XD_i \cdot (\gamma T2_i / PDD_i)^{\sigma T_i} \cdot PD_i^{\sigma T_i} \quad (4.A.41)$$

where  $\sigma T_i = 1/(1 + \rho T_i)$  is the constant elasticity of transformation. Compared to the CES function where the domestic consumers minimize total costs for the CET function the producers maximize total revenues. Thus, the constant elasticity of transformation in (4.A.38) is negative.



## Appendix 4.B

### Model equations

#### 4.B.1. Households sector

$$C_i = \mu H_i + \alpha H_i \cdot [(1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot P_i]^{-1} \cdot [CBUD - \sum_j (1 + vat_j) \cdot (1 + tc_j) \cdot (1 - tsc_j) \cdot P_j \cdot \mu H_j] \quad (4.B.1)$$

$$SH = mps \cdot (YH - ty \cdot YHI - tsch \cdot \sum_i LSK_i \cdot PL \cdot wdif_i) \quad (4.B.2)$$

$$YH = aich \cdot \sum_i KSK_i \cdot RK_i + \sum_i LSK_i \cdot PL \cdot wdif_i + PLWZ \cdot ER \cdot LW + TRHG + TRHF \cdot INDEX + ER \cdot TRHW \quad (4.B.3)$$

$$YHI = aich \cdot \sum_i KSK_i \cdot RK_i + \sum_i LSK_i \cdot PL \cdot wdif_i + PLWZ \cdot ER \cdot LW + TRO \cdot INDEX + GDEBTD_i \cdot RGD \cdot inth \quad (4.B.4)$$

$$CBUD = YH - ty \cdot YHI - tsch \cdot \sum_i LSK_i \cdot PL \cdot wdif_i - SH \quad (4.B.5)$$

$$VL = \left[ CBUD - \sum_i P_i \cdot (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i) \cdot \mu H_i \right] \cdot \prod_i [\alpha H_i / (P_i \cdot (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i))]^{\alpha H_i} \quad (4.B.6)$$

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$$VL0 = \left[ CBUDZ - \sum_i PZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i) \cdot \mu H_i \right] \quad (4.B.7)$$

$$\prod_i [\alpha H_i / (PZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i))]^{\alpha H_i}$$

$$EV = (VL - VL0) \cdot \prod_i \left[ \frac{PZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i)}{\alpha H_i} \right]^{\alpha H_i} \quad (4.B.8)$$

### 4.B.2. Firms sector

$$aP_c \cdot XD_c = KLE_c \quad (4.B.9)$$

$$(1 - tp_c + tsp_c) \cdot PD_c \cdot XD_c = KLE_c \cdot PKLE_c + \sum_{nen} i_{nen,c} \cdot P_{nen} \cdot (1 + vati_{nen,c}) \cdot (1 + tci_{nen,c}) \cdot XD_c \quad (4.B.10)$$

$$KE_c = KLE_c \cdot (PKLE_c / PKE_c)^{\sigma P1_c} \cdot \gamma P11_c^{\sigma P1_c} \quad (4.B.11)$$

$$LSK_c = KLE_c \cdot [PKLE_c / ((1 + tsh_c) \cdot PL \cdot wdif_c)]^{\sigma P1_c} \cdot \gamma P12_c^{\sigma P1_c} \quad (4.B.12)$$

$$PKLE_c \cdot KLE_c = PKE_c \cdot KE_c + (1 + tsh_c) \cdot PL \cdot wdif_c \cdot LSK_c \quad (4.B.13)$$

$$KSK_c = KE_c \cdot (PKE_c / (RK_c + d_c \cdot PI))^{\sigma P2_c} \cdot \gamma P21_c^{\sigma P2_c} \quad (4.B.14)$$

$$ENER_c = KE_c \cdot (PKE_c / PEN_c)^{\sigma P2_c} \cdot \gamma P22_c^{\sigma P2_c} \quad (4.B.15)$$

$$PKE_c \cdot KE_c = RK_c \cdot KSK_c + DEP_c \cdot PI + PEN_c \cdot ENER_c \quad (4.B.16)$$

$$ENEROG_c = ENER_c \cdot (PEN_c / PEOG_c)^{\sigma P3_c} \cdot \gamma P31_c^{\sigma P3_c} \quad (4.B.17)$$

$$ENINP_{el,c} = ENER_c \cdot [PEN_c / (P_{el} \cdot (1 + vati_{el,c}) \cdot (1 + tci_{el,c}))]^{\sigma P3_c} \cdot \gamma P32_{el,c}^{\sigma P3_c} \quad (4.B.18)$$

$$PEN_c \cdot ENER_c = \sum_{el} [ENINP_{el,c} \cdot P_{el} \cdot (1 + vati_{el,c}) \cdot (1 + tci_{el,c})] + PEOG_c \cdot ENEROG_c \quad (4.B.19)$$

$$ENINP_{l,c} = ENEROG_c \cdot [PEOG_c / (P_l \cdot (1 + vati_{l,c}) \cdot (1 + tci_{l,c}))]^{\sigma P4_c} \cdot \gamma P4_{l,c}^{\sigma P4_c} \quad (4.B.20)$$

$$PEOG_c \cdot ENEROG_c = \sum_l [ENINP_{l,c} \cdot P_l \cdot (1 + vati_{l,c}) \cdot (1 + tci_{l,c})] \quad (4.B.21)$$

$$aL1_l \cdot XD_l = KL_l \quad (4.B.22)$$

$$aL2_{en,l} \cdot XD_l = ENINP_{en,l} \quad (4.B.23)$$

$$(1-tp_l + tsp_l) \cdot PD_l \cdot XD_l = KL_l \cdot PKL_l + \sum_{en} [ENINP_{en,l} \cdot P_{en} \cdot (1+vati_{en,l}) \cdot (1+tc_{en,l})] + \quad (4.B.24)$$

$$\sum_{nen} [io_{nen,l} \cdot XD_l \cdot P_{nen} \cdot (1+vati_{nen,l}) \cdot (1+tc_{nen,l})]$$

$$KSK_l = KL_l \cdot [PKL_l / (RK_l + d_l \cdot PI)]^{\sigma Ll} \cdot \gamma L1 I_l^{\sigma Ll} \quad (4.B.25)$$

$$LSK_l = KL_l \cdot [PKL_l / ((1+tsh_l) \cdot PL \cdot wdif_l)]^{\sigma Ll} \cdot \gamma L1 2_l^{\sigma Ll} \quad (4.B.26)$$

$$PKL_l \cdot KL_l = RK_l \cdot KSK_l + DEP_l \cdot PI + (1+tsh_l) \cdot PL \cdot wdif_l \cdot LSK_l \quad (4.B.27)$$

$$YF = (1-aich) \cdot \sum_i KSK_i \cdot RK_i + TRFG \cdot GDPDEF + GDEBTD_{-j} \cdot RGD \cdot intf \quad (4.B.28)$$

$$YFI = (1-aich) \cdot \sum_i KSK_i \cdot RK_i + GDEBTD_{-j} \cdot RGD \cdot intf \quad (4.B.29)$$

$$SF = YF - tyf \cdot YFI - TRHF \cdot INDEX - ER \cdot TRWF \quad (4.B.30)$$

### 4.B.3. Government sector

$$TAXR = ty \cdot YHI + tyf \cdot YFI + tsch \cdot \sum_i LSK_i \cdot PL \cdot wdif_i + \sum_i [P_i \cdot C_i \cdot (1-tsc_i) \cdot tc_i + P_i \cdot C_i \cdot (1-tsc_i) \cdot (1+tc_i) \cdot vat_i + tsh_i \cdot LSK_i \cdot PL \cdot wdif_i + tm_i \cdot M_i \cdot PWMZ_i \cdot ER + XD_i \cdot PD_i \cdot tp_i + P_i \cdot CG_i \cdot vatg_i + P_i \cdot I_i \cdot vatinv_i] + \sum_{nen} \sum_i [io_{nen,i} \cdot P_{nen} \cdot XD_i \cdot \quad (4.B.31)$$

$$tc_{nen,i} + io_{nen,i} \cdot P_{nen} \cdot XD_i \cdot (1+tc_{nen,i}) \cdot vati_{nen,i}] + \sum_{en} \sum_i [ENINP_{en,i} \cdot P_{en} \cdot tc_{en,i} + ENINP_{en,i} \cdot P_{en} \cdot (1+tc_{en,i}) \cdot vati_{en,i}] + ER \cdot TRGW$$

$$GEXP = CGBUD + TRFG \cdot GDPDEF + trep \cdot PL \cdot UNEMP + TRO \cdot INDEX + INTR + \sum_i [P_i \cdot C_i \cdot tsc_i + XD_i \cdot PD_i \cdot tsp_i] \quad (4.B.32)$$

$$TRHG = trep \cdot PL \cdot UNEMP + TRO \cdot INDEX + GDEBTD_{-j} \cdot RGD \cdot inth \quad (4.B.33)$$

$$CGBUD = govsh \cdot GDPC \quad (4.B.34)$$

$$CG_i = [(1+vatg_i) \cdot P_i]^{-1} \cdot \alpha G_i \cdot CGBUD \quad (4.B.35)$$

$$GFCFG = PI^{-1} \cdot \alpha GI \cdot CGBUD \quad (4.B.36)$$

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$$SGP = TAXR-CGBUD-TRFG \cdot GDPDEF-trep \cdot PL \cdot UNEMP-TRO \cdot INDEX- \sum_i [P_i \cdot C_i \cdot tsc_i + XD_i \cdot PD_i \cdot tsp_i] \quad (4.B.37)$$

$$SGC = SGP - INTR \quad (4.B.38)$$

$$INTR = GDEBTD_{-j} \cdot RGD \cdot intf + GDEBTD_{-j} \cdot RGD \cdot inth + GDEBT_{-j} \cdot RGE \cdot ER \quad (4.B.39)$$

$$SGCDEF = (SGC/GDPC) \cdot 100 \quad (4.B.40)$$

$$SGPDEF = (SGP/GDPC) \cdot 100 \quad (4.B.41)$$

### 4.B.4. External sector

$$E_i = XD_i \cdot (PD_i / PE_i)^{\sigma_{T_i}} \cdot \gamma T I_i^{\sigma_{T_i}} \quad (4.B.42)$$

$$XDD_i = XD_i \cdot (PD_i / PDS_i)^{\sigma_{T_i}} \cdot \gamma T 2_i^{\sigma_{T_i}} \quad (4.B.43)$$

$$PD_i \cdot XD_i = PE_i \cdot E_i + PDS_i \cdot XDD_i \quad (4.B.44)$$

$$M_i = X_i \cdot (P_i / PM_i)^{\sigma_{A_i}} \cdot \gamma A I_i^{\sigma_{A_i}} \quad (4.B.45)$$

$$XDD_i = X_i \cdot (P_i / PDD_i)^{\sigma_{A_i}} \cdot \gamma A 2_i^{\sigma_{A_i}} \quad (4.B.46)$$

$$P_i \cdot X_i = PM_i \cdot M_i + PDD_i \cdot XDD_i \quad (4.B.47)$$

$$SW = \sum_i PWEZ_i \cdot E_i - \sum_i PWMZ_i \cdot M_i + TRHW + TRGW + LW \cdot PLWZ - TRWF - GDEBT_{-j} \cdot RGE \quad (4.B.48)$$

### 4.B.5. Investment demand

$$S = SH + SF + SGC + GFCFG \cdot PI - SW \cdot ER + \sum_i DEP_i \cdot PI \quad (4.B.49)$$

$$DEP_i = d_i \cdot KSK_i \quad (4.B.50)$$

$$SV_i = svr_i \cdot X_i \quad (4.B.51)$$

$$I_i = \alpha I_i \cdot [(1 + vatinv_i) \cdot P_i]^{-1} \cdot (S - \sum_j SV_j \cdot P_j) \quad (4.B.52)$$

#### 4.B.6. Price equations

$$INDEX = \frac{\sum_i [P_i \cdot CZ_i \cdot (1 + vat_i) \cdot (1 + tc_i) \cdot (1 - tsc_i)]}{\sum_i [PZ_i \cdot CZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i)]} \quad (4.B.53)$$

$$PI = \prod_i [P_i \cdot (1 + vatinv_i) / \alpha I_i]^{\alpha I_i} \quad (4.B.54)$$

$$PE_i = PWEZ_i \cdot ER - \sum_{ct} tcoe_{ct,i} \cdot P_{ct} - \sum_{ctpr} tcroe_{ctpr,i} \cdot P_{ctpr} - \sum_{ctpa} tcaoe_{ctpa,i} \cdot P_{ctpa} - \sum_{ctpw} tcwoe_{ctpw,i} \cdot P_{ctpw} \quad (4.B.55)$$

$$PM_i = (1 + tm_i) \cdot ER \cdot PWMZ_i + \sum_{ct} tcom_{ct,i} \cdot P_{ct} + \sum_{ctpr} tcrom_{ctpr,i} \cdot P_{ctpr} + \sum_{ctpa} tcaom_{ctpa,i} \cdot P_{ctpa} + \sum_{ctpw} tcwom_{ctpw,i} \cdot P_{ctpw} \quad (4.B.56)$$

$$PDD_i = PDS_i + \sum_{ct} tcod_{ct,i} \cdot P_{ct} + \sum_{ctpr} tcrod_{ctpr,i} \cdot P_{ctpr} + \sum_{ctpa} tcaod_{ctpa,i} \cdot P_{ctpa} + \sum_{ctpw} tcwod_{ctpw,i} \cdot P_{ctpw} \quad (4.B.57)$$

$$GDPDEF = GDPC/GDP \quad (4.B.58)$$

$$INDEXI = \frac{\sum_i [(1 + vatinv_i) \cdot P_i \cdot IZ_i]}{\sum_i [(1 + vatinv0_i) \cdot PZ_i \cdot IZ_i]} \quad (4.B.59)$$

$$INDEXE = \frac{\sum_i [PE_i \cdot EZ_i]}{\sum_i [PEZ_i \cdot EZ_i]} \quad (4.B.60)$$

$$INDEXM = \frac{\sum_i [PM_i \cdot MZ_i]}{\sum_i [PMZ_i \cdot MZ_i]} \quad (4.B.61)$$

$$RINT = \frac{\sum_i (RK_i \cdot KSK_i)}{\sum_i KSK_i} \quad (4.B.62)$$

$$RGD = RINT \cdot RISK \quad (4.B.63)$$

#### 4.B.7. Labor market

$$(PL/INDEX)/(PLZ/INDEXZ) - 1 = \beta \cdot [(UNEMP/LSR)/(UNEMPZ/LSRZ) - 1] \quad (4.B.64)$$

$$LSR = LSRZ \cdot ((PL \cdot INDEXZ)/(PLZ \cdot INDEX))^{elasLS} \quad (4.B.65)$$

## Appendix 4.B

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$$\sum_i LSK_i = LSR - UNEMP \quad (4.B.66)$$

$$LS = LSR + LW \quad (4.B.67)$$

### 4.B.8. Market clearing

$$C_{nct} + I_{nct} + SV_{nct} + \sum_i io_{nct,i} \cdot XD_i + CG_{nct} = X_{nct} \quad (4.B.68)$$

$$C_{ct} + I_{ct} + SV_{ct} + \sum_i io_{ct,i} \cdot XD_i + CG_{ct} + MARG_{ct} = X_{ct} \quad (4.B.69)$$

$$C_{ctpr} + I_{ctpr} + SV_{ctpr} + \sum_i io_{ctpr,i} \cdot XD_i + CG_{ctpr} + MARGR_{ctpr} = X_{ctpr} \quad (4.B.70)$$

$$C_{ctpa} + I_{ctpa} + SV_{ctpa} + \sum_i io_{ctpa,i} \cdot XD_i + CG_{ctpa} + MARGA_{ctpa} = X_{ctpa} \quad (4.B.71)$$

$$C_{ctpw} + I_{ctpw} + SV_{ctpw} + \sum_i io_{ctpw,i} \cdot XD_i + CG_{ctpw} + MARGW_{ctpw} = X_{ctpw} \quad (4.B.72)$$

$$MARG_{ct} = \sum_i (tcod_{ct,i} \cdot XDD_i + tcom_{ct,i} \cdot M_i + tcoe_{ct,i} \cdot E_i) \quad (4.B.73)$$

$$MARGR_{ctpr} = \sum_i (tcred_{ctpr,i} \cdot XDD_i + tcrrom_{ctpr,i} \cdot M_i + tcroe_{ctpr,i} \cdot E_i) \quad (4.B.74)$$

$$MARGA_{ctpa} = \sum_i (tcaod_{ctpa,i} \cdot XDD_i + tcaom_{ctpa,i} \cdot M_i + tcaoe_{ctpa,i} \cdot E_i) \quad (4.B.75)$$

$$MARGW_{ctpw} = \sum_i (tcwod_{ctpw,i} \cdot XDD_i + tcwom_{ctpw,i} \cdot M_i + tcwoe_{ctpw,i} \cdot E_i) \quad (4.B.76)$$

$$C_{en} + I_{en} + SV_{en} + \sum_i ENINP_{en,i} + CG_{en} = X_{en} \quad (4.B.77)$$

$$XD_i = XDD_i + E_i \quad \text{if } XDD_i = 0 \text{ or } E_i = 0 \quad (4.B.78)$$

$$X_i = XDD_i + M_i \quad \text{if } XDD_i = 0 \text{ or } M_i = 0 \quad (4.B.79)$$

#### 4.B.9. Other macroeconomic indicators

$$GDP = \sum_i [C_i \cdot PZ_i \cdot (1+vat\theta_i) \cdot (1+tc\theta_i) \cdot (1-tsc\theta_i) + CG_i \cdot PZ_i \cdot (1+vatg\theta_i) + I_i \cdot PZ_i \cdot (1+vatinv\theta_i) + SV_i \cdot PZ_i + E_i \cdot PWEZ_i \cdot ERZ - M_i \cdot PWMZ_i \cdot ERZ] \quad (4.B.80)$$

$$GDPC = \sum_i [C_i \cdot P_i \cdot (1+vat_i) \cdot (1+tc_i) \cdot (1-tsc_i) + CG_i \cdot P_i \cdot (1+vatg_i) + I_i \cdot P_i \cdot (1+vatinv_i) + SV_i \cdot P_i + E_i \cdot PWEZ_i \cdot ER - M_i \cdot PWMZ_i \cdot ER] \quad (4.B.81)$$

$$CT = \sum_i [P_i \cdot C_i \cdot (1+vat_i) \cdot (1+tc_i) \cdot (1-tsc_i)] / INDEX \quad (4.B.82)$$

$$IT = \sum_i [(1+vatinv_i) \cdot P_i \cdot I_i] / INDEXI \quad (4.B.83)$$

$$ET = \sum_i [PE_i \cdot E_i] / INDEXE \quad (4.B.84)$$

$$MT = \sum_i [PM_i \cdot M_i] / INDEXM \quad (4.B.85)$$

#### 4.B.10. Incorporation of recursive dynamics

$$ROR_{ng,t} = -1 + [RK_{ng,t} / PI_t + 1] / [1 + RINT_t / GDPDEF_t] \quad (4.B.86)$$

$$INV_{ng,t} = KSK_{ng,t} \cdot \left\{ \left[ \alpha ROR_{ng,t} \cdot KSKg_{max_{ng}} \cdot (KSKtrend_{ng} - KSKg_{min_{ng}}) + KSKg_{min_{ng}} \cdot (KSKg_{max_{ng}} - KSKtrend_{ng}) \right] / \left[ \alpha ROR_{ng,t} \cdot (KSKtrend_{ng} - KSKg_{min_{ng}}) + (KSKg_{max_{ng}} - KSKtrend_{ng}) \right] + 1 \right\} - KSK_{ng,t} \cdot (1 - d_{ng}) \quad (4.B.87)$$

$$\alpha ROR_{ng,t} = e^{B_{ng} \cdot (ROR_{ng,t} - ROR_{ng,t})} \quad (4.B.88)$$

$$K_{ng,t+1} = (1 - d_{ng}) \cdot K_{ng,t} + INV_{ng,t} \quad (4.B.89)$$

$$KSK_{gov,t+1} = (1 - d_{gov}) \cdot KSK_{gov,t} + GFCFG_t \quad (4.B.90)$$

$$INV_{ng,T} = (g + d_{ng}) \cdot KSK_{ng,T} \quad (4.B.91)$$

$$INV_{gov,T} = (g + d_{gov}) \cdot KSK_{gov,T} \quad (4.B.92)$$

$$GDEBTD_{t+1} = GDEBTD_t \cdot GDPDEF_t - SGC_t \cdot shdebt_d \quad (4.B.93)$$

$$GDEBT_{t+1} = GDEBT_t \cdot ER_t - SGC_t \cdot (1 - shdebt_d) \quad (4.B.94)$$

$$GDEBTT_{t+1} = GDEBTD_{t+1} + GDEBT_{t+1} \quad (4.B.95)$$

## Appendix 4.B

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$$PVVL = \sum_i \frac{VL_t}{(1+g)^t \cdot (1+\rho)^t} + \frac{VL_T}{\rho \cdot (1+g)^T \cdot (1+\rho)^T} \quad (4.B.96)$$

$$PVVL0 = \sum_i \frac{VL0_t}{(1+g)^t \cdot (1+\rho)^t} + \frac{VL0_T}{\rho \cdot (1+g)^T \cdot (1+\rho)^T} \quad (4.B.97)$$

$$PVEV = (PVVL - PVVL0) \cdot \prod_i \left[ \frac{PZ_i \cdot (1 + vat0_i) \cdot (1 + tc0_i) \cdot (1 - tsc0_i)}{\alpha H_i} \right]^{\alpha H_i} \quad (4.B.98)$$

### 4.B.11. List of endogenous variables

<i>CBUD</i>	households disposable budget for consumption
<i>CGBUD</i>	government disposable budget for purchases of goods and services and capital expenditures
<i>CG<sub>i</sub></i>	government demand for commodity <i>i</i>
<i>C<sub>i</sub></i>	households' demand for commodity <i>i</i>
<i>CT</i>	households' total demand for commodities
<i>DEP<sub>i</sub></i>	depreciation in sector <i>i</i>
<i>E<sub>i</sub></i>	export supply of sector <i>i</i>
<i>ENER<sub>c</sub></i>	demand for energy composite (coal-oil-natural gas-electricity) in sector <i>c</i>
<i>ENEROG<sub>c</sub></i>	demand for non-electric energy composite (coal-oil-natural gas) in sector <i>c</i>
<i>ENINP<sub>en,i</sub></i>	demand for energy input <i>en</i> in sector <i>i</i>
<i>ER</i>	exchange rate
<i>ET</i>	total exports supply
<i>EV</i>	equivalent variation in income
<i>GDEBT<sub>-1</sub></i>	government foreign debt in the previous year
<i>GDEBTD<sub>-1</sub></i>	government domestic debt in the previous year
<i>GDEBTD<sub>t</sub></i>	government domestic debt in year <i>t</i>
<i>GDEBT<sub>t</sub></i>	government foreign debt in year <i>t</i>
<i>GDEBTT<sub>t</sub></i>	total government debt in year <i>t</i>
<i>GDP</i>	gross domestic product at constant prices
<i>GDPC</i>	gross domestic product at current market prices
<i>GEXP</i>	total government expenditures
<i>GFCFG</i>	government capital expenditures
<i>I<sub>i</sub></i>	demand for investment commodity <i>i</i>
<i>INDEX</i>	consumer price index (Laspeyres type)

## Model equations

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$INDEXE$	price index for exports (Laspeyres type)
$INDEXI$	price index for investment commodities (Laspeyres type)
$INDEXM$	price index for imports (Laspeyres type)
$INTR$	total interest payments on government debt
$INV_{i,t}$	investment carried out in sector $i$ in year $t$
$IT$	total demand for investment commodities
$KE_c$	demand for capital-energy composite in sector $c$
$KLE_c$	demand for capital-labor-energy composite in sector $c$
$KL_l$	demand for capital-labor bundle in sector $l$
$KSK_i$	capital demand in sector $i$
$LS$	total labor supply
$LSK_i$	labor demand in sector $i$
$LSR$	domestic labor supply
$MARGA_{ctpa}$	transport margins by land transport sector $ctpa$
$MARG_{ct}$	trade margins by wholesale and retail sector $ct$
$MARGR_{ctpr}$	transport margins by railway transport sector $ctpr$
$MARGW_{ctpw}$	transport margins by water transport sector $ctpw$
$M_i$	import demand for commodity $i$
$MT$	total imports demand
$PDD_i$	producer price of domestic output of sector $i$ delivered to domestic market (including trade margins)
$PD_i$	price of domestic output
$PDS_i$	producer price of domestic output of sector $i$ delivered to domestic market (excluding trade margins)
$PE_i$	domestic price of exports of sector $i$
$PEN_c$	price of energy composite (coal-oil-natural gas-electricity) in sector $c$
$PEOG_c$	price of non-electric energy composite (coal-oil-natural gas) in sector $c$
$PI$	price of composite investment good
$P_i$	price of commodity $i$ (excluding VAT, excises and subsidies)
$PKE_c$	return to capital-energy bundle in sector $c$
$PKLE_c$	return to capital-labor-energy bundle in sector $c$
$PKL_l$	price of capital-labor in sector $l$
$PL$	national average wage rate
$PM_i$	domestic price of imports of commodity $i$
$PVEV$	present value of equivalent variation in income

## Appendix 4.B

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<i>PVVL</i>	present value of indirect utility level in the counter-factual equilibrium (policy scenario) prices
<i>RGD</i>	domestic interest rate on public debt
<i>RINT</i>	domestic interest rate
<i>RK<sub>i</sub></i>	rental rate of capital in sector <i>i</i>
<i>ROR<sub>ng,t</sub></i>	rate of return in sector <i>ng</i> in year <i>t</i>
<i>S</i>	national savings
<i>SF</i>	firms' savings
<i>SGC</i>	government conventional budget balance
<i>SGCDEF</i>	conventional budget balance to GDP ratio
<i>SGP</i>	government primary budget balance
<i>SGPDEF</i>	primary budget balance to GDP ratio
<i>SH</i>	households' savings
<i>SV<sub>i</sub></i>	changes in inventories of commodity <i>i</i>
<i>TAXR</i>	total government revenues
<i>TRHG</i>	total government transfers to the households
<i>UNEMP</i>	unemployment (number of unemployed)
<i>VL</i>	households' indirect utility level in the counter-factual equilibrium (policy scenario) prices
<i>XDD<sub>i</sub></i>	domestic production of commodity <i>i</i> delivered to domestic market
<i>XD<sub>i</sub></i>	gross domestic output of sector <i>i</i>
<i>X<sub>i</sub></i>	domestic sales of commodity <i>i</i> from domestic production and imports
<i>YF</i>	total firms' income
<i>YFI</i>	firms' taxable income
<i>YH</i>	total households' income
<i>YHI</i>	households' taxable income
<i>αROR<sub>ng,t</sub></i>	notation for the exponential function of the rate of return in sector <i>ng</i> in year <i>t</i>

### 4.B.12. List of exogenous variables

<i>CBUDZ</i>	households disposable budget for consumption in the benchmark
<i>CZ<sub>i</sub></i>	benchmark households' consumption level for commodity <i>i</i>
<i>ERZ</i>	benchmark level of exchange rate
<i>EZ<sub>i</sub></i>	benchmark export supply level of sector <i>i</i>
<i>GDPDEF</i>	GDP deflator
<i>INDEXZ</i>	benchmark level of consumer price index (Laspeyres type)

$IZ_i$	benchmark level for investment commodity $i$
$KSKgmax_{ng}$	maximum possible growth rates of capital in sector $ng$
$KSKgmin_{ng}$	minimum possible growth rates of capital in sector $ng$
$KSKtrend_{ng}$	historically normal growth rate in sector $ng$
$LSRZ$	benchmark level of domestic labor supply
$LW$	labor supply to non-resident firms
$MZ_i$	benchmark import level for commodity $i$
$PEZ_i$	benchmark domestic price of exports of sector $i$
$PLWZ$	wage rate in foreign currency on labor supplied to non-resident firms
$PLZ$	benchmark national average wage rate
$PMZ_i$	benchmark domestic price of imports of commodity $i$
$PVVL0$	present value of indirect utility level in the benchmark prices
$PWEZ_i$	world price of exports
$PWMZ_i$	world price of imports
$PZ_i$	benchmark price of commodity $i$ (excluding VAT, excises but including subsidies)
$RGE$	foreign interest rate
$RORZ_{ng,t}$	benchmark rate of return in sector $ng$ in year $t$
$SW$	balance of the balance of payments
$TRFG$	net transfers received by firms from government
$TRGW$	net transfers received by government from external sector
$TRHF$	net transfers of firms to households
$TRHW$	net transfers received by households from external sector
$TRO$	other transfers received by households from government
$TRWF$	net transfers of firms to external sector
$UNEMPZ$	benchmark level of unemployment (number of unemployed)
$VL0$	households' indirect utility level in benchmark prices

#### **4.B.13. List of parameters**

$aich$	share parameter of capital income received by the households
$aKLE_c$	efficiency parameter of Leontief production function in sector $c$
$aLl_1$	efficiency parameter for capital-labor bundle of Leontief production function in sector $l$ (first nest in the nested production structure in sector $l$ )
$aL2_{en,l}$	efficiency parameter for energy input $en$ of Leontief production function in sector $l$ (first nest in the nested production structure in sector $l$ )

## Appendix 4.B

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$\beta$	parameter in the wage curve
$B_{ng}$	sensitivity of capital growth in sector $ng$ to variations in its equilibrium expected rate of return
$d_i$	depreciation rate in sector $i$
$elasLS$	parameter in the labor supply curve
$g$	steady-state growth rate
$govsh$	share of government disposable budget for purchases of goods and services and capital expenditures in GDP at current market prices
$intf$	share of interest payments on government domestic debt received by firms
$inth$	share of interest payments on government domestic debt received by households
$io_{i,j}$	technical coefficients
$mps$	average propensity to save of households
$shdebitd$	share of conventional budget deficit financed from domestic sources
$svr_i$	share of inventories of commodity $i$ in domestic sales
$tc0_i$	benchmark average excise duty rate on households' consumption of commodity $i$ (to be used in consumer price index and indirect utility function at benchmark prices)
$tc_i$	average excise duty rate on households' consumption of commodity $i$
$tc_{i,j}$	average excise duty rate on consumption of commodity $i$ by sector $j$
$tcaod_{ctp,i}$	quantity of commodity $ctp$ as land transport input per unit of commodity $i$ produced and sold domestically
$tcao_{e_{ctp,i}}$	quantity of commodity $ctp$ as land transport input per exported unit of commodity $i$
$tcaom_{ctp,i}$	quantity of commodity $ctp$ as land transport input per imported unit of commodity $i$
$tcod_{ct,i}$	quantity of commodity $ct$ as trade input per unit of commodity $i$ produced and sold domestically
$tcoe_{ct,i}$	quantity of commodity $ct$ as trade input per exported unit of commodity $i$
$tcom_{ct,i}$	quantity of commodity $ct$ as trade input per imported unit of commodity $i$
$tcrod_{ctpr,i}$	quantity of commodity $ctpr$ as railway transport input per unit of commodity $i$ produced and sold domestically
$tcroe_{ctpr,i}$	quantity of commodity $ctpr$ as railway transport input per exported unit of commodity $i$

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$tcrom_{cpr,i}$	quantity of commodity $cpr$ as railway transport input per imported unit of commodity $i$
$tcwod_{cprw,i}$	quantity of commodity $cprw$ as water transport input per unit of commodity $i$ produced and sold domestically
$tcwoe_{cprw,i}$	quantity of commodity $cprw$ as water transport input per exported unit of commodity $i$
$tcwom_{cprw,i}$	quantity of commodity $cprw$ as water transport input per imported unit of commodity $i$
$tm_i$	average tariff rate on commodity $i$
$tp_i$	average tax rate on production of sector $i$
$trep$	replacement rate out of the gross national wage (used to calculate unemployment benefits)
$tsc0_i$	benchmark average subsidy rate on commodity $i$ (to be used in consumer price index and indirect utility function at benchmark prices)
$tsc_i$	average subsidy rate on commodity $i$
$tsch$	average social security contributions tax rate paid by the self employed members of the households
$tsh_i$	average social security contributions rate paid by the employers in sector $i$
$tsp_i$	average subsidy rate on production of sector $i$
$ty$	average tax rate on households' income
$tyf$	average corporate tax rate
$vat0_i$	benchmark average VAT rate on households' consumption of commodity $i$ (to be used in consumer price index and indirect utility function at benchmark prices)
$vat_i$	average VAT rate on households' consumption of commodity $i$
$vatg0_i$	benchmark average VAT rate on government consumption of commodity $i$
$vatg_i$	average VAT rate on government consumption of commodity $i$
$vati_{i,j}$	average VAT rate on consumption of commodity $i$ by sector $j$ (non-deductible VAT)
$vatinv0_i$	benchmark average VAT rate on investment commodity $i$
$vatinv_i$	average VAT rate on investment commodity $i$
$wdif_i$	wage rate differential of sector $i$ with respect to the national average wage rate
$\alpha GI$	income elasticity of government demand for capital
$\alpha G_i$	income elasticity of government demand for commodity $i$
$\alpha H_i$	income elasticity of households' demand for commodity $i$
$\alpha I_i$	income elasticity of demand for investment commodity $i$

## Appendix 4.B

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$\gamma A1_i$	distribution parameter for imports of commodity $i$ in the Armington function
$\gamma A2_i$	distribution parameter for domestic demand from the domestic market of commodity $i$ in the Armington function
$\gamma L11_l$	distribution parameter for capital in the CES production function of sector $l$ (second nest in the nested production structure in sector $l$ )
$\gamma L12_l$	distribution parameter for labor in the CES production function of sector $l$ (second nest in the nested production structure in sector $l$ )
$\gamma P11_c$	distribution parameter for capital-energy bundle in the CES production function of sector $c$ (second nest in the nested production structure in sector $c$ )
$\gamma P12_c$	distribution parameter for labor in the CES production function of sector $c$ (second nest in the nested production structure in sector $c$ )
$\gamma P21_c$	distribution parameter for capital in the CES production function of sector $c$ (third nest in the nested production structure in sector $c$ )
$\gamma P22_c$	distribution parameter for energy bundle in the CES production function of sector $c$ (third nest in the nested production structure in sector $c$ )
$\gamma P31_c$	distribution parameter for non-electric energy composite in the CES production function of sector $c$ (fourth nest in the nested production structure in sector $c$ )
$\gamma P32_{el,c}$	distribution parameter for electricity ( $el$ ) in the CES production function of sector $c$ (fourth nest in the nested production structure in sector $c$ )
$\gamma P4_{l,c}$	distribution parameter for non-electric energy input $l$ in the CES production function of sector $c$ (fifth nest in the nested production structure in sector $c$ )
$\gamma T1_i$	distribution parameter for exports of sector $i$ in the CET production function
$\gamma T2_i$	distribution parameter for domestic deliveries to domestic market of sector $i$ in the CET production function
$\mu H_i$	subsistence households' consumption of commodity $i$
$\rho$	consumer's time preference rate
$\sigma A_i$	elasticity of substitution between imports and domestic demand from domestic market for commodity $i$ in the Armington function
$\sigma L1_l$	elasticity of substitution between capital and labor in sector $l$ (second nest in the nested production structure in sector $l$ )
$\sigma P1_c$	elasticity of substitution between capital-energy bundle and labor in sector $c$ (second nest in the nested production structure in sector $c$ )

$\sigma P2_c$	elasticity of substitution between capital and energy composite in sector $c$ (third nest in the nested production structure in sector $c$ )
$\sigma P3_c$	elasticity of substitution between electricity and other non-electric energy inputs in sector $c$ (fourth nest in the nested production structure in sector $c$ )
$\sigma P4_c$	elasticity of substitution between non-electric energy inputs in sector $c$ (fifth nest in the nested production structure in sector $c$ )
$\sigma T_i$	elasticity of transformation in the CET production function

### 4.B.14. List of sets and subsets used in the model

$c$	a subscript for one of the production sectors, except coal, oil and natural gas sectors (32 sectors) and also a subscript for one of the commodities except coal, oil and natural gas (32 commodities)
$ct$	a subscript for wholesale and retail trade sector (1 sector) and also a subscript for wholesale and retail trade commodity (1 commodity)
$ctpa$	a subscript for land transport sector (1 sector) and also a subscript for land transport commodity (1 commodity)
$ctpr$	a subscript for railways transport sector (1 sector) and also a subscript for railways transport commodity (1 commodity)
$ctpw$	a subscript for water transport sector (1 sector) and also a subscript for water transport commodity (1 commodity)
$el$	a subscript for electricity sector (1 sector) and also a subscript for electricity commodity (1 commodity)
$en$	a subscript for one of the coal, oil, natural gas and electricity sectors (4 sectors) and also a subscript for one of the coal, oil, natural gas and electricity commodities (4 commodities)
$gov$	a subscript for the public administration sector (1 sector)
$i$	a subscript for one of the production sectors (35 sectors) and also a subscript for one of the commodities (35 types of commodities)
$j$	the same as $i$ (used for exposition purposes)
$l$	a subscript for one of the coal, oil and natural gas sectors (3 sectors) and also a subscript for one of the coal, oil and natural gas commodities (3 commodities)
$nct$	a subscript for one of the production sectors except wholesale and retail trade sector, railways transport sector, land transport sector and water transport sector (31 sectors) and also a subscript for one of the commodities except wholesale and retail trade services, railways transport services, land transport services and water transport services (31 commodities)

## Appendix 4.B

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<i>nen</i>	a subscript for one of the production sectors, except coal, oil, natural gas and electricity sectors (31 sectors) and also a subscript for one of the commodities, except coal, oil, natural gas and electricity (31 commodities)
<i>ng</i>	a subscript for one of the production sectors, except public administration sector (34 sectors)
<i>t</i>	a subscript for year <i>t</i> (current year)
<i>T</i>	a subscript for year T (last period in the model)
<i>-l</i>	a subscript for previous year (used in the description of the static setting of the model)

## Appendix 4.C

### Disaggregation of the production sectors and commodities

#### 4.C.1. Disaggregation of the production sectors and of the commodities in RoMod

The classification of the production sectors in RoMod and in the Romanian SAM and its correspondence to ESA 95, NACE Rev.1 is given in table 4.C.1. The classification of the commodities follows the same classification as the one for the production sectors, even though in general it should not necessarily be the same. In this case the assumption is that each production sector produces only one type of commodity.

**Table 4.C.1 - Disaggregation of the commodities and production sectors in RoMod and in the Romanian SAM**

Code RoMod <sup>131</sup>	Classification of the production sectors in the SAM and in RoMod	ESA 95	Code NACE <sup>132</sup> Rev.1
Sec1	Agriculture, forestry and fishing	Agriculture, hunting and related service activities Forestry, logging and related service activities Fishing, fish farming and related service activities	01 02 05
Sec2	Coal sector	Mining of coal and lignite; extraction of peat Manufacture of coke, refined petroleum products and nuclear fuel	10 23 (partly)
Sec3	Oil sector	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying Manufacture of coke, refined petroleum products and nuclear fuel	11 (partly) 23 (partly)

<sup>131</sup> Code of the sectors used in RoMod and in the Romanian SAM.

<sup>132</sup> Classification of Economic Activities in the European Community.

## Appendix 4.C

**Table 4.C.1 - Disaggregation of the commodities and production sectors in RoMod and in the Romanian SAM (continued)**

Code RoMod <sup>133</sup>	Classification of the production sectors in the SAM and in RoMod	ESA 95	Code NACE <sup>134</sup> Rev.1
Sec4	Natural gas sector	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying Manufacture of coke, refined petroleum products and nuclear fuel	11 (partly) 23 (partly)
Sec5	Manufacture of food products and beverages; tobacco	Manufacture of food products and beverages Manufacture of tobacco products	15 16
Sec6	Manufacture of textile and leather products	Manufacture of textiles Manufacture of wearing apparel; dressing and dyeing of fur Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	17 18 19
Sec7	Manufacture of wood and products of wood	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials Manufacture of furniture; manufacturing n.e.c.	20 36
Sec8	Manufacture of paper and paper products	Manufacture of pulp, paper and paper products	21
Sec9	Manufacture of publishing and printing	Publishing, printing and reproduction of recorded media	22
Sec10	Manufacture of chemicals and chemical products	Manufacture of chemicals and chemical products	24 (partly)
Sec11	Manufacture of pharmaceutical products and cosmetics	Manufacture of chemicals and chemical products	24 (partly)
Sec12	Manufacture of rubber and plastic products	Manufacture of rubber and plastic products	25
Sec13	Manufacture of glass and glass products	Manufacture of other non-metallic mineral products	26 (partly)
Sec14	Other mining and quarrying; manufacture of other non-metallic mineral products	Other mining and quarrying Manufacture of other non-metallic mineral products	14 26 (partly)
Sec15	Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	Mining of metal ores Manufacture of basic metals Manufacture of fabricated metal products, except machinery and equipment	13 27 28
Sec16	Manufacture of general purpose machinery; manufacture of special purpose machinery	Manufacture of machinery and equipment n.e.c.	29 (partly)
Sec17	Manufacture of domestic appliances	Manufacture of machinery and equipment n.e.c.	29 (partly)

<sup>133</sup> Code of the sectors used in RoMod and in the Romanian SAM.

<sup>134</sup> Classification of Economic Activities in the European Community.

## Disaggregation of the production sectors and commodities

**Table 4.C.1 - Disaggregation of the commodities and production sectors in RoMod and in the Romanian SAM (continued)**

Code RoMod <sup>135</sup>	Classification of the production sectors in the SAM and in RoMod	ESA 95	Code NACE <sup>136</sup> Rev.1
Sec18	Manufacture of electrical and machinery and apparatus	Manufacture of office machinery and computers	30
		Manufacture of electrical machinery and apparatus n.e.c.	31
		Manufacture of radio, television and communication equipment and apparatus	32
		Manufacture of medical, precision and optical instruments, watches and clocks	33
Sec19	Manufacture of transport equipment	Manufacture of motor vehicles, trailers and semi-trailers	34
		Manufacture of other transport equipment	35
Sec20	Electricity, gas and water supply	Electricity, gas, steam and hot water supply	40
		Collection, purification and distribution of water	41
Sec21	Construction	Construction	45
Sec22	Wholesale and retail trade	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	50
		Wholesale trade and commission trade, except of motor vehicles and motorcycles	51
		Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	52
Sec23	Hotels and restaurants; activities of travel agencies	Hotels and restaurants	55
		Supporting and auxiliary transport activities; activities of travel agencies	63
Sec24	Transport via railways	Land transport; transport via pipelines	60 (partly)
Sec25	Other land transport; transport via pipelines	Land transport; transport via pipelines	60 (partly)
Sec26	Water transport	Water transport	61
Sec27	Air transport	Air transport	62
Sec28	Post and telecommunications	Post and telecommunications	64
Sec29	Financial intermediation	Financial intermediation, except insurance and pension funding	65
		Insurance and pension funding, except compulsory social security	66
		Activities auxiliary to financial intermediation	67
Sec30	Real estate activities	Real estate activities	70
Sec31	Other business activities	Renting of machinery and equipment without operator and of personal and household goods	71
		Computer and related activities	72
		Research and development	73
		Other business activities	74
Sec32	Public administration and defence; compulsory social security	Public administration and defence; compulsory social security	75

<sup>135</sup> Code of the sectors used in RoMod and in the Romanian SAM.

<sup>136</sup> Classification of Economic Activities in the European Community.

## Appendix 4.C

**Table 4.C.1 - Disaggregation of the commodities and production sectors in RoMod and in the Romanian SAM (continued)**

Code RoMod <sup>137</sup>	Classification of the production sectors in the SAM and in RoMod	ESA 95	Code NACE <sup>138</sup> Rev.1
Sec33	Education	Education	80
Sec34	Health and social work	Health and social work	85
Sec35	Other community, social and personal service activities	Sewage and refuse disposal, sanitation and similar activities	90
		Activities of membership organizations n.e.c.	91
		Recreational, cultural and sporting activities	92
		Other service activities	93
		Activities of households as employers of domestic staff	95

<sup>137</sup> Code of the sectors used in RoMod and in the Romanian SAM.

<sup>138</sup> Classification of Economic Activities in the European Community.

## Appendix 4.D

### Some types of budget deficits

The controversial nature of budget deficits requires a short discussion of some conceptual issues. There is an enormous variation in the size of budget deficits (relative to national income), not only across countries and across time but even for one country during one period of time due to the existence of a variety of concepts of budget deficits. Therefore, a presentation of several ways to measure the size of budget deficits is given in this appendix.

Fiscal deficits are often measured on a cash basis. There are several ways to measure the size of fiscal deficits (Tanzi et al., 1988) on a cash basis:

- Overall or conventional deficit;
- Operational deficit;
- Primary deficit.

The simplest and most commonly used definition for the budget deficit is the **overall** or **conventional deficit**, which is expressed as the excess of expenditure over revenue for all levels of government. The conventional deficit excludes debt repayment from government expenditure but includes interest costs. Furthermore, funds obtained through borrowing are excluded from government revenue. Therefore, the conventional deficit measures the gap to be covered by net borrowing.

The **operational deficit** corrects for the inflation component of interest payments, so it includes the real interest costs the government incurs to service its debt and not the nominal interest costs. Therefore, when the government runs an operational deficit the real value of its debt increases.

Finally, the **primary deficit** excludes all interest costs (nominal or real) from the definition of the deficit. The concept of primary deficit proves to be useful in analyzing the government's budget constraint. For example, when the rising interest costs of the government's increasing debt is leading to an unstable, explosive situation the only solution is to reduce the primary deficit (Fry, 1997). In RoMod we use the primary and conventional balance to define the government deficit.

## Appendix 4.D

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Fry (1997) suggests that measuring deficits on an accrual basis might provide better indicators. He argues that treating privatization proceeds as current revenue may distort the deficit measure. Also, measuring the deficits on a cash-basis gives a strong incentive for amalgamating central bank and fiscal deficits. Easterly (1999) also argues in favor of measuring the deficits on an accrual basis. He proposes as a more appropriate measure of fiscal deficits, the change in the government sector's assets minus all its liabilities, or the change in its net worth. Liabilities include in this case both explicit and implicit liabilities. Easterly shows that fiscal adjustment is an illusion when the government lowers the fiscal deficit while leaving its path of net worth unchanged. For example, to lower its debt accumulation, the government might lower its asset accumulation or might increase its implicit liability accumulation by an equal amount. However, defining government net worth is a very difficult task in many countries due to the high demands it makes on data requirements.

## Appendix 5.A

### Balancing the SAM for Romania, 2000

#### 5.A.1. Introduction

Building a Social Accounting Matrix for a recent year is a challenging task. The main problem is to find an efficient way to incorporate and reconcile information from a variety of sources. First, input-output data and national income and product data are produced with a lag. Second, to build a disaggregated SAM, these data may have to be supplemented with information from censuses of manufacturing, agricultural data, government accounts, labor surveys, international trade accounts and household surveys.

In some cases a new SAM is built by updating a consistent SAM for an earlier period on the basis of information on row and column totals but no information on the flows within the SAM using the traditional RAS approach<sup>139</sup>. However, most of the times one must start with an inconsistent SAM with incomplete knowledge about both row and column sums and flows within the SAM. The inconsistencies come from incompatible data sources, measurement errors or lack of data. Robinson, Cattaneo and El-Said (2001) propose a flexible “cross entropy” (CE) approach to estimate a consistent SAM from inconsistent data estimated with error.

The Social Accounting Matrix for Romania, for 2000, presented in chapter 5 is not initially balanced due to inconsistencies in the methodologies applied by the National Institute of Statistics, National Bank of Romania, Ministry of Finance, IMF and the other sources of data used. Here, we address the balancing of the Romanian SAM by using the deterministic approach of the cross entropy method<sup>140</sup>. The

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<sup>139</sup> See Bacharach (1970), Gilchrist and St Louis (1999), Günlük-Şenesen and Bates (1988) for more details on the RAS method and its extensions.

<sup>140</sup> For more information about the stochastic approach of the cross entropy method see Robinson, Cattaneo and El-Said (2001).

## Appendix 5.A

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deterministic approach has been chosen to keep the consistency with the real value of GDP. Thus, we assume that the available data are not measured with error<sup>141</sup>.

### 5.A.2. The Cross-Entropy method: a deterministic approach

As already explained in chapter 5, the SAM can be represented as:

$$T = [t_{jk}] \quad (5.A.1)$$

where  $j$  is the number of the row and  $k$  the number of the column. By convention, receipts are shown in the rows and outlays are shown in the columns. According to this convention,  $t_{jk}$  is the value of all receipts of  $j$  from  $k$  during the accounting period. Correspondingly,  $t_{kj}$  measures payments to  $k$  by  $j$ . Further, the SAM should satisfy the condition:

$$y_j = \sum_k t_{jk} = \sum_k t_{kj} \quad (5.A.2)$$

A SAM coefficient matrix,  $A_{jk}$ , is constructed from  $T$  by dividing the cells in each column of the SAM ( $T$ ) by the sum of the corresponding columns ( $y_k$ ):

$$A_{jk} = \frac{t_{jk}}{y_k} \quad (5.A.3)$$

The cross-entropy method assumes that we have information in the form of a preliminary  $\overline{A_{jk}}$ , based on inconsistent data from the current year. Further, it assumes that we have exact information on current column sums,  $y^*$ . The problem is to find a new set of  $A_{jk}$  coefficients, which minimize the cross-entropy distance between the prior  $\overline{A_{jk}}$  and the newly estimated coefficient matrix. The measure of cross entropy distance between two probability distributions is defined following Kullback and Leibler (1951). In mathematical terms, the problem consists of minimizing:

$$\min_{\{A_{jk}\}} I = \left[ \sum_j \sum_k A_{jk} \cdot \ln \frac{A_{jk}}{\overline{A_{jk}}} \right] = \left[ \sum_j \sum_k A_{jk} \cdot \ln A_{jk} - \sum_j \sum_k A_{jk} \cdot \ln \overline{A_{jk}} \right] \quad (5.A.4)$$

subject to:

$$\sum_k A_{jk} \cdot y_k^* = y_j^* \quad (5.A.5)$$

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<sup>141</sup> In the case where the data are assumed to be measured with errors the stochastic approach of the cross entropy is more appropriate.

$$\sum_k A_{kj} = 1 \quad \text{and} \quad 0 \leq A_{kj} \leq 1 \quad (5.A.6)$$

### 5.A.3. Some technical details

The balancing problem itself is solved by using the general algebraic modeling system GAMS (Brooke *et al*, 1998). The full computer code for estimating a Social Accounting Matrix using the cross-entropy method is provided by Robinson and El-Said (2000).

Some additional remarks should be made regarding the implementation of the method in the computer code. First, when  $x = 0$  then  $x \cdot \ln x = 0$ . In order to solve equation (5.A.4) and to allow for zero entries in the SAM in the computer code, an epsilon small number should be added to the arguments of the equation. Second, an additional constraint has been added to account the fact that some of the data in the SAM are considered reliable. Therefore, GDP has been fixed. Third, the system of constraint equations (5.A.5) is functionally dependent. If the equality in all but one column and row sum hold, the sums of last column and row are also equal. This is analogous to Walras' law in general equilibrium theory. In this case one equation should be dropped from the system (Robinson, Cattaneo and El-Said, 2001).



## **Appendix 7.A**

### **Detailed results of the policy simulations**

#### **7.A.1. Introduction**

Five main policy scenarios aiming at tax harmonization and public expenditures restructuring have been presented in chapter 7, section 7.3. Given the detailed structure of the model, the results of the policy simulations are available at both macro and sectoral levels. Therefore, to keep the presentation concise the sectoral results of the policy measures are presented in this appendix.

The appendix is organized as follows. First, the results for the elimination of the VAT exemptions and the application of a reduced rate of VAT to certain commodities and services are presented in section 7.A.2, tables 7.A.1-7.A.14. Then, in section 7.A.3, tables 7.A.15-7.A.28, we give the detailed results for the increase in excises duties on mineral oils. The results for the elimination of direct subsidies supporting public passenger transport are presented in section 7.A.4, tables 7.A.29-7.A.42, followed by the sectoral results for switching from current expenditures (government purchases of goods and services) to capital expenditures in section 7.A.5, tables 7.A.43-7.A.56. Finally, in section 7.A.6, tables 7.A.57-7.A.70, we provide the results for the combined measure of tax harmonization and public expenditures restructuring.

## Appendix 7.A

### 7.A.2. Detailed results for the elimination of the VAT exemptions and the application of EU oriented VAT rates to certain commodities and services

**Table 7.A.1. Changes in sectoral gross output compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.02	0.00	0.03	0.02	0.02	0.02
Coal sector	sec2	-0.09	-0.08	-0.07	-0.02	-0.02	-0.02
Oil sector	sec3	0.01	0.04	0.06	0.07	0.08	0.08
Natural gas sector	sec4	0.00	0.03	0.06	0.02	0.02	0.02
Manufacture of food products and beverages; tobacco	sec5	-0.08	-0.05	-0.03	0.02	0.02	0.02
Manufacture of textile and leather products	sec6	-0.03	-0.02	-0.01	-0.02	-0.02	-0.02
Manufacture of wood and products of wood	sec7	0.07	0.10	0.13	0.04	0.04	0.04
Manufacture of paper and paper products	sec8	-0.03	-0.01	0.02	0.00	-0.01	-0.01
Manufacture of publishing and printing	sec9	-0.95	-0.95	-0.94	-0.85	-0.86	-0.87
Manufacture of chemicals and chemical products	sec10	0.01	0.03	0.05	0.02	0.02	0.02
Manufacture of pharmaceutical products and cosmetics	sec11	0.19	0.22	0.25	0.27	0.28	0.29
Manufacture of rubber and plastic products	sec12	0.05	0.07	0.09	0.05	0.05	0.05
Manufacture of glass and glass products	sec13	0.00	0.02	0.04	0.00	0.00	0.00
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.09	0.12	0.14	0.00	0.00	0.00
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.01	0.01	0.02	-0.03	-0.03	-0.04
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.50	0.51	0.53	0.04	0.04	0.04
Manufacture of domestic appliances	sec17	-0.04	-0.02	0.00	0.07	0.07	0.07
Manufacture of electrical and machinery and apparatus	sec18	0.04	0.07	0.09	0.03	0.03	0.03
Manufacture of transport equipment	sec19	0.33	0.35	0.37	0.05	0.05	0.04
Electricity, gas and water supply	sec20	-0.09	-0.08	-0.06	-0.03	-0.03	-0.03
Construction	sec21	0.37	0.41	0.44	0.00	-0.01	-0.01
Wholesale and retail trade	sec22	0.01	0.03	0.05	0.03	0.03	0.03
Hotels and restaurants; activities of travel agencies	sec23	0.08	0.10	0.11	0.20	0.21	0.21
Transport via railways	sec24	-0.03	-0.01	0.01	0.03	0.03	0.03
Other land transport; transport via pipelines	sec25	0.00	0.02	0.04	0.03	0.03	0.03
Water transport	sec26	-0.03	0.00	0.03	-0.03	-0.04	-0.05
Air transport	sec27	-0.03	0.00	0.03	0.00	0.00	-0.01
Post and telecommunications	sec28	-0.05	-0.03	-0.01	0.01	0.01	0.01
Financial intermediation	sec29	-0.08	-0.07	-0.07	-0.07	-0.07	-0.07
Real estate activities	sec30	-0.03	-0.01	0.01	0.01	0.02	0.02
Other business activities	sec31	0.06	0.08	0.10	-0.05	-0.05	-0.05
Public administration and defence; compulsory social security	sec32	-0.05	-0.04	-0.04	0.03	0.03	0.03
Education	sec33	-0.06	-0.05	-0.04	0.08	0.08	0.08
Health and social work	sec34	0.10	0.11	0.12	0.23	0.23	0.23
Other community, social and personal service activities	sec35	-1.46	-1.46	-1.46	-1.38	-1.39	-1.40

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Detailed results of the policy simulations

**Table 7.A.2. Changes in domestic sales by sector compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.05	-0.03	-0.01	0.03	0.03	0.03
Coal sector	sec2	-0.08	-0.06	-0.05	-0.03	-0.03	-0.03
Oil sector	sec3	-0.08	-0.06	-0.04	0.02	0.02	0.03
Natural gas sector	sec4	-0.14	-0.12	-0.10	-0.07	-0.07	-0.07
Manufacture of food products and beverages; tobacco	sec5	-0.11	-0.09	-0.07	0.04	0.04	0.04
Manufacture of textile and leather products	sec6	-0.08	-0.07	-0.06	-0.02	-0.02	-0.02
Manufacture of wood and products of wood	sec7	0.05	0.07	0.09	0.00	0.00	0.00
Manufacture of paper and paper products	sec8	-0.11	-0.09	-0.08	-0.04	-0.04	-0.04
Manufacture of publishing and printing	sec9	-0.93	-0.92	-0.91	-0.81	-0.82	-0.83
Manufacture of chemicals and chemical products	sec10	-0.01	0.02	0.04	0.01	0.01	0.01
Manufacture of pharmaceutical products and cosmetics	sec11	0.25	0.27	0.28	0.42	0.42	0.42
Manufacture of rubber and plastic products	sec12	0.03	0.05	0.07	0.02	0.02	0.02
Manufacture of glass and glass products	sec13	-0.04	-0.02	0.00	-0.05	-0.06	-0.06
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.10	0.12	0.15	-0.02	-0.02	-0.03
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.09	0.11	0.13	-0.01	-0.01	-0.01
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.58	0.61	0.64	-0.02	-0.02	-0.02
Manufacture of domestic appliances	sec17	-0.11	-0.09	-0.07	0.07	0.07	0.07
Manufacture of electrical and machinery and apparatus	sec18	0.18	0.20	0.22	0.01	0.01	0.01
Manufacture of transport equipment	sec19	0.33	0.35	0.38	0.02	0.02	0.02
Electricity, gas and water supply	sec20	-0.10	-0.08	-0.06	-0.03	-0.03	-0.03
Construction	sec21	0.38	0.41	0.45	0.00	-0.01	-0.01
Wholesale and retail trade	sec22	0.01	0.03	0.05	0.03	0.03	0.03
Hotels and restaurants; activities of travel agencies	sec23	0.08	0.10	0.12	0.23	0.23	0.23
Transport via railways	sec24	-0.04	-0.02	0.00	0.02	0.02	0.02
Other land transport; transport via pipelines	sec25	-0.02	0.00	0.02	0.02	0.02	0.02
Water transport	sec26	0.01	0.03	0.05	0.00	0.00	0.00
Air transport	sec27	-0.11	-0.10	-0.08	0.06	0.05	0.05
Post and telecommunications	sec28	-0.09	-0.08	-0.06	0.00	0.00	-0.01
Financial intermediation	sec29	0.00	0.02	0.03	0.01	0.01	0.01
Real estate activities	sec30	-0.03	-0.01	0.01	0.01	0.02	0.02
Other business activities	sec31	0.17	0.19	0.22	-0.03	-0.04	-0.04
Public administration and defence; compulsory social security	sec32	-0.05	-0.04	-0.04	0.03	0.03	0.03
Education	sec33	-0.06	-0.05	-0.04	0.08	0.08	0.08
Health and social work	sec34	0.10	0.11	0.12	0.23	0.23	0.23
Other community, social and personal service activities	sec35	-1.48	-1.47	-1.47	-1.39	-1.40	-1.41

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.3. Changes in private consumption compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.07	-0.06	-0.04	0.04	0.04	0.04
Coal sector	sec2	-0.17	-0.15	-0.14	0.09	0.09	0.09
Oil sector	sec3	-0.15	-0.14	-0.12	0.09	0.09	0.09
Natural gas sector	sec4	-0.16	-0.14	-0.13	0.09	0.09	0.09
Manufacture of food products and beverages; tobacco	sec5	-0.14	-0.12	-0.10	0.07	0.07	0.07
Manufacture of textile and leather products	sec6	-0.08	-0.08	-0.07	0.05	0.05	0.05
Manufacture of wood and products of wood	sec7	-0.12	-0.11	-0.09	0.07	0.07	0.07
Manufacture of paper and paper products	sec8	-0.15	-0.13	-0.12	0.09	0.09	0.09
Manufacture of publishing and printing	sec9	-2.06	-2.05	-2.04	-1.84	-1.85	-1.86
Manufacture of chemicals and chemical products	sec10	-0.16	-0.15	-0.13	0.08	0.08	0.08
Manufacture of pharmaceutical products and cosmetics	sec11	0.44	0.45	0.47	0.68	0.68	0.68
Manufacture of rubber and plastic products	sec12	-0.16	-0.14	-0.13	0.09	0.09	0.09
Manufacture of glass and glass products	sec13	-0.14	-0.12	-0.11	0.10	0.10	0.10
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.15	-0.14	-0.12	0.09	0.09	0.09
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.16	-0.15	-0.13	0.07	0.07	0.07
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.16	-0.15	-0.13	0.08	0.08	0.08
Manufacture of domestic appliances	sec17	-0.15	-0.14	-0.12	0.08	0.08	0.08
Manufacture of electrical and machinery and apparatus	sec18	-0.16	-0.15	-0.13	0.08	0.08	0.08
Manufacture of transport equipment	sec19	-0.18	-0.17	-0.15	0.10	0.10	0.10
Electricity, gas and water supply	sec20	-0.17	-0.15	-0.13	0.10	0.10	0.10
Construction	sec21	-0.22	-0.20	-0.19	0.08	0.08	0.08
Wholesale and retail trade	sec22	-0.14	-0.13	-0.11	0.08	0.08	0.08
Hotels and restaurants; activities of travel agencies	sec23	0.11	0.13	0.15	0.31	0.31	0.31
Transport via railways	sec24	-0.13	-0.12	-0.10	0.09	0.09	0.09
Other land transport; transport via pipelines	sec25	-0.14	-0.12	-0.11	0.08	0.08	0.08
Water transport	sec26	-0.16	-0.15	-0.13	0.08	0.08	0.08
Air transport	sec27	-0.16	-0.14	-0.12	0.08	0.08	0.08
Post and telecommunications	sec28	-0.12	-0.10	-0.09	0.09	0.09	0.09
Financial intermediation	sec29	-0.18	-0.17	-0.16	0.05	0.05	0.05
Real estate activities	sec30	-0.02	0.00	0.02	0.02	0.03	0.03
Other business activities	sec31	-0.17	-0.16	-0.15	0.08	0.08	0.08
Public administration and defence; compulsory social security	sec32	-0.18	-0.16	-0.15	0.04	0.04	0.04
Education	sec33	-0.17	-0.16	-0.15	0.06	0.06	0.06
Health and social work	sec34	-0.12	-0.11	-0.10	0.11	0.11	0.11
Other community, social and personal service activities	sec35	-1.47	-1.46	-1.46	-1.25	-1.26	-1.27

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.4. Changes in employment by sector compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.07	-0.07	-0.06	0.10	0.10	0.10
Coal sector	sec2	-0.09	-0.08	-0.07	-0.02	-0.02	-0.02
Oil sector	sec3	0.02	0.04	0.06	0.13	0.13	0.14
Natural gas sector	sec4	0.00	0.02	0.04	0.08	0.08	0.08
Manufacture of food products and beverages; tobacco	sec5	-0.17	-0.16	-0.15	0.08	0.08	0.08
Manufacture of textile and leather products	sec6	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02
Manufacture of wood and products of wood	sec7	0.14	0.16	0.17	0.07	0.07	0.08
Manufacture of paper and paper products	sec8	-0.06	-0.05	-0.04	0.01	0.01	0.01
Manufacture of publishing and printing	sec9	-1.72	-1.70	-1.67	-1.53	-1.51	-1.48
Manufacture of chemicals and chemical products	sec10	0.03	0.05	0.06	0.05	0.05	0.05
Manufacture of pharmaceutical products and cosmetics	sec11	0.43	0.43	0.44	0.61	0.61	0.62
Manufacture of rubber and plastic products	sec12	0.09	0.10	0.11	0.09	0.09	0.09
Manufacture of glass and glass products	sec13	0.01	0.02	0.03	0.03	0.03	0.03
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.15	0.16	0.18	0.03	0.03	0.03
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.00	0.01	0.02	0.00	-0.01	-0.01
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.56	0.57	0.57	0.06	0.06	0.06
Manufacture of domestic appliances	sec17	-0.06	-0.05	-0.04	0.14	0.14	0.15
Manufacture of electrical and machinery and apparatus	sec18	0.08	0.09	0.10	0.07	0.07	0.07
Manufacture of transport equipment	sec19	0.37	0.38	0.39	0.07	0.07	0.07
Electricity, gas and water supply	sec20	-0.06	-0.06	-0.05	0.05	0.05	0.06
Construction	sec21	0.69	0.70	0.72	0.01	0.01	0.01
Wholesale and retail trade	sec22	0.02	0.02	0.02	0.06	0.06	0.06
Hotels and restaurants; activities of travel agencies	sec23	0.16	0.16	0.16	0.42	0.42	0.41
Transport via railways	sec24	-0.04	-0.04	-0.04	0.09	0.09	0.09
Other land transport; transport via pipelines	sec25	0.00	0.01	0.02	0.06	0.06	0.07
Water transport	sec26	-0.08	-0.06	-0.04	-0.08	-0.08	-0.09
Air transport	sec27	-0.05	-0.04	-0.02	0.06	0.05	0.05
Post and telecommunications	sec28	-0.13	-0.12	-0.12	0.03	0.03	0.03
Financial intermediation	sec29	-0.08	-0.07	-0.07	-0.07	-0.07	-0.07
Real estate activities	sec30	-0.26	-0.26	-0.26	0.16	0.16	0.16
Other business activities	sec31	0.11	0.12	0.13	-0.07	-0.07	-0.07
Public administration and defence; compulsory social security	sec32	-0.05	-0.05	-0.05	0.04	0.04	0.04
Education	sec33	-0.06	-0.05	-0.05	0.09	0.09	0.09
Health and social work	sec34	0.11	0.12	0.12	0.24	0.24	0.24
Other community, social and personal service activities	sec35	-1.84	-1.82	-1.81	-1.73	-1.72	-1.72

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.5. Changes in capital-energy bundle for all the sectors except coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.01	0.02	0.04	0.01	0.01	0.01
Manufacture of food products and beverages; tobacco	sec5	-0.05	-0.02	0.00	0.00	0.00	0.00
Manufacture of textile and leather products	sec6	-0.05	-0.02	0.00	-0.03	-0.04	-0.04
Manufacture of wood and products of wood	sec7	0.01	0.05	0.09	0.00	0.00	0.00
Manufacture of paper and paper products	sec8	-0.02	0.01	0.04	-0.01	-0.01	-0.02
Manufacture of publishing and printing	sec9	-0.19	-0.21	-0.23	-0.17	-0.22	-0.27
Manufacture of chemicals and chemical products	sec10	0.00	0.02	0.05	0.01	0.01	0.01
Manufacture of pharmaceutical products and cosmetics	sec11	0.08	0.12	0.17	0.11	0.13	0.14
Manufacture of rubber and plastic products	sec12	0.01	0.05	0.08	0.01	0.01	0.01
Manufacture of glass and glass products	sec13	-0.01	0.02	0.04	-0.02	-0.02	-0.03
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.06	0.09	0.12	-0.02	-0.02	-0.03
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.02	0.00	0.02	-0.05	-0.05	-0.06
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.37	0.40	0.43	-0.01	-0.01	-0.01
Manufacture of domestic appliances	sec17	-0.02	0.01	0.04	0.01	0.01	0.01
Manufacture of electrical and machinery and apparatus	sec18	0.01	0.04	0.08	0.00	0.00	0.00
Manufacture of transport equipment	sec19	0.24	0.27	0.30	-0.01	-0.01	-0.01
Electricity, gas and water supply	sec20	-0.10	-0.08	-0.06	-0.04	-0.04	-0.05
Construction	sec21	0.13	0.18	0.23	-0.01	-0.02	-0.02
Wholesale and retail trade	sec22	0.00	0.03	0.07	0.00	0.00	-0.01
Hotels and restaurants; activities of travel agencies	sec23	0.02	0.05	0.09	0.06	0.07	0.07
Transport via railways	sec24	-0.02	0.01	0.04	0.00	0.00	0.00
Other land transport; transport via pipelines	sec25	-0.01	0.02	0.05	0.00	0.00	0.00
Water transport	sec26	-0.02	0.01	0.04	-0.02	-0.03	-0.04
Air transport	sec27	-0.02	0.01	0.04	-0.01	-0.02	-0.02
Post and telecommunications	sec28	-0.01	0.03	0.06	0.00	0.00	-0.01
Financial intermediation	sec29	-0.09	-0.07	-0.04	-0.10	-0.11	-0.11
Real estate activities	sec30	-0.02	0.00	0.02	0.01	0.01	0.02
Other business activities	sec31	0.01	0.04	0.08	-0.02	-0.03	-0.03
Public administration and defence; compulsory social security	sec32	-0.02	-0.02	-0.02	0.01	0.01	0.01
Education	sec33	-0.04	-0.01	0.01	0.02	0.02	0.02
Health and social work	sec34	0.05	0.08	0.10	0.14	0.14	0.14
Other community, social and personal service activities	sec35	-0.80	-0.82	-0.84	-0.76	-0.81	-0.85

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Detailed results of the policy simulations

**Table 7.A.6. Changes in capital-labor bundle for the coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Coal sector	sec2	-0.09	-0.08	-0.07	-0.02	-0.02	-0.02
Oil sector	sec3	0.01	0.04	0.06	0.07	0.08	0.08
Natural gas sector	sec4	0.00	0.03	0.06	0.02	0.02	0.02

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

**Table 7.A.7. Changes in government purchases of goods and services compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	0.18	0.22	0.27	0.09	0.10	0.10
Manufacture of publishing and printing	sec9	-7.57	-7.58	-7.58	-7.51	-7.53	-7.56
Electricity, gas and water supply	sec20	0.05	0.06	0.08	0.18	0.17	0.17
Construction	sec21	-0.19	-0.17	-0.15	0.16	0.16	0.16
Transport via railways	sec24	0.08	0.11	0.13	0.19	0.18	0.18
Other land transport; transport via pipelines	sec25	0.06	0.08	0.10	0.17	0.17	0.17
Water transport	sec26	0.01	0.03	0.04	0.14	0.14	0.14
Air transport	sec27	0.03	0.05	0.06	0.14	0.14	0.14
Post and telecommunications	sec28	0.15	0.17	0.19	0.20	0.19	0.19
Real estate activities	sec30	0.48	0.51	0.54	-0.03	-0.02	-0.01
Other business activities	sec31	-0.03	-0.02	-0.01	0.14	0.14	0.14
Public administration and defence; compulsory social security	sec32	-0.04	-0.04	-0.03	0.03	0.03	0.03
Education	sec33	-0.03	-0.02	-0.01	0.09	0.09	0.09
Health and social work	sec34	0.14	0.15	0.16	0.26	0.26	0.26
Other community, social and personal service activities	sec35	-5.49	-5.50	-5.51	-5.41	-5.43	-5.46

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

**Table 7.A.8. Changes in demand for investment commodities compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	0.88	0.94	1.01	-0.09	-0.09	-0.08
Manufacture of wood and products of wood	sec7	0.75	0.79	0.83	0.00	0.00	0.00
Manufacture of publishing and printing	sec9	0.58	0.60	0.61	-0.22	-0.25	-0.27
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.69	0.72	0.76	-0.04	-0.04	-0.04
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.71	0.74	0.77	-0.02	-0.02	-0.02
Manufacture of domestic appliances	sec17	0.75	0.79	0.83	-0.03	-0.03	-0.03
Manufacture of electrical and machinery and apparatus	sec18	0.72	0.75	0.79	-0.03	-0.03	-0.03
Manufacture of transport equipment	sec19	0.72	0.75	0.78	-0.02	-0.02	-0.02
Construction	sec21	0.51	0.55	0.59	-0.02	-0.02	-0.02
Other business activities	sec31	0.67	0.70	0.73	-0.04	-0.04	-0.04

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Appendix 7.A

**Table 7.A.9. Changes in exports compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	0.62	0.75	0.88	-0.19	-0.18	-0.17
Coal sector	sec2	-0.10	-0.10	-0.10	0.06	0.05	0.05
Oil sector	sec3	0.19	0.22	0.26	0.16	0.17	0.17
Natural gas sector	sec4	0.14	0.19	0.23	0.11	0.11	0.11
Manufacture of food products and beverages; tobacco	sec5	0.26	0.31	0.37	-0.14	-0.14	-0.14
Manufacture of textile and leather products	sec6	0.07	0.07	0.08	-0.01	-0.01	0.00
Manufacture of wood and products of wood	sec7	0.10	0.13	0.16	0.06	0.06	0.06
Manufacture of paper and paper products	sec8	0.03	0.06	0.09	0.02	0.02	0.02
Manufacture of publishing and printing	sec9	-1.14	-1.17	-1.19	-1.13	-1.17	-1.22
Manufacture of chemicals and chemical products	sec10	0.02	0.04	0.06	0.02	0.02	0.02
Manufacture of pharmaceutical products and cosmetics	sec11	0.17	0.21	0.25	0.19	0.21	0.22
Manufacture of rubber and plastic products	sec12	0.08	0.10	0.12	0.07	0.07	0.07
Manufacture of glass and glass products	sec13	0.04	0.06	0.09	0.06	0.06	0.06
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.09	0.12	0.16	0.15	0.15	0.14
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.04	-0.02	-0.01	-0.04	-0.04	-0.04
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.46	0.46	0.47	0.07	0.08	0.08
Manufacture of domestic appliances	sec17	0.29	0.33	0.38	0.14	0.15	0.15
Manufacture of electrical and machinery and apparatus	sec18	0.03	0.06	0.08	0.04	0.04	0.04
Manufacture of transport equipment	sec19	0.34	0.35	0.36	0.08	0.08	0.08
Electricity, gas and water supply	sec20	-0.02	-0.01	0.01	0.03	0.03	0.03
Construction	sec21	-0.07	-0.03	0.01	0.03	0.03	0.02
Hotels and restaurants; activities of travel agencies	sec23	0.05	0.08	0.11	0.08	0.09	0.10
Transport via railways	sec24	0.02	0.04	0.07	0.05	0.05	0.05
Other land transport; transport via pipelines	sec25	0.02	0.05	0.07	0.04	0.04	0.04
Water transport	sec26	-0.04	-0.01	0.02	-0.04	-0.05	-0.06
Air transport	sec27	0.00	0.03	0.06	-0.02	-0.02	-0.03
Post and telecommunications	sec28	0.23	0.26	0.29	0.11	0.11	0.10
Financial intermediation	sec29	-0.24	-0.26	-0.29	-0.24	-0.25	-0.25
Other business activities	sec31	-0.06	-0.04	-0.02	-0.06	-0.07	-0.07
Other community, social and personal service activities	sec35	-1.19	-1.26	-1.32	-1.22	-1.29	-1.36

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.10. Changes in imports compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.28	-0.30	-0.31	0.11	0.11	0.10
Coal sector	sec2	-0.03	0.00	0.03	-0.06	-0.07	-0.07
Oil sector	sec3	-0.19	-0.17	-0.16	-0.03	-0.03	-0.04
Natural gas sector	sec4	-0.20	-0.19	-0.17	-0.11	-0.11	-0.11
Manufacture of food products and beverages; tobacco	sec5	-0.37	-0.38	-0.39	0.19	0.19	0.19
Manufacture of textile and leather products	sec6	-0.14	-0.12	-0.10	-0.02	-0.02	-0.02
Manufacture of wood and products of wood	sec7	0.01	0.02	0.03	-0.05	-0.05	-0.06
Manufacture of paper and paper products	sec8	-0.20	-0.19	-0.18	-0.07	-0.07	-0.07
Manufacture of publishing and printing	sec9	-0.74	-0.70	-0.67	-0.54	-0.52	-0.49
Manufacture of chemicals and chemical products	sec10	-0.01	0.01	0.03	0.01	0.01	0.01
Manufacture of pharmaceutical products and cosmetics	sec11	0.30	0.31	0.31	0.54	0.53	0.52
Manufacture of rubber and plastic products	sec12	0.01	0.03	0.05	0.00	0.00	0.00
Manufacture of glass and glass products	sec13	-0.09	-0.07	-0.05	-0.13	-0.13	-0.13
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.12	0.14	0.16	-0.09	-0.09	-0.09
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.18	0.20	0.23	0.02	0.02	0.02
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.62	0.66	0.69	-0.04	-0.04	-0.04
Manufacture of domestic appliances	sec17	-0.16	-0.14	-0.13	0.10	0.10	0.10
Manufacture of electrical and machinery and apparatus	sec18	0.18	0.21	0.23	0.01	0.01	0.01
Manufacture of transport equipment	sec19	0.33	0.35	0.38	0.00	0.00	0.00
Electricity, gas and water supply	sec20	-0.16	-0.14	-0.12	-0.08	-0.08	-0.08
Construction	sec21	0.91	0.93	0.95	-0.04	-0.04	-0.04
Hotels and restaurants; activities of travel agencies	sec23	0.12	0.12	0.13	0.43	0.43	0.42
Transport via railways	sec24	-0.13	-0.12	-0.11	-0.03	-0.03	-0.03
Other land transport; transport via pipelines	sec25	-0.08	-0.07	-0.06	0.00	-0.01	-0.01
Water transport	sec26	0.03	0.04	0.06	0.01	0.02	0.02
Air transport	sec27	-0.15	-0.14	-0.13	0.08	0.08	0.08
Post and telecommunications	sec28	-0.49	-0.49	-0.49	-0.14	-0.14	-0.14
Financial intermediation	sec29	0.22	0.27	0.33	0.25	0.25	0.25
Other business activities	sec31	0.32	0.34	0.37	-0.02	-0.02	-0.02
Other community, social and personal service activities	sec35	-1.83	-1.74	-1.65	-1.60	-1.53	-1.46

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.11. Changes in investments carried out in the sectors compared to the baseline (%)**

Sectors		Non-neutral scenario		Neutral scenario	
		2005	2006	2005	2006
Agriculture, forestry and fishing	sec1	0.65	0.67	0.03	0.03
Coal sector	sec2	0.61	0.65	-0.13	-0.13
Oil sector	sec3	0.75	0.79	0.04	0.04
Natural gas sector	sec4	0.72	0.77	-0.02	-0.02
Manufacture of food products and beverages; tobacco	sec5	0.61	0.65	-0.01	-0.01
Manufacture of textile and leather products	sec6	0.71	0.76	-0.06	-0.06
Manufacture of wood and products of wood	sec7	0.83	0.88	-0.02	-0.02
Manufacture of paper and paper products	sec8	0.67	0.71	-0.07	-0.07
Manufacture of publishing and printing	sec9	-0.56	-0.52	-1.21	-1.21
Manufacture of chemicals and chemical products	sec10	0.76	0.80	-0.02	-0.02
Manufacture of pharmaceutical products and cosmetics	sec11	1.04	1.09	0.38	0.39
Manufacture of rubber and plastic products	sec12	0.79	0.83	-0.01	-0.01
Manufacture of glass and glass products	sec13	0.73	0.77	-0.07	-0.08
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.88	0.92	-0.07	-0.07
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.73	0.76	-0.10	-0.11
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.03	1.09	-0.03	-0.04
Manufacture of domestic appliances	sec17	0.69	0.73	0.02	0.02
Manufacture of electrical and machinery and apparatus	sec18	0.78	0.82	-0.03	-0.03
Manufacture of transport equipment	sec19	0.93	0.98	-0.03	-0.03
Electricity, gas and water supply	sec20	0.69	0.73	-0.06	-0.06
Construction	sec21	1.15	1.21	-0.07	-0.07
Wholesale and retail trade	sec22	0.73	0.78	-0.04	-0.04
Hotels and restaurants; activities of travel agencies	sec23	0.82	0.86	0.17	0.17
Transport via railways	sec24	0.68	0.71	-0.03	-0.03
Other land transport; transport via pipelines	sec25	0.72	0.76	-0.02	-0.02
Water transport	sec26	0.65	0.70	-0.15	-0.16
Air transport	sec27	0.67	0.72	-0.09	-0.09
Post and telecommunications	sec28	0.65	0.69	-0.06	-0.06
Financial intermediation	sec29	0.68	0.72	-0.11	-0.12
Real estate activities	sec30	0.42	0.45	0.11	0.11
Other business activities	sec31	0.79	0.83	-0.12	-0.12
Education	sec33	0.67	0.69	0.03	0.02
Health and social work	sec34	0.83	0.87	0.17	0.17
Other community, social and personal service activities	sec35	-1.16	-1.12	-1.84	-1.84

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Detailed results of the policy simulations

**Table 7.A.12. Changes in rental rate of capital compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.32	-0.37	-0.41	-0.06	-0.07	-0.07
Coal sector	sec2	-0.40	-0.43	-0.46	-0.42	-0.41	-0.40
Oil sector	sec3	-0.11	-0.13	-0.16	-0.04	-0.04	-0.04
Natural gas sector	sec4	-0.16	-0.18	-0.19	-0.18	-0.18	-0.18
Manufacture of food products and beverages; tobacco	sec5	-0.41	-0.43	-0.44	-0.17	-0.16	-0.16
Manufacture of textile and leather products	sec6	-0.19	-0.20	-0.22	-0.27	-0.26	-0.26
Manufacture of wood and products of wood	sec7	0.07	0.05	0.04	-0.19	-0.18	-0.18
Manufacture of paper and paper products	sec8	-0.27	-0.29	-0.31	-0.29	-0.28	-0.28
Manufacture of publishing and printing	sec9	-2.93	-2.82	-2.73	-2.77	-2.63	-2.50
Manufacture of chemicals and chemical products	sec10	-0.09	-0.10	-0.12	-0.18	-0.18	-0.18
Manufacture of pharmaceutical products and cosmetics	sec11	0.53	0.48	0.42	0.69	0.66	0.63
Manufacture of rubber and plastic products	sec12	-0.02	-0.04	-0.06	-0.16	-0.15	-0.15
Manufacture of glass and glass products	sec13	-0.15	-0.18	-0.21	-0.30	-0.29	-0.28
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.19	0.14	0.10	-0.29	-0.29	-0.28
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.16	-0.20	-0.24	-0.36	-0.36	-0.35
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.50	0.48	0.45	-0.21	-0.21	-0.21
Manufacture of domestic appliances	sec17	-0.24	-0.25	-0.26	-0.10	-0.10	-0.10
Manufacture of electrical and machinery and apparatus	sec18	-0.05	-0.06	-0.08	-0.20	-0.20	-0.20
Manufacture of transport equipment	sec19	0.28	0.27	0.25	-0.20	-0.20	-0.20
Electricity, gas and water supply	sec20	-0.24	-0.25	-0.27	-0.26	-0.25	-0.25
Construction	sec21	0.76	0.72	0.69	-0.28	-0.28	-0.28
Wholesale and retail trade	sec22	-0.14	-0.16	-0.18	-0.23	-0.22	-0.22
Hotels and restaurants; activities of travel agencies	sec23	0.05	0.01	-0.02	0.23	0.22	0.20
Transport via railways	sec24	-0.25	-0.29	-0.32	-0.20	-0.20	-0.20
Other land transport; transport via pipelines	sec25	-0.16	-0.19	-0.22	-0.18	-0.18	-0.18
Water transport	sec26	-0.32	-0.32	-0.33	-0.46	-0.46	-0.46
Air transport	sec27	-0.28	-0.28	-0.29	-0.32	-0.32	-0.32
Post and telecommunications	sec28	-0.32	-0.34	-0.36	-0.26	-0.26	-0.25
Financial intermediation	sec29	-0.26	-0.28	-0.29	-0.38	-0.38	-0.37
Real estate activities	sec30	-0.81	-0.83	-0.86	0.11	0.09	0.06
Other business activities	sec31	-0.03	-0.04	-0.06	-0.39	-0.39	-0.38
Public administration and defence; compulsory social security	sec32	-0.28	-0.24	-0.21	-0.15	-0.17	-0.19
Education	sec33	-0.29	-0.33	-0.37	-0.08	-0.09	-0.09
Health and social work	sec34	0.07	0.03	-0.02	0.23	0.21	0.19
Other community, social and personal service activities	sec35	-4.24	-4.06	-3.90	-4.13	-3.93	-3.73

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.13. Changes in commodities prices net of taxes compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.22	-0.24	-0.26	-0.11	-0.12	-0.12
Coal sector	sec2	-0.05	-0.04	-0.04	-0.18	-0.18	-0.18
Oil sector	sec3	-0.09	-0.09	-0.09	-0.19	-0.19	-0.19
Natural gas sector	sec4	-0.07	-0.07	-0.07	-0.18	-0.18	-0.18
Manufacture of food products and beverages; tobacco	sec5	-0.15	-0.15	-0.16	-0.12	-0.12	-0.12
Manufacture of textile and leather products	sec6	-0.10	-0.09	-0.09	-0.17	-0.17	-0.17
Manufacture of wood and products of wood	sec7	-0.08	-0.09	-0.09	-0.20	-0.20	-0.20
Manufacture of paper and paper products	sec8	-0.10	-0.10	-0.10	-0.19	-0.19	-0.19
Manufacture of publishing and printing	sec9	0.08	0.10	0.13	0.02	0.05	0.07
Manufacture of chemicals and chemical products	sec10	-0.06	-0.06	-0.05	-0.17	-0.17	-0.17
Manufacture of pharmaceutical products and cosmetics	sec11	-0.04	-0.04	-0.04	-0.12	-0.12	-0.12
Manufacture of rubber and plastic products	sec12	-0.07	-0.07	-0.07	-0.19	-0.18	-0.18
Manufacture of glass and glass products	sec13	-0.10	-0.10	-0.10	-0.24	-0.24	-0.24
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.05	-0.05	-0.05	-0.22	-0.22	-0.22
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.03	-0.02	-0.02	-0.16	-0.16	-0.16
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.05	-0.04	-0.03	-0.18	-0.18	-0.18
Manufacture of domestic appliances	sec17	-0.09	-0.09	-0.09	-0.17	-0.17	-0.17
Manufacture of electrical and machinery and apparatus	sec18	-0.06	-0.05	-0.05	-0.17	-0.17	-0.17
Manufacture of transport equipment	sec19	-0.06	-0.05	-0.04	-0.18	-0.18	-0.18
Electricity, gas and water supply	sec20	-0.09	-0.08	-0.08	-0.20	-0.19	-0.19
Construction	sec21	0.15	0.15	0.15	-0.18	-0.18	-0.18
Wholesale and retail trade	sec22	-0.10	-0.10	-0.10	-0.19	-0.19	-0.19
Hotels and restaurants; activities of travel agencies	sec23	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
Transport via railways	sec24	-0.12	-0.12	-0.13	-0.20	-0.20	-0.20
Other land transport; transport via pipelines	sec25	-0.10	-0.10	-0.10	-0.19	-0.19	-0.19
Water transport	sec26	-0.05	-0.04	-0.04	-0.16	-0.16	-0.16
Air transport	sec27	-0.07	-0.06	-0.06	-0.16	-0.16	-0.16
Post and telecommunications	sec28	-0.19	-0.19	-0.19	-0.22	-0.21	-0.21
Financial intermediation	sec29	0.02	0.04	0.05	-0.09	-0.09	-0.09
Real estate activities	sec30	-0.51	-0.52	-0.53	0.02	0.00	-0.01
Other business activities	sec31	0.00	0.00	0.01	-0.16	-0.16	-0.16
Public administration and defence; compulsory social security	sec32	0.00	0.02	0.04	-0.05	-0.05	-0.05
Education	sec33	-0.01	0.00	0.02	-0.11	-0.11	-0.11
Health and social work	sec34	-0.18	-0.17	-0.16	-0.28	-0.28	-0.28
Other community, social and personal service activities	sec35	-0.17	-0.14	-0.11	-0.24	-0.21	-0.18

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.14. Changes in price of domestic output compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.22	-0.24	-0.27	-0.11	-0.11	-0.11
Coal sector	sec2	-0.04	-0.02	-0.01	-0.18	-0.18	-0.18
Oil sector	sec3	-0.09	-0.09	-0.08	-0.19	-0.19	-0.19
Natural gas sector	sec4	-0.10	-0.10	-0.10	-0.20	-0.20	-0.20
Manufacture of food products and beverages; tobacco	sec5	-0.16	-0.17	-0.18	-0.10	-0.10	-0.10
Manufacture of textile and leather products	sec6	-0.09	-0.08	-0.07	-0.16	-0.16	-0.16
Manufacture of wood and products of wood	sec7	-0.06	-0.06	-0.06	-0.19	-0.19	-0.19
Manufacture of paper and paper products	sec8	-0.12	-0.13	-0.13	-0.20	-0.20	-0.19
Manufacture of publishing and printing	sec9	0.12	0.15	0.18	0.07	0.10	0.13
Manufacture of chemicals and chemical products	sec10	-0.06	-0.05	-0.05	-0.17	-0.17	-0.17
Manufacture of pharmaceutical products and cosmetics	sec11	0.01	0.00	-0.01	-0.02	-0.03	-0.04
Manufacture of rubber and plastic products	sec12	-0.07	-0.07	-0.07	-0.19	-0.19	-0.19
Manufacture of glass and glass products	sec13	-0.10	-0.10	-0.09	-0.25	-0.24	-0.24
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.03	-0.03	-0.03	-0.23	-0.23	-0.23
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.02	-0.02	-0.01	-0.16	-0.16	-0.16
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.03	-0.02	-0.01	-0.18	-0.18	-0.18
Manufacture of domestic appliances	sec17	-0.08	-0.07	-0.07	-0.15	-0.15	-0.15
Manufacture of electrical and machinery and apparatus	sec18	-0.04	-0.04	-0.03	-0.17	-0.17	-0.16
Manufacture of transport equipment	sec19	-0.05	-0.04	-0.03	-0.18	-0.18	-0.18
Electricity, gas and water supply	sec20	-0.09	-0.08	-0.08	-0.19	-0.19	-0.19
Construction	sec21	0.15	0.15	0.15	-0.18	-0.18	-0.18
Wholesale and retail trade	sec22	-0.10	-0.10	-0.10	-0.19	-0.19	-0.19
Hotels and restaurants; activities of travel agencies	sec23	-0.03	-0.03	-0.03	-0.02	-0.02	-0.03
Transport via railways	sec24	-0.12	-0.13	-0.13	-0.21	-0.21	-0.20
Other land transport; transport via pipelines	sec25	-0.10	-0.10	-0.10	-0.19	-0.19	-0.19
Water transport	sec26	-0.05	-0.04	-0.04	-0.16	-0.16	-0.16
Air transport	sec27	-0.06	-0.06	-0.06	-0.16	-0.16	-0.16
Post and telecommunications	sec28	-0.18	-0.18	-0.18	-0.21	-0.21	-0.21
Financial intermediation	sec29	0.02	0.04	0.06	-0.09	-0.09	-0.09
Real estate activities	sec30	-0.51	-0.52	-0.53	0.02	0.00	-0.01
Other business activities	sec31	0.00	0.01	0.01	-0.16	-0.16	-0.16
Public administration and defence; compulsory social security	sec32	0.00	0.02	0.04	-0.05	-0.05	-0.05
Education	sec33	-0.01	0.00	0.02	-0.11	-0.11	-0.11
Health and social work	sec34	-0.18	-0.17	-0.16	-0.28	-0.28	-0.28
Other community, social and personal service activities	sec35	-0.18	-0.14	-0.11	-0.24	-0.21	-0.18

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

### 7.A.3. Detailed results for the increase in excise duties on mineral oils

**Table 7.A.15. Changes in sectoral gross output compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.49	-0.42	-0.35	-0.41	-0.40	-0.40
Coal sector	sec2	-1.82	-1.94	-2.06	-1.58	-1.71	-1.85
Oil sector	sec3	-2.06	-2.24	-2.43	-1.92	-2.15	-2.39
Natural gas sector	sec4	-0.03	0.08	0.20	-0.04	-0.04	-0.03
Manufacture of food products and beverages; tobacco	sec5	-0.80	-0.77	-0.73	-0.51	-0.51	-0.51
Manufacture of textile and leather products	sec6	0.01	0.07	0.13	0.02	0.05	0.08
Manufacture of wood and products of wood	sec7	0.17	0.30	0.45	-0.06	-0.04	-0.03
Manufacture of paper and paper products	sec8	-0.23	-0.14	-0.04	-0.21	-0.19	-0.19
Manufacture of publishing and printing	sec9	-0.39	-0.37	-0.34	-0.05	-0.02	0.01
Manufacture of chemicals and chemical products	sec10	-1.25	-1.27	-1.28	-1.28	-1.37	-1.46
Manufacture of pharmaceutical products and cosmetics	sec11	-0.51	-0.46	-0.40	-0.28	-0.26	-0.24
Manufacture of rubber and plastic products	sec12	-0.44	-0.38	-0.32	-0.52	-0.54	-0.57
Manufacture of glass and glass products	sec13	-0.36	-0.30	-0.24	-0.40	-0.42	-0.44
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.05	0.05	0.16	-0.47	-0.51	-0.55
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-1.41	-1.49	-1.56	-1.55	-1.70	-1.86
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.83	2.05	2.27	0.15	0.08	0.01
Manufacture of domestic appliances	sec17	-0.30	-0.23	-0.15	0.03	0.08	0.13
Manufacture of electrical and machinery and apparatus	sec18	-0.13	-0.02	0.10	-0.24	-0.22	-0.20
Manufacture of transport equipment	sec19	0.82	0.96	1.10	-0.26	-0.33	-0.40
Electricity, gas and water supply	sec20	-1.29	-1.34	-1.40	-1.10	-1.18	-1.27
Construction	sec21	1.82	2.13	2.44	0.39	0.37	0.35
Wholesale and retail trade	sec22	-0.53	-0.49	-0.46	-0.52	-0.54	-0.57
Hotels and restaurants; activities of travel agencies	sec23	-0.70	-0.69	-0.67	-0.29	-0.28	-0.26
Transport via railways	sec24	-0.92	-0.92	-0.93	-0.79	-0.84	-0.89
Other land transport; transport via pipelines	sec25	-0.95	-0.96	-0.97	-0.89	-0.96	-1.04
Water transport	sec26	-1.92	-2.03	-2.13	-2.04	-2.27	-2.51
Air transport	sec27	-2.88	-3.11	-3.34	-2.87	-3.19	-3.54
Post and telecommunications	sec28	-0.31	-0.25	-0.19	-0.14	-0.12	-0.10
Financial intermediation	sec29	-0.65	-0.67	-0.69	-0.64	-0.68	-0.72
Real estate activities	sec30	-0.14	-0.09	-0.02	-0.02	0.01	0.03
Other business activities	sec31	0.28	0.42	0.57	-0.17	-0.18	-0.19
Public administration and defence; compulsory social security	sec32	0.06	0.08	0.10	0.35	0.40	0.44
Education	sec33	0.17	0.21	0.26	0.64	0.74	0.83
Health and social work	sec34	0.12	0.17	0.22	0.57	0.65	0.72
Other community, social and personal service activities	sec35	-0.58	-0.56	-0.54	-0.32	-0.31	-0.31

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.16. Changes in domestic sales by sector compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.57	-0.54	-0.49	-0.34	-0.32	-0.32
Coal sector	sec2	-1.62	-1.71	-1.80	-1.49	-1.61	-1.74
Oil sector	sec3	-4.86	-5.22	-5.58	-4.58	-4.96	-5.35
Natural gas sector	sec4	-1.48	-1.55	-1.62	-1.29	-1.39	-1.49
Manufacture of food products and beverages; tobacco	sec5	-0.86	-0.85	-0.84	-0.37	-0.36	-0.34
Manufacture of textile and leather products	sec6	-0.27	-0.24	-0.20	-0.10	-0.08	-0.07
Manufacture of wood and products of wood	sec7	0.22	0.33	0.46	0.00	0.01	0.01
Manufacture of paper and paper products	sec8	-0.33	-0.29	-0.24	-0.12	-0.10	-0.08
Manufacture of publishing and printing	sec9	-0.43	-0.41	-0.39	-0.05	-0.02	0.01
Manufacture of chemicals and chemical products	sec10	-0.55	-0.51	-0.47	-0.56	-0.58	-0.61
Manufacture of pharmaceutical products and cosmetics	sec11	-0.61	-0.61	-0.59	-0.07	-0.04	0.00
Manufacture of rubber and plastic products	sec12	-0.30	-0.24	-0.17	-0.38	-0.40	-0.42
Manufacture of glass and glass products	sec13	-0.02	0.05	0.14	-0.13	-0.12	-0.13
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.37	0.50	0.65	-0.12	-0.14	-0.17
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.25	-0.20	-0.14	-0.65	-0.73	-0.80
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	3.09	3.46	3.86	0.85	0.81	0.76
Manufacture of domestic appliances	sec17	-0.77	-0.77	-0.76	-0.16	-0.13	-0.10
Manufacture of electrical and machinery and apparatus	sec18	0.78	0.93	1.09	0.13	0.12	0.10
Manufacture of transport equipment	sec19	1.39	1.60	1.83	0.22	0.18	0.14
Electricity, gas and water supply	sec20	-1.30	-1.36	-1.42	-1.11	-1.20	-1.29
Construction	sec21	1.88	2.19	2.51	0.42	0.40	0.38
Wholesale and retail trade	sec22	-0.53	-0.49	-0.46	-0.52	-0.54	-0.57
Hotels and restaurants; activities of travel agencies	sec23	-0.79	-0.80	-0.80	-0.30	-0.28	-0.27
Transport via railways	sec24	-0.85	-0.85	-0.85	-0.70	-0.74	-0.79
Other land transport; transport via pipelines	sec25	-0.88	-0.89	-0.89	-0.79	-0.84	-0.90
Water transport	sec26	-0.54	-0.52	-0.49	-0.64	-0.69	-0.75
Air transport	sec27	-0.93	-0.95	-0.97	-0.37	-0.37	-0.37
Post and telecommunications	sec28	-0.53	-0.51	-0.48	-0.26	-0.25	-0.25
Financial intermediation	sec29	-0.49	-0.46	-0.43	-0.49	-0.52	-0.55
Real estate activities	sec30	-0.14	-0.09	-0.02	-0.02	0.01	0.03
Other business activities	sec31	0.74	0.90	1.07	-0.06	-0.09	-0.13
Public administration and defence; compulsory social security	sec32	0.06	0.08	0.10	0.35	0.40	0.44
Education	sec33	0.17	0.21	0.26	0.64	0.74	0.83
Health and social work	sec34	0.12	0.17	0.22	0.57	0.65	0.72
Other community, social and personal service activities	sec35	-0.55	-0.54	-0.51	-0.26	-0.25	-0.25

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.17. Changes in private consumption compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.62	-0.61	-0.60	-0.25	-0.24	-0.22
Coal sector	sec2	-1.17	-1.22	-1.27	-0.31	-0.28	-0.25
Oil sector	sec3	-6.42	-6.86	-7.29	-5.74	-6.14	-6.53
Natural gas sector	sec4	-1.06	-1.09	-1.12	-0.22	-0.19	-0.15
Manufacture of food products and beverages; tobacco	sec5	-1.05	-1.06	-1.08	-0.37	-0.35	-0.32
Manufacture of textile and leather products	sec6	-0.58	-0.59	-0.61	-0.13	-0.11	-0.09
Manufacture of wood and products of wood	sec7	-0.85	-0.88	-0.90	-0.21	-0.19	-0.16
Manufacture of paper and paper products	sec8	-1.08	-1.11	-1.14	-0.28	-0.24	-0.21
Manufacture of publishing and printing	sec9	-1.04	-1.06	-1.08	-0.27	-0.23	-0.20
Manufacture of chemicals and chemical products	sec10	-1.18	-1.23	-1.27	-0.34	-0.32	-0.29
Manufacture of pharmaceutical products and cosmetics	sec11	-1.07	-1.10	-1.13	-0.27	-0.24	-0.21
Manufacture of rubber and plastic products	sec12	-1.12	-1.16	-1.19	-0.28	-0.24	-0.21
Manufacture of glass and glass products	sec13	-1.12	-1.17	-1.20	-0.33	-0.31	-0.29
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-1.29	-1.35	-1.40	-0.47	-0.46	-0.44
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-1.10	-1.15	-1.19	-0.31	-0.29	-0.27
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-1.11	-1.15	-1.19	-0.28	-0.25	-0.22
Manufacture of domestic appliances	sec17	-1.03	-1.06	-1.08	-0.23	-0.19	-0.16
Manufacture of electrical and machinery and apparatus	sec18	-1.10	-1.14	-1.18	-0.26	-0.22	-0.19
Manufacture of transport equipment	sec19	-1.32	-1.38	-1.43	-0.37	-0.33	-0.30
Electricity, gas and water supply	sec20	-1.11	-1.14	-1.18	-0.20	-0.16	-0.12
Construction	sec21	-1.46	-1.52	-1.57	-0.44	-0.40	-0.37
Wholesale and retail trade	sec22	-0.90	-0.92	-0.93	-0.12	-0.08	-0.03
Hotels and restaurants; activities of travel agencies	sec23	-0.89	-0.91	-0.92	-0.24	-0.21	-0.18
Transport via railways	sec24	-1.14	-1.18	-1.21	-0.40	-0.39	-0.37
Other land transport; transport via pipelines	sec25	-1.08	-1.12	-1.16	-0.34	-0.32	-0.30
Water transport	sec26	-1.12	-1.17	-1.21	-0.32	-0.29	-0.27
Air transport	sec27	-1.15	-1.20	-1.24	-0.37	-0.35	-0.33
Post and telecommunications	sec28	-0.85	-0.86	-0.86	-0.14	-0.09	-0.05
Financial intermediation	sec29	-1.11	-1.16	-1.21	-0.30	-0.27	-0.24
Real estate activities	sec30	-0.14	-0.08	-0.02	-0.01	0.01	0.04
Other business activities	sec31	-1.13	-1.17	-1.20	-0.27	-0.24	-0.20
Public administration and defence; compulsory social security	sec32	-1.12	-1.17	-1.22	-0.36	-0.34	-0.32
Education	sec33	-1.02	-1.06	-1.10	-0.22	-0.18	-0.15
Health and social work	sec34	-1.06	-1.10	-1.14	-0.27	-0.23	-0.20
Other community, social and personal service activities	sec35	-1.12	-1.15	-1.19	-0.36	-0.33	-0.31

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.18. Changes in employment by sector compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.59	-0.63	-0.66	0.01	0.05	0.08
Coal sector	sec2	-1.87	-1.99	-2.12	-1.62	-1.75	-1.89
Oil sector	sec3	-3.52	-3.83	-4.14	-3.21	-3.52	-3.84
Natural gas sector	sec4	-0.57	-0.55	-0.53	-0.35	-0.37	-0.38
Manufacture of food products and beverages; tobacco	sec5	-0.57	-0.61	-0.64	0.31	0.38	0.46
Manufacture of textile and leather products	sec6	0.26	0.32	0.39	0.28	0.33	0.38
Manufacture of wood and products of wood	sec7	0.62	0.76	0.90	0.32	0.37	0.41
Manufacture of paper and paper products	sec8	-0.04	-0.01	0.03	0.19	0.24	0.29
Manufacture of publishing and printing	sec9	-0.43	-0.48	-0.53	0.28	0.34	0.40
Manufacture of chemicals and chemical products	sec10	-0.91	-0.93	-0.94	-0.89	-0.94	-0.99
Manufacture of pharmaceutical products and cosmetics	sec11	-0.45	-0.47	-0.48	0.20	0.27	0.33
Manufacture of rubber and plastic products	sec12	-0.02	0.02	0.07	-0.05	-0.04	-0.03
Manufacture of glass and glass products	sec13	0.10	0.17	0.24	0.15	0.18	0.22
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	1.05	1.20	1.36	0.58	0.62	0.66
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-1.06	-1.12	-1.19	-1.13	-1.24	-1.36
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	2.47	2.72	2.98	0.68	0.64	0.61
Manufacture of domestic appliances	sec17	-0.12	-0.09	-0.06	0.58	0.68	0.78
Manufacture of electrical and machinery and apparatus	sec18	0.19	0.28	0.39	0.11	0.15	0.20
Manufacture of transport equipment	sec19	1.65	1.84	2.04	0.52	0.51	0.50
Electricity, gas and water supply	sec20	-1.26	-1.37	-1.47	-0.87	-0.92	-0.98
Construction	sec21	3.96	4.34	4.74	1.50	1.48	1.47
Wholesale and retail trade	sec22	-0.86	-0.92	-0.98	-0.72	-0.76	-0.81
Hotels and restaurants; activities of travel agencies	sec23	-0.93	-1.01	-1.10	-0.01	0.04	0.09
Transport via railways	sec24	-0.41	-0.44	-0.46	0.03	0.07	0.10
Other land transport; transport via pipelines	sec25	-0.58	-0.60	-0.62	-0.39	-0.41	-0.42
Water transport	sec26	-1.56	-1.66	-1.76	-1.63	-1.82	-2.01
Air transport	sec27	-2.42	-2.65	-2.87	-2.08	-2.31	-2.55
Post and telecommunications	sec28	-0.68	-0.74	-0.81	-0.12	-0.09	-0.07
Financial intermediation	sec29	-0.12	-0.10	-0.08	-0.09	-0.08	-0.08
Real estate activities	sec30	-1.86	-2.00	-2.15	-0.32	-0.26	-0.21
Other business activities	sec31	0.96	1.10	1.25	0.28	0.29	0.30
Public administration and defence; compulsory social security	sec32	0.34	0.38	0.43	0.66	0.73	0.81
Education	sec33	0.23	0.27	0.31	0.76	0.86	0.96
Health and social work	sec34	0.31	0.37	0.43	0.78	0.88	0.97
Other community, social and personal service activities	sec35	-0.26	-0.24	-0.22	0.12	0.16	0.19

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.19. Changes in capital-energy bundle for all the sectors except coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.47	-0.39	-0.29	-0.48	-0.48	-0.48
Manufacture of food products and beverages; tobacco	sec5	-0.87	-0.82	-0.76	-0.76	-0.78	-0.80
Manufacture of textile and leather products	sec6	-1.13	-1.11	-1.08	-1.17	-1.23	-1.31
Manufacture of wood and products of wood	sec7	-0.27	-0.13	0.02	-0.43	-0.44	-0.45
Manufacture of paper and paper products	sec8	-0.30	-0.19	-0.07	-0.36	-0.36	-0.37
Manufacture of publishing and printing	sec9	-0.35	-0.26	-0.15	-0.37	-0.37	-0.37
Manufacture of chemicals and chemical products	sec10	-1.38	-1.40	-1.42	-1.43	-1.54	-1.65
Manufacture of pharmaceutical products and cosmetics	sec11	-0.54	-0.45	-0.36	-0.50	-0.50	-0.50
Manufacture of rubber and plastic products	sec12	-0.83	-0.76	-0.68	-0.95	-1.00	-1.06
Manufacture of glass and glass products	sec13	-0.75	-0.70	-0.64	-0.87	-0.93	-0.99
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.76	-0.69	-0.61	-1.15	-1.24	-1.34
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-1.68	-1.76	-1.84	-1.85	-2.04	-2.23
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.48	0.63	0.80	-0.96	-1.10	-1.25
Manufacture of domestic appliances	sec17	-0.45	-0.35	-0.23	-0.43	-0.41	-0.40
Manufacture of electrical and machinery and apparatus	sec18	-0.43	-0.31	-0.17	-0.57	-0.58	-0.59
Manufacture of transport equipment	sec19	-1.32	-1.32	-1.30	-2.26	-2.48	-2.72
Electricity, gas and water supply	sec20	-1.29	-1.34	-1.38	-1.14	-1.23	-1.33
Construction	sec21	0.24	0.49	0.75	-0.44	-0.45	-0.48
Wholesale and retail trade	sec22	-0.23	-0.12	0.01	-0.34	-0.35	-0.37
Hotels and restaurants; activities of travel agencies	sec23	-0.54	-0.47	-0.39	-0.48	-0.49	-0.50
Transport via railways	sec24	-1.18	-1.17	-1.17	-1.20	-1.29	-1.40
Other land transport; transport via pipelines	sec25	-1.26	-1.27	-1.27	-1.32	-1.44	-1.56
Water transport	sec26	-1.99	-2.10	-2.20	-2.12	-2.36	-2.61
Air transport	sec27	-2.99	-3.23	-3.46	-3.07	-3.42	-3.79
Post and telecommunications	sec28	-0.07	0.07	0.22	-0.15	-0.13	-0.12
Financial intermediation	sec29	-5.84	-6.24	-6.63	-5.95	-6.44	-6.94
Real estate activities	sec30	-0.09	-0.03	0.04	-0.01	0.01	0.04
Other business activities	sec31	-0.44	-0.30	-0.15	-0.66	-0.69	-0.72
Public administration and defence; compulsory social security	sec32	-1.27	-1.38	-1.49	-1.15	-1.23	-1.31
Education	sec33	-0.26	-0.16	-0.06	-0.13	-0.08	-0.04
Health and social work	sec34	-1.66	-1.71	-1.75	-1.43	-1.51	-1.60
Other community, social and personal service activities	sec35	-1.13	-1.11	-1.09	-1.06	-1.11	-1.17

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Detailed results of the policy simulations

**Table 7.A.20. Changes in capital-labor bundle for the coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Coal sector	sec2	-1.82	-1.94	-2.06	-1.58	-1.71	-1.85
Oil sector	sec3	-2.06	-2.24	-2.43	-1.92	-2.15	-2.39
Natural gas sector	sec4	-0.03	0.08	0.20	-0.04	-0.04	-0.03

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

**Table 7.A.21. Changes in government purchases of goods and services compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	0.78	1.03	1.30	0.34	0.40	0.46
Manufacture of publishing and printing	sec9	0.57	0.69	0.82	0.76	0.85	0.94
Electricity, gas and water supply	sec20	0.60	0.70	0.80	1.01	1.11	1.22
Construction	sec21	-1.04	-1.04	-1.04	0.13	0.23	0.33
Transport via railways	sec24	-0.11	-0.04	0.03	0.19	0.23	0.26
Other land transport; transport via pipelines	sec25	0.10	0.16	0.23	0.43	0.48	0.52
Water transport	sec26	0.12	0.18	0.24	0.55	0.61	0.67
Air transport	sec27	0.03	0.07	0.12	0.38	0.42	0.45
Post and telecommunications	sec28	1.06	1.24	1.43	1.16	1.28	1.41
Real estate activities	sec30	3.53	3.94	4.37	1.57	1.64	1.71
Other business activities	sec31	0.11	0.18	0.25	0.70	0.80	0.90
Public administration and defence; compulsory social security	sec32	0.14	0.16	0.18	0.39	0.44	0.49
Education	sec33	0.48	0.55	0.63	0.87	0.98	1.09
Health and social work	sec34	0.34	0.40	0.46	0.72	0.81	0.89
Other community, social and personal service activities	sec35	0.15	0.22	0.29	0.40	0.47	0.53

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

**Table 7.A.22. Changes in demand for investment commodities compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	4.49	5.15	5.84	0.82	0.76	0.68
Manufacture of wood and products of wood	sec7	3.97	4.47	4.99	1.19	1.16	1.12
Manufacture of publishing and printing	sec9	4.27	4.79	5.34	1.24	1.20	1.16
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	3.70	4.14	4.60	1.00	0.94	0.87
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	3.87	4.32	4.80	1.17	1.12	1.08
Manufacture of domestic appliances	sec17	4.29	4.80	5.34	1.35	1.32	1.29
Manufacture of electrical and machinery and apparatus	sec18	4.04	4.52	5.01	1.26	1.22	1.18
Manufacture of transport equipment	sec19	3.77	4.21	4.67	1.04	0.98	0.93
Construction	sec21	2.60	2.99	3.40	0.61	0.59	0.55
Other business activities	sec31	3.80	4.26	4.74	1.19	1.16	1.12

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Appendix 7.A

**Table 7.A.23. Changes in exports compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	1.29	2.05	2.85	-1.98	-2.07	-2.16
Coal sector	sec2	-2.82	-3.07	-3.34	-2.28	-2.46	-2.65
Oil sector	sec3	2.44	2.56	2.69	2.30	2.30	2.29
Natural gas sector	sec4	1.37	1.66	1.97	1.12	1.23	1.34
Manufacture of food products and beverages; tobacco	sec5	-0.06	0.26	0.61	-1.66	-1.74	-1.83
Manufacture of textile and leather products	sec6	0.64	0.75	0.88	0.35	0.40	0.46
Manufacture of wood and products of wood	sec7	0.16	0.31	0.48	-0.08	-0.05	-0.03
Manufacture of paper and paper products	sec8	-0.12	0.00	0.14	-0.25	-0.25	-0.24
Manufacture of publishing and printing	sec9	-0.02	0.07	0.18	-0.04	-0.01	0.02
Manufacture of chemicals and chemical products	sec10	-1.47	-1.51	-1.55	-1.52	-1.63	-1.74
Manufacture of pharmaceutical products and cosmetics	sec11	-0.36	-0.27	-0.17	-0.34	-0.33	-0.31
Manufacture of rubber and plastic products	sec12	-0.51	-0.44	-0.37	-0.60	-0.62	-0.65
Manufacture of glass and glass products	sec13	-0.66	-0.62	-0.57	-0.65	-0.69	-0.72
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-2.86	-2.94	-3.01	-2.77	-2.96	-3.16
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-1.73	-1.84	-1.94	-1.79	-1.97	-2.15
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.14	1.27	1.40	-0.23	-0.31	-0.39
Manufacture of domestic appliances	sec17	2.58	3.04	3.53	1.91	2.14	2.37
Manufacture of electrical and machinery and apparatus	sec18	-0.19	-0.09	0.03	-0.26	-0.24	-0.22
Manufacture of transport equipment	sec19	0.24	0.30	0.38	-0.74	-0.84	-0.95
Electricity, gas and water supply	sec20	-0.71	-0.72	-0.72	-0.57	-0.62	-0.67
Construction	sec21	-1.19	-1.06	-0.92	-0.97	-0.95	-0.95
Hotels and restaurants; activities of travel agencies	sec23	-0.31	-0.24	-0.16	-0.27	-0.25	-0.24
Transport via railways	sec24	-1.18	-1.20	-1.20	-1.13	-1.21	-1.30
Other land transport; transport via pipelines	sec25	-1.08	-1.10	-1.11	-1.08	-1.18	-1.27
Water transport	sec26	-2.35	-2.49	-2.63	-2.47	-2.76	-3.06
Air transport	sec27	-3.47	-3.77	-4.06	-3.63	-4.05	-4.50
Post and telecommunications	sec28	1.27	1.55	1.85	0.73	0.82	0.92
Financial intermediation	sec29	-0.98	-1.11	-1.24	-0.94	-1.00	-1.07
Other business activities	sec31	-0.23	-0.12	0.00	-0.30	-0.28	-0.26
Other community, social and personal service activities	sec35	-0.97	-0.97	-0.95	-1.10	-1.15	-1.21

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.24. Changes in imports compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-1.19	-1.39	-1.60	0.25	0.30	0.35
Coal sector	sec2	-0.98	-0.96	-0.93	-1.17	-1.28	-1.40
Oil sector	sec3	-8.27	-8.83	-9.39	-7.86	-8.41	-8.97
Natural gas sector	sec4	-2.14	-2.29	-2.44	-1.86	-2.01	-2.16
Manufacture of food products and beverages; tobacco	sec5	-1.26	-1.47	-1.69	0.80	0.91	1.01
Manufacture of textile and leather products	sec6	-0.52	-0.50	-0.47	-0.14	-0.13	-0.12
Manufacture of wood and products of wood	sec7	0.43	0.52	0.61	0.18	0.19	0.19
Manufacture of paper and paper products	sec8	-0.44	-0.45	-0.45	-0.01	0.02	0.05
Manufacture of publishing and printing	sec9	-0.71	-0.75	-0.79	-0.01	0.02	0.05
Manufacture of chemicals and chemical products	sec10	-0.11	-0.03	0.05	-0.11	-0.09	-0.08
Manufacture of pharmaceutical products and cosmetics	sec11	-0.70	-0.73	-0.75	0.10	0.15	0.20
Manufacture of rubber and plastic products	sec12	-0.14	-0.08	-0.01	-0.23	-0.24	-0.26
Manufacture of glass and glass products	sec13	0.46	0.57	0.69	0.27	0.30	0.32
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	1.82	2.05	2.30	1.03	1.08	1.14
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.75	0.91	1.08	0.11	0.10	0.09
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	3.65	4.10	4.57	1.17	1.14	1.10
Manufacture of domestic appliances	sec17	-0.87	-0.90	-0.93	0.03	0.08	0.12
Manufacture of electrical and machinery and apparatus	sec18	0.83	0.98	1.15	0.15	0.14	0.12
Manufacture of transport equipment	sec19	1.79	2.05	2.33	0.54	0.53	0.51
Electricity, gas and water supply	sec20	-1.80	-1.89	-1.99	-1.56	-1.68	-1.80
Construction	sec21	5.57	6.09	6.64	2.05	1.99	1.94
Hotels and restaurants; activities of travel agencies	sec23	-1.43	-1.53	-1.63	-0.34	-0.32	-0.30
Transport via railways	sec24	-0.26	-0.25	-0.24	0.08	0.11	0.14
Other land transport; transport via pipelines	sec25	-0.58	-0.57	-0.55	-0.34	-0.34	-0.35
Water transport	sec26	0.05	0.13	0.22	-0.04	-0.01	0.01
Air transport	sec27	-0.06	0.01	0.09	0.74	0.89	1.05
Post and telecommunications	sec28	-2.71	-2.98	-3.26	-1.47	-1.56	-1.66
Financial intermediation	sec29	-0.04	0.13	0.33	-0.08	-0.07	-0.08
Other business activities	sec31	1.36	1.56	1.76	0.09	0.03	-0.05
Other community, social and personal service activities	sec35	-0.04	-0.01	0.03	0.78	0.87	0.95

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.25. Changes in investments carried out in the sectors compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	3.15	3.59	4.00	1.31	1.31	1.31
Coal sector	sec2	1.46	1.74	2.02	-0.74	-0.99	-1.21
Oil sector	sec3	-0.19	-0.11	-0.01	-2.29	-2.73	-3.12
Natural gas sector	sec4	2.75	3.21	3.65	0.54	0.42	0.32
Manufacture of food products and beverages; tobacco	sec5	3.32	3.83	4.32	1.47	1.50	1.53
Manufacture of textile and leather products	sec6	3.96	4.58	5.17	1.64	1.68	1.71
Manufacture of wood and products of wood	sec7	3.60	4.20	4.77	1.05	1.00	0.95
Manufacture of paper and paper products	sec8	3.20	3.71	4.20	0.98	0.94	0.90
Manufacture of publishing and printing	sec9	3.08	3.54	3.97	1.13	1.10	1.08
Manufacture of chemicals and chemical products	sec10	3.22	3.74	4.25	0.89	0.83	0.77
Manufacture of pharmaceutical products and cosmetics	sec11	3.25	3.76	4.24	1.28	1.28	1.28
Manufacture of rubber and plastic products	sec12	3.59	4.16	4.70	1.21	1.17	1.14
Manufacture of glass and glass products	sec13	3.37	3.89	4.37	0.97	0.90	0.84
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	4.25	4.86	5.43	1.39	1.32	1.26
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	2.22	2.58	2.92	-0.24	-0.47	-0.68
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	4.91	5.66	6.37	1.72	1.68	1.65
Manufacture of domestic appliances	sec17	3.48	4.03	4.56	1.47	1.50	1.53
Manufacture of electrical and machinery and apparatus	sec18	3.64	4.24	4.82	1.23	1.21	1.20
Manufacture of transport equipment	sec19	4.69	5.42	6.12	1.81	1.81	1.81
Electricity, gas and water supply	sec20	2.79	3.25	3.69	0.58	0.47	0.38
Construction	sec21	5.71	6.56	7.36	2.05	2.01	1.96
Wholesale and retail trade	sec22	3.01	3.49	3.96	0.69	0.60	0.52
Hotels and restaurants; activities of travel agencies	sec23	2.98	3.45	3.91	1.04	1.02	1.00
Transport via railways	sec24	2.74	3.16	3.56	0.61	0.52	0.43
Other land transport; transport via pipelines	sec25	2.57	2.99	3.39	0.35	0.23	0.11
Water transport	sec26	1.65	1.96	2.26	-0.73	-1.03	-1.31
Air transport	sec27	0.77	0.94	1.12	-1.46	-1.85	-2.22
Post and telecommunications	sec28	3.11	3.60	4.07	1.00	0.95	0.92
Financial intermediation	sec29	3.39	3.94	4.46	1.03	0.98	0.93
Real estate activities	sec30	1.53	1.81	2.08	0.63	0.62	0.61
Other business activities	sec31	3.95	4.59	5.19	1.25	1.20	1.16
Education	sec33	3.78	4.31	4.79	1.87	1.93	1.97
Health and social work	sec34	4.27	4.86	5.42	2.28	2.37	2.46
Other community, social and personal service activities	sec35	3.49	4.01	4.49	1.46	1.47	1.47

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Detailed results of the policy simulations

**Table 7.A.26. Changes in rental rate of capital compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-1.98	-2.36	-2.76	-0.93	-1.03	-1.13
Coal sector	sec2	-5.71	-6.19	-6.68	-5.67	-6.03	-6.40
Oil sector	sec3	-9.46	-10.16	-10.86	-9.24	-9.83	-10.42
Natural gas sector	sec4	-2.73	-3.01	-3.30	-2.76	-3.00	-3.24
Manufacture of food products and beverages; tobacco	sec5	-1.49	-1.73	-1.99	-0.54	-0.60	-0.66
Manufacture of textile and leather products	sec6	0.03	-0.07	-0.17	-0.20	-0.26	-0.32
Manufacture of wood and products of wood	sec7	-0.74	-0.85	-0.96	-1.60	-1.77	-1.94
Manufacture of paper and paper products	sec8	-1.72	-1.95	-2.20	-1.72	-1.86	-2.01
Manufacture of publishing and printing	sec9	-2.08	-2.40	-2.74	-1.36	-1.49	-1.61
Manufacture of chemicals and chemical products	sec10	-1.66	-1.85	-2.05	-1.94	-2.11	-2.28
Manufacture of pharmaceutical products and cosmetics	sec11	-1.63	-1.88	-2.15	-1.00	-1.08	-1.17
Manufacture of rubber and plastic products	sec12	-0.82	-0.98	-1.16	-1.24	-1.39	-1.54
Manufacture of glass and glass products	sec13	-1.38	-1.63	-1.90	-1.79	-1.98	-2.17
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.58	0.41	0.23	-0.97	-1.20	-1.42
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-4.02	-4.44	-4.88	-4.62	-4.99	-5.36
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	2.21	2.26	2.30	-0.24	-0.44	-0.63
Manufacture of domestic appliances	sec17	-1.08	-1.24	-1.42	-0.55	-0.60	-0.66
Manufacture of electrical and machinery and apparatus	sec18	-0.65	-0.74	-0.83	-1.16	-1.27	-1.38
Manufacture of transport equipment	sec19	1.73	1.77	1.80	0.04	-0.10	-0.23
Electricity, gas and water supply	sec20	-2.65	-2.94	-3.24	-2.66	-2.89	-3.12
Construction	sec21	4.01	4.15	4.28	0.40	0.14	-0.11
Wholesale and retail trade	sec22	-2.16	-2.41	-2.67	-2.40	-2.61	-2.82
Hotels and restaurants; activities of travel agencies	sec23	-2.25	-2.52	-2.81	-1.53	-1.65	-1.77
Transport via railways	sec24	-2.85	-3.21	-3.59	-2.57	-2.78	-2.99
Other land transport; transport via pipelines	sec25	-3.19	-3.53	-3.89	-3.17	-3.41	-3.66
Water transport	sec26	-5.27	-5.71	-6.16	-5.76	-6.24	-6.73
Air transport	sec27	-7.34	-7.96	-8.60	-7.46	-8.06	-8.67
Post and telecommunications	sec28	-1.95	-2.20	-2.47	-1.67	-1.82	-1.96
Financial intermediation	sec29	-1.26	-1.43	-1.62	-1.64	-1.81	-1.97
Real estate activities	sec30	-5.58	-6.09	-6.62	-2.29	-2.35	-2.41
Other business activities	sec31	0.04	-0.01	-0.08	-1.20	-1.38	-1.56
Public administration and defence; compulsory social security	sec32	0.97	1.22	1.47	1.26	1.37	1.48
Education	sec33	-0.53	-0.83	-1.14	0.33	0.27	0.21
Health and social work	sec34	0.59	0.39	0.17	1.23	1.22	1.20
Other community, social and personal service activities	sec35	-1.14	-1.41	-1.70	-0.62	-0.72	-0.83

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.27. Changes in commodities prices net of taxes compared to the baseline (%)**

Commodities		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.89	-1.07	-1.26	-0.45	-0.51	-0.56
Coal sector	sec2	-0.23	-0.21	-0.19	-0.72	-0.79	-0.86
Oil sector	sec3	-1.39	-1.46	-1.54	-1.75	-1.88	-2.01
Natural gas sector	sec4	-0.61	-0.64	-0.67	-1.00	-1.09	-1.18
Manufacture of food products and beverages; tobacco	sec5	-0.64	-0.73	-0.82	-0.53	-0.58	-0.63
Manufacture of textile and leather products	sec6	-0.71	-0.74	-0.77	-0.98	-1.07	-1.16
Manufacture of wood and products of wood	sec7	-0.40	-0.43	-0.47	-0.82	-0.90	-0.99
Manufacture of paper and paper products	sec8	-0.53	-0.57	-0.61	-0.84	-0.91	-0.99
Manufacture of publishing and printing	sec9	-0.68	-0.74	-0.79	-0.87	-0.95	-1.03
Manufacture of chemicals and chemical products	sec10	-0.21	-0.19	-0.18	-0.61	-0.67	-0.72
Manufacture of pharmaceutical products and cosmetics	sec11	-0.56	-0.59	-0.63	-0.84	-0.92	-0.99
Manufacture of rubber and plastic products	sec12	-0.41	-0.43	-0.44	-0.82	-0.90	-0.98
Manufacture of glass and glass products	sec13	-0.07	-0.06	-0.04	-0.55	-0.61	-0.67
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.54	0.60	0.66	-0.06	-0.09	-0.12
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.14	-0.11	-0.09	-0.63	-0.69	-0.75
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.30	-0.29	-0.28	-0.79	-0.87	-0.95
Manufacture of domestic appliances	sec17	-0.70	-0.74	-0.79	-0.98	-1.06	-1.16
Manufacture of electrical and machinery and apparatus	sec18	-0.46	-0.47	-0.48	-0.89	-0.97	-1.05
Manufacture of transport equipment	sec19	-0.21	-0.18	-0.16	-0.67	-0.73	-0.80
Electricity, gas and water supply	sec20	-0.72	-0.75	-0.77	-1.11	-1.21	-1.31
Construction	sec21	0.93	1.00	1.07	-0.25	-0.34	-0.43
Wholesale and retail trade	sec22	-1.00	-1.08	-1.16	-1.31	-1.43	-1.55
Hotels and restaurants; activities of travel agencies	sec23	-0.89	-0.97	-1.05	-0.89	-0.97	-1.04
Transport via railways	sec24	-0.01	-0.01	-0.01	-0.31	-0.34	-0.36
Other land transport; transport via pipelines	sec25	-0.22	-0.22	-0.21	-0.54	-0.58	-0.62
Water transport	sec26	-0.24	-0.23	-0.22	-0.66	-0.72	-0.77
Air transport	sec27	-0.15	-0.12	-0.10	-0.49	-0.52	-0.55
Post and telecommunications	sec28	-1.17	-1.28	-1.39	-1.26	-1.38	-1.49
Financial intermediation	sec29	-0.29	-0.25	-0.20	-0.73	-0.79	-0.86
Real estate activities	sec30	-3.53	-3.84	-4.17	-1.66	-1.72	-1.79
Other business activities	sec31	-0.23	-0.23	-0.22	-0.81	-0.90	-0.99
Public administration and defence; compulsory social security	sec32	-0.26	-0.21	-0.16	-0.51	-0.55	-0.59
Education	sec33	-0.60	-0.60	-0.60	-0.98	-1.08	-1.18
Health and social work	sec34	-0.46	-0.45	-0.44	-0.83	-0.91	-0.99
Other community, social and personal service activities	sec35	-0.27	-0.27	-0.27	-0.52	-0.57	-0.63

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Detailed results of the policy simulations

**Table 7.A.28. Changes in price of domestic output compared to the baseline (%)**

Sectors		Non-neutral scenario			Neutral scenario		
		2004	2005	2006	2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.89	-1.08	-1.27	-0.43	-0.48	-0.53
Coal sector	sec2	-0.18	-0.15	-0.10	-0.74	-0.81	-0.88
Oil sector	sec3	-1.74	-1.83	-1.92	-2.11	-2.26	-2.41
Natural gas sector	sec4	-0.96	-1.03	-1.10	-1.31	-1.43	-1.54
Manufacture of food products and beverages; tobacco	sec5	-0.60	-0.70	-0.81	-0.36	-0.39	-0.43
Manufacture of textile and leather products	sec6	-0.53	-0.53	-0.54	-0.82	-0.90	-0.97
Manufacture of wood and products of wood	sec7	-0.30	-0.31	-0.33	-0.75	-0.83	-0.91
Manufacture of paper and paper products	sec8	-0.52	-0.57	-0.61	-0.77	-0.84	-0.91
Manufacture of publishing and printing	sec9	-0.69	-0.74	-0.80	-0.83	-0.91	-0.99
Manufacture of chemicals and chemical products	sec10	-0.08	-0.05	-0.02	-0.50	-0.55	-0.59
Manufacture of pharmaceutical products and cosmetics	sec11	-0.53	-0.58	-0.63	-0.65	-0.71	-0.77
Manufacture of rubber and plastic products	sec12	-0.27	-0.27	-0.27	-0.70	-0.77	-0.85
Manufacture of glass and glass products	sec13	0.11	0.13	0.17	-0.42	-0.47	-0.52
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.92	1.01	1.10	0.22	0.22	0.21
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.11	-0.08	-0.05	-0.61	-0.67	-0.73
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.07	-0.03	0.01	-0.65	-0.72	-0.79
Manufacture of domestic appliances	sec17	-0.40	-0.41	-0.42	-0.67	-0.73	-0.79
Manufacture of electrical and machinery and apparatus	sec18	-0.36	-0.36	-0.35	-0.81	-0.89	-0.97
Manufacture of transport equipment	sec19	-0.07	-0.03	0.01	-0.57	-0.62	-0.68
Electricity, gas and water supply	sec20	-0.71	-0.74	-0.77	-1.11	-1.21	-1.31
Construction	sec21	0.93	1.00	1.07	-0.25	-0.34	-0.43
Wholesale and retail trade	sec22	-1.00	-1.08	-1.16	-1.31	-1.43	-1.55
Hotels and restaurants; activities of travel agencies	sec23	-0.92	-1.00	-1.08	-0.89	-0.97	-1.05
Transport via railways	sec24	0.01	0.01	0.02	-0.28	-0.31	-0.33
Other land transport; transport via pipelines	sec25	-0.22	-0.22	-0.21	-0.54	-0.58	-0.62
Water transport	sec26	-0.24	-0.23	-0.22	-0.66	-0.72	-0.77
Air transport	sec27	-0.16	-0.14	-0.11	-0.51	-0.54	-0.57
Post and telecommunications	sec28	-1.15	-1.25	-1.36	-1.25	-1.36	-1.47
Financial intermediation	sec29	-0.29	-0.25	-0.20	-0.72	-0.79	-0.86
Real estate activities	sec30	-3.53	-3.84	-4.17	-1.66	-1.72	-1.79
Other business activities	sec31	-0.21	-0.20	-0.20	-0.81	-0.90	-0.99
Public administration and defence; compulsory social security	sec32	-0.26	-0.21	-0.16	-0.51	-0.55	-0.59
Education	sec33	-0.60	-0.60	-0.60	-0.98	-1.08	-1.18
Health and social work	sec34	-0.46	-0.45	-0.44	-0.83	-0.91	-0.99
Other community, social and personal service activities	sec35	-0.26	-0.26	-0.26	-0.51	-0.56	-0.61

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

### 7.A.4. Detailed results for elimination of direct subsidies on public passenger transport

Table 7.A.29. Changes in sectoral gross output compared to the baseline (%)

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.02	-0.03	0.00
Coal sector	sec2	-0.39	-0.96	-1.28
Oil sector	sec3	-0.10	-0.22	-0.27
Natural gas sector	sec4	0.00	0.04	0.11
Manufacture of food products and beverages; tobacco	sec5	-0.06	-0.14	-0.14
Manufacture of textile and leather products	sec6	0.11	0.29	0.40
Manufacture of wood and products of wood	sec7	0.10	0.26	0.39
Manufacture of paper and paper products	sec8	0.01	0.05	0.12
Manufacture of publishing and printing	sec9	-0.03	-0.07	-0.07
Manufacture of chemicals and chemical products	sec10	-0.07	-0.16	-0.18
Manufacture of pharmaceutical products and cosmetics	sec11	-0.05	-0.12	-0.12
Manufacture of rubber and plastic products	sec12	0.01	0.03	0.07
Manufacture of glass and glass products	sec13	0.02	0.06	0.11
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.07	0.17	0.26
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.19	-0.47	-0.63
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.39	0.94	1.23
Manufacture of domestic appliances	sec17	0.00	0.01	0.06
Manufacture of electrical and machinery and apparatus	sec18	0.08	0.21	0.33
Manufacture of transport equipment	sec19	0.13	0.32	0.43
Electricity, gas and water supply	sec20	-0.19	-0.45	-0.57
Construction	sec21	0.30	0.75	1.04
Wholesale and retail trade	sec22	0.00	0.00	0.03
Hotels and restaurants; activities of travel agencies	sec23	-0.08	-0.17	-0.20
Transport via railways	sec24	-1.03	-2.48	-3.25
Other land transport; transport via pipelines	sec25	-0.14	-0.31	-0.38
Water transport	sec26	-0.41	-0.99	-1.33
Air transport	sec27	-0.25	-0.60	-0.76
Post and telecommunications	sec28	-0.01	0.00	0.04
Financial intermediation	sec29	0.11	0.28	0.38
Real estate activities	sec30	-0.04	-0.07	-0.07
Other business activities	sec31	0.16	0.40	0.58
Public administration and defence; compulsory social security	sec32	0.03	0.06	0.09
Education	sec33	0.00	0.01	0.03
Health and social work	sec34	-0.04	-0.08	-0.10
Other community, social and personal service activities	sec35	-0.05	-0.10	-0.11

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Detailed results of the policy simulations

**Table 7.A.30. Changes in domestic sales by sector compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.05	-0.12	-0.12
Coal sector	sec2	-0.35	-0.87	-1.15
Oil sector	sec3	-0.19	-0.44	-0.56
Natural gas sector	sec4	-0.21	-0.51	-0.66
Manufacture of food products and beverages; tobacco	sec5	-0.11	-0.25	-0.30
Manufacture of textile and leather products	sec6	0.00	0.00	0.02
Manufacture of wood and products of wood	sec7	0.06	0.17	0.26
Manufacture of paper and paper products	sec8	-0.02	-0.04	-0.03
Manufacture of publishing and printing	sec9	-0.05	-0.11	-0.12
Manufacture of chemicals and chemical products	sec10	-0.02	-0.04	-0.03
Manufacture of pharmaceutical products and cosmetics	sec11	-0.13	-0.30	-0.37
Manufacture of rubber and plastic products	sec12	-0.03	-0.06	-0.04
Manufacture of glass and glass products	sec13	0.01	0.04	0.09
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.09	0.23	0.33
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.03	-0.07	-0.08
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.46	1.12	1.50
Manufacture of domestic appliances	sec17	-0.13	-0.31	-0.38
Manufacture of electrical and machinery and apparatus	sec18	0.11	0.27	0.38
Manufacture of transport equipment	sec19	0.15	0.37	0.51
Electricity, gas and water supply	sec20	-0.19	-0.45	-0.57
Construction	sec21	0.31	0.77	1.06
Wholesale and retail trade	sec22	0.00	0.00	0.03
Hotels and restaurants; activities of travel agencies	sec23	-0.11	-0.26	-0.31
Transport via railways	sec24	-0.48	-1.14	-1.47
Other land transport; transport via pipelines	sec25	-0.08	-0.19	-0.23
Water transport	sec26	-0.06	-0.14	-0.17
Air transport	sec27	-0.15	-0.36	-0.45
Post and telecommunications	sec28	-0.06	-0.12	-0.13
Financial intermediation	sec29	-0.03	-0.06	-0.05
Real estate activities	sec30	-0.04	-0.07	-0.07
Other business activities	sec31	0.14	0.35	0.49
Public administration and defence; compulsory social security	sec32	0.03	0.06	0.09
Education	sec33	0.00	0.01	0.03
Health and social work	sec34	-0.04	-0.08	-0.10
Other community, social and personal service activities	sec35	-0.06	-0.14	-0.16

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.31. Changes in private consumption compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.09	-0.21	-0.25
Coal sector	sec2	-0.32	-0.78	-1.01
Oil sector	sec3	-0.20	-0.47	-0.59
Natural gas sector	sec4	-0.19	-0.46	-0.58
Manufacture of food products and beverages; tobacco	sec5	-0.16	-0.37	-0.46
Manufacture of textile and leather products	sec6	-0.09	-0.21	-0.26
Manufacture of wood and products of wood	sec7	-0.14	-0.34	-0.42
Manufacture of paper and paper products	sec8	-0.20	-0.46	-0.58
Manufacture of publishing and printing	sec9	-0.17	-0.41	-0.51
Manufacture of chemicals and chemical products	sec10	-0.21	-0.51	-0.64
Manufacture of pharmaceutical products and cosmetics	sec11	-0.21	-0.50	-0.63
Manufacture of rubber and plastic products	sec12	-0.19	-0.46	-0.57
Manufacture of glass and glass products	sec13	-0.19	-0.44	-0.55
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.21	-0.49	-0.62
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.20	-0.48	-0.60
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.19	-0.45	-0.57
Manufacture of domestic appliances	sec17	-0.18	-0.41	-0.52
Manufacture of electrical and machinery and apparatus	sec18	-0.20	-0.46	-0.58
Manufacture of transport equipment	sec19	-0.22	-0.53	-0.67
Electricity, gas and water supply	sec20	-0.21	-0.50	-0.63
Construction	sec21	-0.23	-0.55	-0.69
Wholesale and retail trade	sec22	-0.15	-0.34	-0.42
Hotels and restaurants; activities of travel agencies	sec23	-0.14	-0.32	-0.39
Transport via railways	sec24	-1.14	-2.70	-3.50
Other land transport; transport via pipelines	sec25	-0.23	-0.53	-0.67
Water transport	sec26	-0.20	-0.49	-0.62
Air transport	sec27	-0.19	-0.46	-0.58
Post and telecommunications	sec28	-0.14	-0.33	-0.41
Financial intermediation	sec29	-0.15	-0.35	-0.44
Real estate activities	sec30	-0.04	-0.08	-0.07
Other business activities	sec31	-0.19	-0.44	-0.56
Public administration and defence; compulsory social security	sec32	-0.15	-0.36	-0.45
Education	sec33	-0.15	-0.35	-0.44
Health and social work	sec34	-0.17	-0.39	-0.49
Other community, social and personal service activities	sec35	-0.16	-0.38	-0.47

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.32. Changes in employment by sector compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.05	-0.13	-0.16
Coal sector	sec2	-0.40	-0.98	-1.31
Oil sector	sec3	-0.17	-0.41	-0.53
Natural gas sector	sec4	0.02	0.06	0.11
Manufacture of food products and beverages; tobacco	sec5	-0.10	-0.25	-0.31
Manufacture of textile and leather products	sec6	0.13	0.33	0.46
Manufacture of wood and products of wood	sec7	0.19	0.47	0.65
Manufacture of paper and paper products	sec8	0.07	0.18	0.25
Manufacture of publishing and printing	sec9	-0.05	-0.13	-0.18
Manufacture of chemicals and chemical products	sec10	-0.02	-0.05	-0.05
Manufacture of pharmaceutical products and cosmetics	sec11	-0.08	-0.21	-0.27
Manufacture of rubber and plastic products	sec12	0.04	0.09	0.13
Manufacture of glass and glass products	sec13	0.06	0.14	0.20
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.14	0.33	0.46
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.15	-0.40	-0.54
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.46	1.10	1.44
Manufacture of domestic appliances	sec17	0.02	0.06	0.10
Manufacture of electrical and machinery and apparatus	sec18	0.15	0.39	0.54
Manufacture of transport equipment	sec19	0.17	0.41	0.55
Electricity, gas and water supply	sec20	-0.07	-0.17	-0.22
Construction	sec21	0.59	1.43	1.89
Wholesale and retail trade	sec22	0.00	-0.01	-0.01
Hotels and restaurants; activities of travel agencies	sec23	-0.12	-0.28	-0.37
Transport via railways	sec24	-2.08	-4.87	-6.22
Other land transport; transport via pipelines	sec25	-0.21	-0.50	-0.64
Water transport	sec26	-1.30	-3.08	-4.01
Air transport	sec27	-0.61	-1.43	-1.85
Post and telecommunications	sec28	-0.01	-0.03	-0.04
Financial intermediation	sec29	0.13	0.31	0.42
Real estate activities	sec30	-0.26	-0.63	-0.82
Other business activities	sec31	0.29	0.70	0.94
Public administration and defence; compulsory social security	sec32	0.03	0.08	0.11
Education	sec33	0.01	0.02	0.03
Health and social work	sec34	-0.03	-0.07	-0.09
Other community, social and personal service activities	sec35	-0.04	-0.10	-0.12

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.33. Changes in capital-energy bundle for all the sectors except coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.02	-0.02	0.03
Manufacture of food products and beverages; tobacco	sec5	-0.05	-0.10	-0.08
Manufacture of textile and leather products	sec6	0.01	0.06	0.13
Manufacture of wood and products of wood	sec7	0.01	0.05	0.15
Manufacture of paper and paper products	sec8	-0.01	0.01	0.07
Manufacture of publishing and printing	sec9	-0.02	-0.02	0.03
Manufacture of chemicals and chemical products	sec10	-0.09	-0.20	-0.23
Manufacture of pharmaceutical products and cosmetics	sec11	-0.04	-0.08	-0.05
Manufacture of rubber and plastic products	sec12	-0.02	-0.03	0.02
Manufacture of glass and glass products	sec13	-0.01	-0.02	0.03
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.02	0.07	0.14
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.21	-0.53	-0.69
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.24	0.58	0.79
Manufacture of domestic appliances	sec17	-0.02	-0.02	0.03
Manufacture of electrical and machinery and apparatus	sec18	0.00	0.04	0.12
Manufacture of transport equipment	sec19	0.03	0.08	0.14
Electricity, gas and water supply	sec20	-0.21	-0.50	-0.64
Construction	sec21	0.09	0.24	0.40
Wholesale and retail trade	sec22	-0.01	0.01	0.08
Hotels and restaurants; activities of travel agencies	sec23	-0.05	-0.10	-0.08
Transport via railways	sec24	-0.48	-1.21	-1.65
Other land transport; transport via pipelines	sec25	-0.07	-0.15	-0.15
Water transport	sec26	-0.23	-0.58	-0.80
Air transport	sec27	-0.16	-0.38	-0.48
Post and telecommunications	sec28	0.00	0.02	0.09
Financial intermediation	sec29	-0.02	-0.02	0.02
Real estate activities	sec30	-0.03	-0.06	-0.04
Other business activities	sec31	0.02	0.08	0.18
Public administration and defence; compulsory social security	sec32	-0.01	-0.03	-0.05
Education	sec33	-0.03	-0.04	-0.01
Health and social work	sec34	-0.07	-0.16	-0.18
Other community, social and personal service activities	sec35	-0.05	-0.10	-0.09

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.34. Changes in capital-labor bundle for the coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Coal sector	sec2	-0.39	-0.96	-1.28
Oil sector	sec3	-0.10	-0.22	-0.27
Natural gas sector	sec4	0.00	0.04	0.11

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

**Table 7.A.35. Changes in government purchases of goods and services compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	0.09	0.25	0.40
Manufacture of publishing and printing	sec9	-0.02	-0.03	-0.01
Electricity, gas and water supply	sec20	-0.08	-0.19	-0.24
Construction	sec21	-0.23	-0.55	-0.68
Transport via railways	sec24	-3.44	-8.22	-10.75
Other land transport; transport via pipelines	sec25	-0.25	-0.57	-0.72
Water transport	sec26	-0.14	-0.34	-0.44
Air transport	sec27	-0.11	-0.25	-0.32
Post and telecommunications	sec28	0.06	0.17	0.27
Real estate activities	sec30	0.41	1.03	1.40
Other business activities	sec31	-0.08	-0.19	-0.23
Public administration and defence; compulsory social security	sec32	0.04	0.09	0.12
Education	sec33	0.04	0.11	0.15
Health and social work	sec34	-0.01	-0.03	-0.02
Other community, social and personal service activities	sec35	0.01	0.02	0.05

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

**Table 7.A.36. Changes in demand for investment commodities compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	0.76	1.87	2.56
Manufacture of wood and products of wood	sec7	0.61	1.48	2.00
Manufacture of publishing and printing	sec9	0.65	1.59	2.14
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.51	1.24	1.65
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.57	1.38	1.85
Manufacture of domestic appliances	sec17	0.65	1.58	2.12
Manufacture of electrical and machinery and apparatus	sec18	0.58	1.41	1.90
Manufacture of transport equipment	sec19	0.57	1.37	1.83
Construction	sec21	0.43	1.06	1.45
Other business activities	sec31	0.58	1.42	1.91

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.37. Changes in exports compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	0.68	1.80	2.63
Coal sector	sec2	-2.39	-5.94	-7.96
Oil sector	sec3	-0.10	-0.25	-0.31
Natural gas sector	sec4	0.17	0.47	0.72
Manufacture of food products and beverages; tobacco	sec5	0.38	0.98	1.41
Manufacture of textile and leather products	sec6	0.33	0.83	1.12
Manufacture of wood and products of wood	sec7	0.12	0.31	0.47
Manufacture of paper and paper products	sec8	0.03	0.10	0.19
Manufacture of publishing and printing	sec9	0.08	0.21	0.32
Manufacture of chemicals and chemical products	sec10	-0.10	-0.23	-0.28
Manufacture of pharmaceutical products and cosmetics	sec11	-0.09	-0.20	-0.22
Manufacture of rubber and plastic products	sec12	0.03	0.10	0.17
Manufacture of glass and glass products	sec13	0.01	0.03	0.08
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.22	-0.51	-0.62
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.24	-0.62	-0.82
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.36	0.84	1.09
Manufacture of domestic appliances	sec17	0.75	1.89	2.62
Manufacture of electrical and machinery and apparatus	sec18	0.08	0.21	0.33
Manufacture of transport equipment	sec19	0.12	0.27	0.35
Electricity, gas and water supply	sec20	-0.16	-0.40	-0.51
Construction	sec21	-0.01	0.03	0.12
Hotels and restaurants; activities of travel agencies	sec23	0.06	0.16	0.25
Transport via railways	sec24	-3.14	-7.51	-9.83
Other land transport; transport via pipelines	sec25	-0.23	-0.52	-0.65
Water transport	sec26	-0.51	-1.25	-1.69
Air transport	sec27	-0.28	-0.67	-0.86
Post and telecommunications	sec28	0.33	0.84	1.19
Financial intermediation	sec29	0.42	1.01	1.32
Other business activities	sec31	0.18	0.47	0.67
Other community, social and personal service activities	sec35	0.18	0.45	0.62

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.38. Changes in imports compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.31	-0.77	-1.05
Coal sector	sec2	-0.25	-0.60	-0.75
Oil sector	sec3	-0.37	-0.89	-1.16
Natural gas sector	sec4	-0.32	-0.78	-1.02
Manufacture of food products and beverages; tobacco	sec5	-0.48	-1.19	-1.59
Manufacture of textile and leather products	sec6	-0.17	-0.41	-0.51
Manufacture of wood and products of wood	sec7	0.00	0.01	0.02
Manufacture of paper and paper products	sec8	-0.07	-0.16	-0.20
Manufacture of publishing and printing	sec9	-0.17	-0.41	-0.53
Manufacture of chemicals and chemical products	sec10	-0.01	0.00	0.03
Manufacture of pharmaceutical products and cosmetics	sec11	-0.19	-0.46	-0.59
Manufacture of rubber and plastic products	sec12	-0.06	-0.14	-0.16
Manufacture of glass and glass products	sec13	-0.01	-0.01	0.01
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.11	0.28	0.39
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.09	0.22	0.33
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.49	1.20	1.62
Manufacture of domestic appliances	sec17	-0.18	-0.42	-0.53
Manufacture of electrical and machinery and apparatus	sec18	0.11	0.27	0.39
Manufacture of transport equipment	sec19	0.16	0.40	0.56
Electricity, gas and water supply	sec20	-0.21	-0.49	-0.63
Construction	sec21	0.68	1.63	2.15
Hotels and restaurants; activities of travel agencies	sec23	-0.34	-0.81	-1.06
Transport via railways	sec24	4.38	11.13	15.10
Other land transport; transport via pipelines	sec25	0.13	0.30	0.41
Water transport	sec26	0.09	0.22	0.33
Air transport	sec27	-0.11	-0.25	-0.31
Post and telecommunications	sec28	-0.53	-1.29	-1.73
Financial intermediation	sec29	-0.44	-1.04	-1.31
Other business activities	sec31	0.11	0.27	0.37
Other community, social and personal service activities	sec35	-0.36	-0.86	-1.11

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.39. Changes in investments carried out in the sectors compared to the baseline (%)**

Sectors		Non-neutral scenario	
		2005	2006
Agriculture, forestry and fishing	sec1	0.59	1.42
Coal sector	sec2	0.18	0.40
Oil sector	sec3	0.44	1.07
Natural gas sector	sec4	0.66	1.61
Manufacture of food products and beverages; tobacco	sec5	0.58	1.40
Manufacture of textile and leather products	sec6	0.74	1.81
Manufacture of wood and products of wood	sec7	0.78	1.91
Manufacture of paper and paper products	sec8	0.69	1.68
Manufacture of publishing and printing	sec9	0.60	1.45
Manufacture of chemicals and chemical products	sec10	0.67	1.62
Manufacture of pharmaceutical products and cosmetics	sec11	0.58	1.42
Manufacture of rubber and plastic products	sec12	0.67	1.64
Manufacture of glass and glass products	sec13	0.70	1.69
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.79	1.90
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.45	1.06
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.91	2.21
Manufacture of domestic appliances	sec17	0.66	1.61
Manufacture of electrical and machinery and apparatus	sec18	0.74	1.82
Manufacture of transport equipment	sec19	0.75	1.83
Electricity, gas and water supply	sec20	0.61	1.48
Construction	sec21	1.01	2.46
Wholesale and retail trade	sec22	0.64	1.56
Hotels and restaurants; activities of travel agencies	sec23	0.57	1.40
Transport via railways	sec24	-1.27	-2.87
Other land transport; transport via pipelines	sec25	0.44	1.07
Water transport	sec26	-0.54	-1.22
Air transport	sec27	0.07	0.22
Post and telecommunications	sec28	0.63	1.55
Financial intermediation	sec29	0.72	1.75
Real estate activities	sec30	0.34	0.83
Other business activities	sec31	0.81	1.98
Education	sec33	0.66	1.59
Health and social work	sec34	0.63	1.52
Other community, social and personal service activities	sec35	0.61	1.47

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.40. Changes in rental rate of capital compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.23	-0.60	-0.88
Coal sector	sec2	-1.12	-2.77	-3.67
Oil sector	sec3	-0.54	-1.35	-1.83
Natural gas sector	sec4	-0.07	-0.20	-0.29
Manufacture of food products and beverages; tobacco	sec5	-0.26	-0.64	-0.88
Manufacture of textile and leather products	sec6	0.10	0.23	0.26
Manufacture of wood and products of wood	sec7	0.19	0.43	0.52
Manufacture of paper and paper products	sec8	-0.01	-0.06	-0.14
Manufacture of publishing and printing	sec9	-0.20	-0.53	-0.77
Manufacture of chemicals and chemical products	sec10	-0.06	-0.18	-0.28
Manufacture of pharmaceutical products and cosmetics	sec11	-0.24	-0.61	-0.86
Manufacture of rubber and plastic products	sec12	-0.04	-0.14	-0.23
Manufacture of glass and glass products	sec13	0.01	-0.04	-0.14
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.20	0.42	0.44
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.52	-1.36	-1.90
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.47	1.07	1.32
Manufacture of domestic appliances	sec17	-0.08	-0.20	-0.29
Manufacture of electrical and machinery and apparatus	sec18	0.11	0.25	0.29
Manufacture of transport equipment	sec19	0.13	0.27	0.30
Electricity, gas and water supply	sec20	-0.19	-0.48	-0.68
Construction	sec21	0.69	1.60	2.01
Wholesale and retail trade	sec22	-0.11	-0.31	-0.45
Hotels and restaurants; activities of travel agencies	sec23	-0.26	-0.66	-0.90
Transport via railways	sec24	-4.26	-9.71	-12.08
Other land transport; transport via pipelines	sec25	-0.55	-1.33	-1.76
Water transport	sec26	-2.67	-6.20	-7.92
Air transport	sec27	-1.35	-3.15	-4.05
Post and telecommunications	sec28	-0.13	-0.33	-0.49
Financial intermediation	sec29	0.05	0.09	0.08
Real estate activities	sec30	-0.76	-1.85	-2.46
Other business activities	sec31	0.25	0.58	0.72
Public administration and defence; compulsory social security	sec32	-0.02	-0.01	0.07
Education	sec33	-0.08	-0.24	-0.41
Health and social work	sec34	-0.15	-0.40	-0.60
Other community, social and personal service activities	sec35	-0.19	-0.50	-0.73

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.41. Changes in commodities prices net of taxes compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.10	-0.26	-0.39
Coal sector	sec2	0.49	1.24	1.69
Oil sector	sec3	0.08	0.21	0.29
Natural gas sector	sec4	0.07	0.18	0.24
Manufacture of food products and beverages; tobacco	sec5	-0.04	-0.11	-0.16
Manufacture of textile and leather products	sec6	-0.04	-0.09	-0.11
Manufacture of wood and products of wood	sec7	0.05	0.12	0.15
Manufacture of paper and paper products	sec8	0.08	0.19	0.24
Manufacture of publishing and printing	sec9	0.01	0.01	0.02
Manufacture of chemicals and chemical products	sec10	0.13	0.33	0.45
Manufacture of pharmaceutical products and cosmetics	sec11	0.13	0.31	0.42
Manufacture of rubber and plastic products	sec12	0.06	0.16	0.22
Manufacture of glass and glass products	sec13	0.09	0.23	0.31
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.17	0.41	0.55
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.14	0.36	0.50
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.09	0.22	0.30
Manufacture of domestic appliances	sec17	0.01	0.02	0.04
Manufacture of electrical and machinery and apparatus	sec18	0.08	0.19	0.26
Manufacture of transport equipment	sec19	0.09	0.23	0.32
Electricity, gas and water supply	sec20	0.07	0.18	0.25
Construction	sec21	0.22	0.53	0.70
Wholesale and retail trade	sec22	-0.07	-0.16	-0.22
Hotels and restaurants; activities of travel agencies	sec23	-0.08	-0.19	-0.26
Transport via railways	sec24	3.55	8.94	12.06
Other land transport; transport via pipelines	sec25	0.24	0.56	0.74
Water transport	sec26	0.13	0.33	0.45
Air transport	sec27	0.10	0.24	0.33
Post and telecommunications	sec28	-0.08	-0.19	-0.26
Financial intermediation	sec29	-0.06	-0.12	-0.14
Real estate activities	sec30	-0.42	-1.04	-1.37
Other business activities	sec31	0.07	0.18	0.24
Public administration and defence; compulsory social security	sec32	-0.05	-0.11	-0.11
Education	sec33	-0.05	-0.12	-0.14
Health and social work	sec34	0.00	0.01	0.03
Other community, social and personal service activities	sec35	-0.02	-0.04	-0.04

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.42. Changes in price of domestic output compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.11	-0.28	-0.41
Coal sector	sec2	0.12	0.31	0.44
Oil sector	sec3	0.00	0.00	0.01
Natural gas sector	sec4	0.00	-0.01	-0.01
Manufacture of food products and beverages; tobacco	sec5	-0.08	-0.20	-0.28
Manufacture of textile and leather products	sec6	-0.03	-0.07	-0.07
Manufacture of wood and products of wood	sec7	0.06	0.14	0.18
Manufacture of paper and paper products	sec8	0.04	0.10	0.12
Manufacture of publishing and printing	sec9	-0.03	-0.06	-0.09
Manufacture of chemicals and chemical products	sec10	0.07	0.19	0.26
Manufacture of pharmaceutical products and cosmetics	sec11	0.00	0.00	-0.01
Manufacture of rubber and plastic products	sec12	0.05	0.11	0.16
Manufacture of glass and glass products	sec13	0.05	0.12	0.15
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.10	0.23	0.31
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.10	0.26	0.36
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.10	0.26	0.36
Manufacture of domestic appliances	sec17	0.08	0.20	0.28
Manufacture of electrical and machinery and apparatus	sec18	0.09	0.23	0.31
Manufacture of transport equipment	sec19	0.09	0.23	0.32
Electricity, gas and water supply	sec20	0.07	0.18	0.25
Construction	sec21	0.22	0.53	0.70
Wholesale and retail trade	sec22	-0.07	-0.16	-0.22
Hotels and restaurants; activities of travel agencies	sec23	-0.09	-0.22	-0.29
Transport via railways	sec24	3.74	9.45	12.78
Other land transport; transport via pipelines	sec25	0.24	0.56	0.73
Water transport	sec26	0.13	0.33	0.45
Air transport	sec27	0.10	0.24	0.32
Post and telecommunications	sec28	-0.07	-0.18	-0.24
Financial intermediation	sec29	-0.06	-0.13	-0.14
Real estate activities	sec30	-0.42	-1.04	-1.37
Other business activities	sec31	0.07	0.18	0.24
Public administration and defence; compulsory social security	sec32	-0.05	-0.11	-0.11
Education	sec33	-0.05	-0.12	-0.14
Health and social work	sec34	0.00	0.01	0.03
Other community, social and personal service activities	sec35	-0.02	-0.05	-0.05

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

### 7.A.5. Detailed results for shifting public expenditures from current to capital expenditures

**Table 7.A.43. Changes in sectoral gross output compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.04	-0.01	-0.05
Coal sector	sec2	-0.14	-0.13	-0.34
Oil sector	sec3	0.01	0.04	0.08
Natural gas sector	sec4	-0.04	-0.01	-0.03
Manufacture of food products and beverages; tobacco	sec5	0.06	0.09	0.21
Manufacture of textile and leather products	sec6	0.07	0.08	0.19
Manufacture of wood and products of wood	sec7	0.12	0.15	0.36
Manufacture of paper and paper products	sec8	0.05	0.09	0.20
Manufacture of publishing and printing	sec9	0.01	0.03	0.07
Manufacture of chemicals and chemical products	sec10	0.18	0.20	0.50
Manufacture of pharmaceutical products and cosmetics	sec11	0.04	0.07	0.15
Manufacture of rubber and plastic products	sec12	0.07	0.10	0.23
Manufacture of glass and glass products	sec13	0.10	0.13	0.31
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.15	0.18	0.45
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.22	0.25	0.61
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.84	0.86	2.16
Manufacture of domestic appliances	sec17	0.03	0.06	0.13
Manufacture of electrical and machinery and apparatus	sec18	0.08	0.11	0.25
Manufacture of transport equipment	sec19	0.56	0.58	1.47
Electricity, gas and water supply	sec20	-0.53	-0.52	-1.32
Construction	sec21	0.28	0.31	0.77
Wholesale and retail trade	sec22	0.11	0.14	0.33
Hotels and restaurants; activities of travel agencies	sec23	0.05	0.07	0.17
Transport via railways	sec24	-0.28	-0.27	-0.69
Other land transport; transport via pipelines	sec25	-0.08	-0.05	-0.15
Water transport	sec26	0.00	0.03	0.06
Air transport	sec27	-0.04	-0.01	-0.04
Post and telecommunications	sec28	0.01	0.04	0.08
Financial intermediation	sec29	0.11	0.12	0.30
Real estate activities	sec30	0.00	0.04	0.08
Other business activities	sec31	0.14	0.17	0.40
Public administration and defence; compulsory social security	sec32	0.02	0.09	0.20
Education	sec33	0.03	0.03	0.08
Health and social work	sec34	0.03	0.03	0.08
Other community, social and personal service activities	sec35	0.05	0.07	0.18

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.44. Changes in domestic sales by sector compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.08	-0.06	-0.16
Coal sector	sec2	-0.18	-0.17	-0.43
Oil sector	sec3	-0.05	-0.03	-0.10
Natural gas sector	sec4	-0.49	-0.47	-1.21
Manufacture of food products and beverages; tobacco	sec5	0.05	0.07	0.17
Manufacture of textile and leather products	sec6	0.06	0.07	0.18
Manufacture of wood and products of wood	sec7	0.18	0.20	0.50
Manufacture of paper and paper products	sec8	0.06	0.08	0.20
Manufacture of publishing and printing	sec9	0.01	0.03	0.07
Manufacture of chemicals and chemical products	sec10	0.08	0.11	0.26
Manufacture of pharmaceutical products and cosmetics	sec11	0.03	0.05	0.12
Manufacture of rubber and plastic products	sec12	0.07	0.10	0.24
Manufacture of glass and glass products	sec13	0.10	0.13	0.32
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.16	0.20	0.48
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.22	0.25	0.61
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.91	0.95	2.38
Manufacture of domestic appliances	sec17	0.08	0.09	0.23
Manufacture of electrical and machinery and apparatus	sec18	0.34	0.37	0.92
Manufacture of transport equipment	sec19	0.56	0.59	1.47
Electricity, gas and water supply	sec20	-0.54	-0.53	-1.35
Construction	sec21	0.28	0.32	0.79
Wholesale and retail trade	sec22	0.11	0.14	0.33
Hotels and restaurants; activities of travel agencies	sec23	0.05	0.07	0.16
Transport via railways	sec24	-0.35	-0.33	-0.85
Other land transport; transport via pipelines	sec25	-0.11	-0.09	-0.23
Water transport	sec26	-0.20	-0.18	-0.47
Air transport	sec27	-0.71	-0.69	-1.75
Post and telecommunications	sec28	0.01	0.03	0.07
Financial intermediation	sec29	0.09	0.11	0.27
Real estate activities	sec30	0.00	0.04	0.08
Other business activities	sec31	0.22	0.25	0.62
Public administration and defence; compulsory social security	sec32	0.02	0.09	0.20
Education	sec33	0.03	0.03	0.08
Health and social work	sec34	0.03	0.03	0.08
Other community, social and personal service activities	sec35	0.05	0.07	0.17

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.45. Changes in private consumption compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	0.07	0.09	0.21
Coal sector	sec2	0.06	0.07	0.18
Oil sector	sec3	0.04	0.06	0.14
Natural gas sector	sec4	0.06	0.07	0.18
Manufacture of food products and beverages; tobacco	sec5	0.04	0.06	0.15
Manufacture of textile and leather products	sec6	0.02	0.03	0.07
Manufacture of wood and products of wood	sec7	0.01	0.03	0.06
Manufacture of paper and paper products	sec8	0.03	0.05	0.12
Manufacture of publishing and printing	sec9	0.04	0.06	0.13
Manufacture of chemicals and chemical products	sec10	0.05	0.06	0.15
Manufacture of pharmaceutical products and cosmetics	sec11	0.04	0.05	0.13
Manufacture of rubber and plastic products	sec12	0.03	0.05	0.12
Manufacture of glass and glass products	sec13	0.03	0.05	0.11
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.03	0.04	0.10
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.03	0.05	0.11
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.03	0.05	0.11
Manufacture of domestic appliances	sec17	0.03	0.05	0.11
Manufacture of electrical and machinery and apparatus	sec18	0.03	0.05	0.12
Manufacture of transport equipment	sec19	0.04	0.06	0.14
Electricity, gas and water supply	sec20	0.10	0.12	0.29
Construction	sec21	0.00	0.01	0.02
Wholesale and retail trade	sec22	0.01	0.03	0.07
Hotels and restaurants; activities of travel agencies	sec23	0.03	0.05	0.12
Transport via railways	sec24	0.15	0.16	0.39
Other land transport; transport via pipelines	sec25	0.06	0.08	0.19
Water transport	sec26	0.04	0.06	0.14
Air transport	sec27	0.06	0.08	0.19
Post and telecommunications	sec28	0.03	0.05	0.13
Financial intermediation	sec29	0.04	0.05	0.13
Real estate activities	sec30	0.04	0.08	0.18
Other business activities	sec31	0.02	0.04	0.09
Public administration and defence; compulsory social security	sec32	0.04	0.07	0.17
Education	sec33	0.04	0.05	0.13
Health and social work	sec34	0.04	0.05	0.13
Other community, social and personal service activities	sec35	0.04	0.05	0.13

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.46. Changes in employment by sector compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.16	-0.15	-0.39
Coal sector	sec2	-0.15	-0.14	-0.36
Oil sector	sec3	0.02	0.03	0.07
Natural gas sector	sec4	-0.13	-0.11	-0.29
Manufacture of food products and beverages; tobacco	sec5	0.12	0.12	0.31
Manufacture of textile and leather products	sec6	0.06	0.07	0.18
Manufacture of wood and products of wood	sec7	0.20	0.22	0.55
Manufacture of paper and paper products	sec8	0.10	0.11	0.27
Manufacture of publishing and printing	sec9	0.01	0.02	0.05
Manufacture of chemicals and chemical products	sec10	0.17	0.18	0.45
Manufacture of pharmaceutical products and cosmetics	sec11	0.06	0.07	0.17
Manufacture of rubber and plastic products	sec12	0.10	0.11	0.27
Manufacture of glass and glass products	sec13	0.12	0.13	0.33
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.20	0.22	0.54
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.24	0.26	0.64
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.89	0.90	2.28
Manufacture of domestic appliances	sec17	0.04	0.05	0.13
Manufacture of electrical and machinery and apparatus	sec18	0.12	0.13	0.32
Manufacture of transport equipment	sec19	0.59	0.60	1.52
Electricity, gas and water supply	sec20	-0.67	-0.67	-1.69
Construction	sec21	0.48	0.50	1.26
Wholesale and retail trade	sec22	0.22	0.22	0.56
Hotels and restaurants; activities of travel agencies	sec23	0.08	0.07	0.19
Transport via railways	sec24	-0.60	-0.58	-1.48
Other land transport; transport via pipelines	sec25	-0.14	-0.12	-0.32
Water transport	sec26	-0.02	0.01	0.00
Air transport	sec27	-0.11	-0.09	-0.24
Post and telecommunications	sec28	0.03	0.03	0.08
Financial intermediation	sec29	0.11	0.12	0.30
Real estate activities	sec30	0.00	-0.01	-0.03
Other business activities	sec31	0.22	0.24	0.59
Public administration and defence; compulsory social security	sec32	0.03	0.05	0.12
Education	sec33	0.03	0.03	0.08
Health and social work	sec34	0.03	0.03	0.08
Other community, social and personal service activities	sec35	0.06	0.07	0.18

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.47. Changes in capital-energy bundle for all the sectors except coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.02	0.01	0.02
Manufacture of food products and beverages; tobacco	sec5	0.04	0.08	0.18
Manufacture of textile and leather products	sec6	0.09	0.12	0.28
Manufacture of wood and products of wood	sec7	0.03	0.08	0.18
Manufacture of paper and paper products	sec8	0.03	0.08	0.17
Manufacture of publishing and printing	sec9	0.01	0.05	0.10
Manufacture of chemicals and chemical products	sec10	0.19	0.21	0.52
Manufacture of pharmaceutical products and cosmetics	sec11	0.03	0.06	0.14
Manufacture of rubber and plastic products	sec12	0.05	0.09	0.20
Manufacture of glass and glass products	sec13	0.08	0.12	0.29
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.12	0.16	0.39
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.21	0.24	0.59
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.73	0.76	1.91
Manufacture of domestic appliances	sec17	0.02	0.06	0.14
Manufacture of electrical and machinery and apparatus	sec18	0.04	0.08	0.18
Manufacture of transport equipment	sec19	0.50	0.53	1.33
Electricity, gas and water supply	sec20	-0.51	-0.49	-1.25
Construction	sec21	0.12	0.17	0.40
Wholesale and retail trade	sec22	0.01	0.06	0.13
Hotels and restaurants; activities of travel agencies	sec23	0.03	0.07	0.15
Transport via railways	sec24	-0.12	-0.10	-0.27
Other land transport; transport via pipelines	sec25	-0.02	0.01	0.01
Water transport	sec26	0.00	0.04	0.07
Air transport	sec27	-0.02	0.01	0.01
Post and telecommunications	sec28	0.00	0.04	0.09
Financial intermediation	sec29	0.11	0.15	0.35
Real estate activities	sec30	0.00	0.04	0.08
Other business activities	sec31	0.04	0.09	0.20
Public administration and defence; compulsory social security	sec32	0.02	0.31	0.61
Education	sec33	0.03	0.06	0.13
Health and social work	sec34	0.04	0.06	0.15
Other community, social and personal service activities	sec35	0.04	0.08	0.17

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.48. Changes in capital-labor bundle for the coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Coal sector	sec2	-0.14	-0.13	-0.34
Oil sector	sec3	0.01	0.04	0.08
Natural gas sector	sec4	-0.04	-0.01	-0.03

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

**Table 7.A.49. Changes in government purchases of goods and services compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-11.22	-11.19	-28.48
Manufacture of publishing and printing	sec9	-11.43	-11.42	-28.92
Electricity, gas and water supply	sec20	-11.28	-11.27	-28.62
Construction	sec21	-11.55	-11.54	-29.17
Transport via railways	sec24	-11.09	-11.09	-28.25
Other land transport; transport via pipelines	sec25	-11.35	-11.34	-28.76
Water transport	sec26	-11.41	-11.40	-28.89
Air transport	sec27	-11.35	-11.34	-28.76
Post and telecommunications	sec28	-11.43	-11.42	-28.93
Real estate activities	sec30	-11.41	-11.35	-28.81
Other business activities	sec31	-11.47	-11.46	-29.01
Public administration and defence; compulsory social security	sec32	0.02	0.10	0.20
Education	sec33	0.03	0.03	0.07
Health and social work	sec34	0.02	0.03	0.07
Other community, social and personal service activities	sec35	0.02	0.03	0.07

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

**Table 7.A.50. Changes in demand for investment commodities compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	1.34	1.41	3.54
Manufacture of wood and products of wood	sec7	1.04	1.08	2.72
Manufacture of publishing and printing	sec9	1.11	1.15	2.90
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	1.10	1.14	2.87
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.09	1.12	2.83
Manufacture of domestic appliances	sec17	1.07	1.12	2.81
Manufacture of electrical and machinery and apparatus	sec18	1.09	1.13	2.84
Manufacture of transport equipment	sec19	1.10	1.14	2.86
Construction	sec21	0.97	1.01	2.54
Other business activities	sec31	1.06	1.10	2.76

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.51. Changes in exports compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	0.90	1.01	2.53
Coal sector	sec2	0.24	0.21	0.55
Oil sector	sec3	0.12	0.16	0.38
Natural gas sector	sec4	0.44	0.48	1.20
Manufacture of food products and beverages; tobacco	sec5	0.15	0.23	0.55
Manufacture of textile and leather products	sec6	0.06	0.08	0.19
Manufacture of wood and products of wood	sec7	0.08	0.11	0.27
Manufacture of paper and paper products	sec8	0.05	0.09	0.20
Manufacture of publishing and printing	sec9	0.02	0.05	0.12
Manufacture of chemicals and chemical products	sec10	0.21	0.24	0.59
Manufacture of pharmaceutical products and cosmetics	sec11	0.04	0.08	0.18
Manufacture of rubber and plastic products	sec12	0.07	0.09	0.22
Manufacture of glass and glass products	sec13	0.09	0.12	0.29
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.09	0.13	0.30
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.22	0.25	0.61
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.79	0.80	2.02
Manufacture of domestic appliances	sec17	-0.28	-0.22	-0.59
Manufacture of electrical and machinery and apparatus	sec18	0.05	0.08	0.19
Manufacture of transport equipment	sec19	0.57	0.58	1.46
Electricity, gas and water supply	sec20	-0.16	-0.15	-0.38
Construction	sec21	0.00	0.04	0.08
Hotels and restaurants; activities of travel agencies	sec23	0.05	0.08	0.19
Transport via railways	sec24	-0.04	-0.03	-0.08
Other land transport; transport via pipelines	sec25	-0.01	0.01	0.01
Water transport	sec26	0.06	0.10	0.23
Air transport	sec27	0.16	0.20	0.49
Post and telecommunications	sec28	0.02	0.07	0.14
Financial intermediation	sec29	0.16	0.14	0.37
Other business activities	sec31	0.04	0.07	0.16
Other community, social and personal service activities	sec35	0.08	0.10	0.24

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.52. Changes in imports compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.42	-0.43	-1.08
Coal sector	sec2	-0.30	-0.27	-0.70
Oil sector	sec3	-0.13	-0.11	-0.30
Natural gas sector	sec4	-0.70	-0.68	-1.74
Manufacture of food products and beverages; tobacco	sec5	-0.05	-0.07	-0.15
Manufacture of textile and leather products	sec6	0.02	0.05	0.10
Manufacture of wood and products of wood	sec7	0.27	0.29	0.73
Manufacture of paper and paper products	sec8	0.06	0.08	0.19
Manufacture of publishing and printing	sec9	-0.01	0.01	0.02
Manufacture of chemicals and chemical products	sec10	0.02	0.05	0.11
Manufacture of pharmaceutical products and cosmetics	sec11	0.03	0.04	0.10
Manufacture of rubber and plastic products	sec12	0.07	0.10	0.24
Manufacture of glass and glass products	sec13	0.11	0.14	0.34
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.21	0.24	0.58
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.22	0.25	0.61
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.94	0.98	2.47
Manufacture of domestic appliances	sec17	0.07	0.09	0.22
Manufacture of electrical and machinery and apparatus	sec18	0.35	0.38	0.95
Manufacture of transport equipment	sec19	0.55	0.59	1.47
Electricity, gas and water supply	sec20	-0.87	-0.84	-2.15
Construction	sec21	0.61	0.64	1.61
Hotels and restaurants; activities of travel agencies	sec23	0.04	0.05	0.12
Transport via railways	sec24	-0.89	-0.85	-2.18
Other land transport; transport via pipelines	sec25	-0.25	-0.23	-0.59
Water transport	sec26	-0.29	-0.27	-0.69
Air transport	sec27	-1.00	-0.98	-2.50
Post and telecommunications	sec28	-0.01	0.00	-0.01
Financial intermediation	sec29	0.03	0.08	0.18
Other business activities	sec31	0.33	0.37	0.91
Other community, social and personal service activities	sec35	0.02	0.04	0.09

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.53. Changes in investments carried out in the sectors compared to the baseline (%)**

Sectors		Non-neutral scenario	
		2005	2006
Agriculture, forestry and fishing	sec1	0.66	0.70
Coal sector	sec2	0.67	0.70
Oil sector	sec3	0.86	0.91
Natural gas sector	sec4	0.69	0.74
Manufacture of food products and beverages; tobacco	sec5	0.92	0.97
Manufacture of textile and leather products	sec6	0.87	0.92
Manufacture of wood and products of wood	sec7	1.01	1.06
Manufacture of paper and paper products	sec8	0.93	0.98
Manufacture of publishing and printing	sec9	0.85	0.90
Manufacture of chemicals and chemical products	sec10	0.93	0.98
Manufacture of pharmaceutical products and cosmetics	sec11	0.89	0.93
Manufacture of rubber and plastic products	sec12	0.91	0.96
Manufacture of glass and glass products	sec13	0.97	1.02
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	1.07	1.11
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	1.12	1.17
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.32	1.38
Manufacture of domestic appliances	sec17	0.87	0.92
Manufacture of electrical and machinery and apparatus	sec18	0.92	0.97
Manufacture of transport equipment	sec19	1.15	1.22
Electricity, gas and water supply	sec20	0.44	0.48
Construction	sec21	1.14	1.21
Wholesale and retail trade	sec22	0.97	1.02
Hotels and restaurants; activities of travel agencies	sec23	0.89	0.93
Transport via railways	sec24	0.29	0.34
Other land transport; transport via pipelines	sec25	0.72	0.76
Water transport	sec26	0.83	0.88
Air transport	sec27	0.74	0.79
Post and telecommunications	sec28	0.86	0.91
Financial intermediation	sec29	0.91	0.96
Real estate activities	sec30	0.84	0.85
Other business activities	sec31	0.97	1.03
Education	sec33	0.87	0.90
Health and social work	sec34	0.86	0.90
Other community, social and personal service activities	sec35	0.90	0.94

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.54. Changes in rental rate of capital compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.38	-0.40	-1.00
Coal sector	sec2	-0.37	-0.39	-0.98
Oil sector	sec3	0.05	0.02	0.07
Natural gas sector	sec4	-0.32	-0.33	-0.83
Manufacture of food products and beverages; tobacco	sec5	0.18	0.15	0.40
Manufacture of textile and leather products	sec6	0.06	0.05	0.13
Manufacture of wood and products of wood	sec7	0.36	0.35	0.88
Manufacture of paper and paper products	sec8	0.19	0.18	0.46
Manufacture of publishing and printing	sec9	0.02	0.02	0.04
Manufacture of chemicals and chemical products	sec10	0.19	0.18	0.45
Manufacture of pharmaceutical products and cosmetics	sec11	0.10	0.08	0.20
Manufacture of rubber and plastic products	sec12	0.15	0.14	0.35
Manufacture of glass and glass products	sec13	0.29	0.26	0.68
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.49	0.45	1.16
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.61	0.56	1.44
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.03	1.00	2.54
Manufacture of domestic appliances	sec17	0.06	0.05	0.13
Manufacture of electrical and machinery and apparatus	sec18	0.16	0.16	0.40
Manufacture of transport equipment	sec19	0.67	0.66	1.68
Electricity, gas and water supply	sec20	-0.86	-0.85	-2.15
Construction	sec21	0.65	0.64	1.63
Wholesale and retail trade	sec22	0.29	0.27	0.69
Hotels and restaurants; activities of travel agencies	sec23	0.10	0.08	0.22
Transport via railways	sec24	-1.18	-1.13	-2.90
Other land transport; transport via pipelines	sec25	-0.26	-0.27	-0.68
Water transport	sec26	-0.03	-0.02	-0.06
Air transport	sec27	-0.21	-0.20	-0.52
Post and telecommunications	sec28	0.04	0.03	0.08
Financial intermediation	sec29	0.15	0.14	0.36
Real estate activities	sec30	-0.01	-0.10	-0.19
Other business activities	sec31	0.29	0.29	0.73
Public administration and defence; compulsory social security	sec32	0.06	-0.78	-1.48
Education	sec33	0.06	0.01	0.04
Health and social work	sec34	0.04	0.00	0.03
Other community, social and personal service activities	sec35	0.13	0.10	0.26

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.55. Changes in commodities prices net of taxes compared to the baseline (%)**

Commodities		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.21	-0.22	-0.54
Coal sector	sec2	-0.04	-0.02	-0.07
Oil sector	sec3	0.01	0.02	0.05
Natural gas sector	sec4	-0.04	-0.02	-0.06
Manufacture of food products and beverages; tobacco	sec5	0.01	0.01	0.01
Manufacture of textile and leather products	sec6	0.02	0.04	0.09
Manufacture of wood and products of wood	sec7	0.09	0.10	0.25
Manufacture of paper and paper products	sec8	0.04	0.05	0.11
Manufacture of publishing and printing	sec9	0.02	0.04	0.08
Manufacture of chemicals and chemical products	sec10	-0.01	0.01	0.02
Manufacture of pharmaceutical products and cosmetics	sec11	0.03	0.04	0.10
Manufacture of rubber and plastic products	sec12	0.04	0.05	0.12
Manufacture of glass and glass products	sec13	0.04	0.06	0.13
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.06	0.07	0.17
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.03	0.05	0.11
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.05	0.06	0.15
Manufacture of domestic appliances	sec17	0.06	0.07	0.17
Manufacture of electrical and machinery and apparatus	sec18	0.04	0.06	0.13
Manufacture of transport equipment	sec19	0.03	0.05	0.12
Electricity, gas and water supply	sec20	-0.15	-0.13	-0.34
Construction	sec21	0.16	0.17	0.43
Wholesale and retail trade	sec22	0.10	0.11	0.27
Hotels and restaurants; activities of travel agencies	sec23	0.03	0.04	0.09
Transport via railways	sec24	-0.36	-0.33	-0.86
Other land transport; transport via pipelines	sec25	-0.07	-0.05	-0.15
Water transport	sec26	0.00	0.02	0.04
Air transport	sec27	-0.07	-0.05	-0.14
Post and telecommunications	sec28	0.03	0.04	0.08
Financial intermediation	sec29	0.01	0.04	0.08
Real estate activities	sec30	0.01	-0.04	-0.08
Other business activities	sec31	0.07	0.09	0.21
Public administration and defence; compulsory social security	sec32	0.01	-0.03	-0.05
Education	sec33	0.01	0.04	0.08
Health and social work	sec34	0.01	0.04	0.08
Other community, social and personal service activities	sec35	0.02	0.04	0.08

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.56. Changes in price of domestic output compared to the baseline (%)**

Sectors		Non-neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.22	-0.22	-0.57
Coal sector	sec2	-0.02	0.01	0.00
Oil sector	sec3	0.01	0.02	0.04
Natural gas sector	sec4	-0.12	-0.11	-0.29
Manufacture of food products and beverages; tobacco	sec5	-0.01	-0.01	-0.03
Manufacture of textile and leather products	sec6	0.00	0.02	0.04
Manufacture of wood and products of wood	sec7	0.07	0.08	0.20
Manufacture of paper and paper products	sec8	0.04	0.05	0.11
Manufacture of publishing and printing	sec9	0.02	0.03	0.07
Manufacture of chemicals and chemical products	sec10	-0.01	0.01	0.00
Manufacture of pharmaceutical products and cosmetics	sec11	0.03	0.03	0.08
Manufacture of rubber and plastic products	sec12	0.03	0.05	0.11
Manufacture of glass and glass products	sec13	0.04	0.06	0.13
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.07	0.09	0.21
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.03	0.05	0.11
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.05	0.07	0.16
Manufacture of domestic appliances	sec17	0.02	0.03	0.08
Manufacture of electrical and machinery and apparatus	sec18	0.04	0.06	0.13
Manufacture of transport equipment	sec19	0.03	0.05	0.11
Electricity, gas and water supply	sec20	-0.15	-0.13	-0.34
Construction	sec21	0.16	0.17	0.43
Wholesale and retail trade	sec22	0.10	0.11	0.27
Hotels and restaurants; activities of travel agencies	sec23	0.03	0.04	0.08
Transport via railways	sec24	-0.38	-0.35	-0.90
Other land transport; transport via pipelines	sec25	-0.07	-0.05	-0.14
Water transport	sec26	0.00	0.02	0.04
Air transport	sec27	-0.06	-0.05	-0.13
Post and telecommunications	sec28	0.03	0.04	0.08
Financial intermediation	sec29	0.01	0.04	0.08
Real estate activities	sec30	0.01	-0.04	-0.08
Other business activities	sec31	0.08	0.09	0.22
Public administration and defence; compulsory social security	sec32	0.01	-0.03	-0.05
Education	sec33	0.01	0.04	0.08
Health and social work	sec34	0.01	0.04	0.08
Other community, social and personal service activities	sec35	0.02	0.04	0.08

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

### 7.A.6. Detailed results of the combined measure of tax harmonization and public expenditures restructuring

Table 7.A.57. Changes in sectoral gross output compared to the baseline (%)

Sectors		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.40	-0.35	-0.36
Coal sector	sec2	-2.06	-2.66	-3.31
Oil sector	sec3	-1.87	-2.16	-2.42
Natural gas sector	sec4	-0.03	0.04	0.02
Manufacture of food products and beverages; tobacco	sec5	-0.39	-0.31	-0.16
Manufacture of textile and leather products	sec6	0.20	0.42	0.66
Manufacture of wood and products of wood	sec7	0.15	0.27	0.53
Manufacture of paper and paper products	sec8	-0.12	-0.03	0.12
Manufacture of publishing and printing	sec9	-0.81	-0.67	-0.56
Manufacture of chemicals and chemical products	sec10	-1.14	-1.30	-1.17
Manufacture of pharmaceutical products and cosmetics	sec11	0.07	0.15	0.28
Manufacture of rubber and plastic products	sec12	-0.40	-0.40	-0.31
Manufacture of glass and glass products	sec13	-0.28	-0.25	-0.09
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.36	-0.43	-0.27
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-1.57	-2.04	-2.06
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.92	0.74	1.82
Manufacture of domestic appliances	sec17	0.25	0.48	0.69
Manufacture of electrical and machinery and apparatus	sec18	-0.06	0.08	0.29
Manufacture of transport equipment	sec19	0.18	-0.12	0.50
Electricity, gas and water supply	sec20	-1.78	-2.05	-3.07
Construction	sec21	0.56	0.46	0.75
Wholesale and retail trade	sec22	-0.36	-0.36	-0.19
Hotels and restaurants; activities of travel agencies	sec23	0.02	0.12	0.27
Transport via railways	sec24	-2.01	-3.43	-4.63
Other land transport; transport via pipelines	sec25	-1.04	-1.24	-1.50
Water transport	sec26	-2.52	-3.38	-4.05
Air transport	sec27	-3.15	-3.81	-4.43
Post and telecommunications	sec28	-0.05	0.06	0.17
Financial intermediation	sec29	-0.47	-0.33	-0.11
Real estate activities	sec30	0.01	0.08	0.16
Other business activities	sec31	-0.04	0.04	0.28
Public administration and defence; compulsory social security	sec32	0.51	0.78	1.02
Education	sec33	0.90	1.19	1.45
Health and social work	sec34	0.93	1.14	1.34
Other community, social and personal service activities	sec35	-1.60	-1.54	-1.42

Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.

## Detailed results of the policy simulations

**Table 7.A.58. Changes in domestic sales by sector compared to the baseline (%)**

Commodities		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.36	-0.29	-0.36
Coal sector	sec2	-2.00	-2.58	-3.26
Oil sector	sec3	-4.69	-5.18	-5.71
Natural gas sector	sec4	-2.00	-2.30	-3.29
Manufacture of food products and beverages; tobacco	sec5	-0.24	-0.15	0.00
Manufacture of textile and leather products	sec6	-0.01	0.09	0.25
Manufacture of wood and products of wood	sec7	0.19	0.25	0.54
Manufacture of paper and paper products	sec8	-0.04	0.07	0.23
Manufacture of publishing and printing	sec9	-0.78	-0.64	-0.53
Manufacture of chemicals and chemical products	sec10	-0.47	-0.50	-0.40
Manufacture of pharmaceutical products and cosmetics	sec11	0.42	0.51	0.65
Manufacture of rubber and plastic products	sec12	-0.32	-0.38	-0.31
Manufacture of glass and glass products	sec13	-0.08	-0.06	0.10
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.03	-0.08	0.11
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.57	-0.83	-0.69
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.56	1.32	2.48
Manufacture of domestic appliances	sec17	0.05	0.16	0.37
Manufacture of electrical and machinery and apparatus	sec18	0.42	0.33	0.78
Manufacture of transport equipment	sec19	0.61	0.35	1.00
Electricity, gas and water supply	sec20	-1.81	-2.08	-3.12
Construction	sec21	0.59	0.48	0.77
Wholesale and retail trade	sec22	-0.36	-0.36	-0.19
Hotels and restaurants; activities of travel agencies	sec23	0.03	0.12	0.26
Transport via railways	sec24	-1.43	-2.05	-2.89
Other land transport; transport via pipelines	sec25	-0.92	-1.02	-1.28
Water transport	sec26	-0.92	-1.07	-1.52
Air transport	sec27	-1.00	-0.97	-2.03
Post and telecommunications	sec28	-0.22	-0.14	-0.07
Financial intermediation	sec29	-0.41	-0.45	-0.35
Real estate activities	sec30	0.01	0.08	0.16
Other business activities	sec31	0.04	-0.07	0.15
Public administration and defence; compulsory social security	sec32	0.51	0.78	1.02
Education	sec33	0.90	1.19	1.45
Health and social work	sec34	0.93	1.14	1.34
Other community, social and personal service activities	sec35	-1.56	-1.51	-1.39

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.59. Changes in private consumption compared to the baseline (%)**

Commodities		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.11	-0.05	0.12
Coal sector	sec2	-0.22	-0.31	-0.23
Oil sector	sec3	-5.59	-5.93	-6.22
Natural gas sector	sec4	-0.02	0.10	0.30
Manufacture of food products and beverages; tobacco	sec5	-0.20	-0.10	0.05
Manufacture of textile and leather products	sec6	-0.01	0.07	0.17
Manufacture of wood and products of wood	sec7	-0.07	0.03	0.14
Manufacture of paper and paper products	sec8	-0.10	0.00	0.15
Manufacture of publishing and printing	sec9	-1.99	-1.89	-1.74
Manufacture of chemicals and chemical products	sec10	-0.17	-0.09	0.06
Manufacture of pharmaceutical products and cosmetics	sec11	0.48	0.55	0.69
Manufacture of rubber and plastic products	sec12	-0.09	0.03	0.19
Manufacture of glass and glass products	sec13	-0.15	-0.05	0.09
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.31	-0.24	-0.12
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.16	-0.09	0.04
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.10	0.01	0.16
Manufacture of domestic appliances	sec17	-0.05	0.08	0.24
Manufacture of electrical and machinery and apparatus	sec18	-0.08	0.03	0.19
Manufacture of transport equipment	sec19	-0.16	-0.04	0.13
Electricity, gas and water supply	sec20	0.07	0.19	0.46
Construction	sec21	-0.27	-0.13	0.00
Wholesale and retail trade	sec22	0.08	0.25	0.41
Hotels and restaurants; activities of travel agencies	sec23	0.17	0.30	0.46
Transport via railways	sec24	-1.09	-2.37	-2.85
Other land transport; transport via pipelines	sec25	-0.19	-0.17	-0.03
Water transport	sec26	-0.15	-0.08	0.06
Air transport	sec27	-0.18	-0.10	0.06
Post and telecommunications	sec28	0.08	0.23	0.41
Financial intermediation	sec29	-0.10	0.06	0.24
Real estate activities	sec30	0.06	0.13	0.27
Other business activities	sec31	-0.09	0.04	0.19
Public administration and defence; compulsory social security	sec32	-0.20	-0.05	0.13
Education	sec33	-0.02	0.14	0.33
Health and social work	sec34	-0.04	0.10	0.27
Other community, social and personal service activities	sec35	-1.49	-1.38	-1.24

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.60. Changes in employment by sector compared to the baseline (%)**

Sectors		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	0.07	0.27	0.17
Coal sector	sec2	-2.11	-2.73	-3.39
Oil sector	sec3	-3.14	-3.55	-3.91
Natural gas sector	sec4	-0.31	-0.18	-0.32
Manufacture of food products and beverages; tobacco	sec5	0.67	0.95	1.36
Manufacture of textile and leather products	sec6	0.47	0.75	1.02
Manufacture of wood and products of wood	sec7	0.71	0.95	1.41
Manufacture of paper and paper products	sec8	0.45	0.71	1.04
Manufacture of publishing and printing	sec9	-1.09	-0.79	-0.56
Manufacture of chemicals and chemical products	sec10	-0.67	-0.73	-0.53
Manufacture of pharmaceutical products and cosmetics	sec11	0.99	1.20	1.46
Manufacture of rubber and plastic products	sec12	0.16	0.23	0.41
Manufacture of glass and glass products	sec13	0.37	0.53	0.80
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	0.81	0.88	1.22
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-1.06	-1.44	-1.36
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.56	1.46	2.68
Manufacture of domestic appliances	sec17	1.00	1.43	1.81
Manufacture of electrical and machinery and apparatus	sec18	0.43	0.70	1.05
Manufacture of transport equipment	sec19	1.02	0.82	1.56
Electricity, gas and water supply	sec20	-1.44	-1.44	-2.52
Construction	sec21	1.86	1.73	2.29
Wholesale and retail trade	sec22	-0.40	-0.39	-0.07
Hotels and restaurants; activities of travel agencies	sec23	0.64	0.88	1.18
Transport via railways	sec24	-2.39	-4.93	-6.92
Other land transport; transport via pipelines	sec25	-0.62	-0.83	-1.15
Water transport	sec26	-3.05	-5.02	-6.22
Air transport	sec27	-2.64	-3.54	-4.31
Post and telecommunications	sec28	0.09	0.32	0.52
Financial intermediation	sec29	0.09	0.30	0.59
Real estate activities	sec30	0.04	0.30	0.50
Other business activities	sec31	0.53	0.70	1.12
Public administration and defence; compulsory social security	sec32	0.85	1.12	1.36
Education	sec33	1.05	1.37	1.65
Health and social work	sec34	1.16	1.40	1.63
Other community, social and personal service activities	sec35	-1.49	-1.34	-1.15

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.61. Changes in capital-energy bundle for all the sectors except coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.49	-0.46	-0.46
Manufacture of food products and beverages; tobacco	sec5	-0.71	-0.70	-0.62
Manufacture of textile and leather products	sec6	-1.09	-1.10	-1.00
Manufacture of wood and products of wood	sec7	-0.40	-0.37	-0.31
Manufacture of paper and paper products	sec8	-0.33	-0.31	-0.23
Manufacture of publishing and printing	sec9	-0.54	-0.55	-0.56
Manufacture of chemicals and chemical products	sec10	-1.32	-1.53	-1.42
Manufacture of pharmaceutical products and cosmetics	sec11	-0.36	-0.33	-0.26
Manufacture of rubber and plastic products	sec12	-0.92	-0.99	-0.98
Manufacture of glass and glass products	sec13	-0.84	-0.91	-0.85
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-1.12	-1.28	-1.24
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-1.94	-2.48	-2.58
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.42	-0.77	0.01
Manufacture of domestic appliances	sec17	-0.38	-0.31	-0.22
Manufacture of electrical and machinery and apparatus	sec18	-0.53	-0.52	-0.45
Manufacture of transport equipment	sec19	-2.01	-2.52	-2.22
Electricity, gas and water supply	sec20	-1.85	-2.16	-3.18
Construction	sec21	-0.41	-0.49	-0.39
Wholesale and retail trade	sec22	-0.33	-0.32	-0.30
Hotels and restaurants; activities of travel agencies	sec23	-0.40	-0.38	-0.32
Transport via railways	sec24	-1.81	-2.64	-3.41
Other land transport; transport via pipelines	sec25	-1.41	-1.60	-1.81
Water transport	sec26	-2.41	-3.06	-3.63
Air transport	sec27	-3.29	-3.88	-4.46
Post and telecommunications	sec28	-0.15	-0.10	-0.06
Financial intermediation	sec29	-5.97	-6.48	-6.84
Real estate activities	sec30	0.01	0.07	0.15
Other business activities	sec31	-0.65	-0.67	-0.63
Public administration and defence; compulsory social security	sec32	-1.11	-0.88	-0.64
Education	sec33	-0.04	0.06	0.19
Health and social work	sec34	-1.24	-1.30	-1.30
Other community, social and personal service activities	sec35	-1.79	-1.88	-1.90

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.62. Changes in capital-labor bundle for the coal, oil and natural gas sectors, compared to the baseline (%)**

Sectors		Neutral scenario		
		2004	2005	2006
Coal sector	sec2	-2.06	-2.66	-3.31
Oil sector	sec3	-1.87	-2.16	-2.42
Natural gas sector	sec4	-0.03	0.04	0.02

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

**Table 7.A.63. Changes in government purchases of goods and services compared to the baseline (%)**

Commodities		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-10.85	-10.77	-28.11
Manufacture of publishing and printing	sec9	-17.42	-17.30	-33.59
Electricity, gas and water supply	sec20	-10.18	-10.05	-27.55
Construction	sec21	-11.17	-10.93	-28.54
Transport via railways	sec24	-13.76	-17.94	-35.63
Other land transport; transport via pipelines	sec25	-10.94	-11.08	-28.60
Water transport	sec26	-10.81	-10.78	-28.38
Air transport	sec27	-10.89	-10.86	-28.37
Post and telecommunications	sec28	-10.13	-9.87	-27.55
Real estate activities	sec30	-10.18	-10.15	-27.88
Other business activities	sec31	-10.64	-10.44	-28.07
Public administration and defence; compulsory social security	sec32	0.56	0.83	1.07
Education	sec33	1.15	1.48	1.75
Health and social work	sec34	1.11	1.33	1.53
Other community, social and personal service activities	sec35	-4.92	-4.77	-4.65

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

**Table 7.A.64. Changes in demand for investment commodities compared to the baseline (%)**

Commodities		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	1.80	1.47	3.20
Manufacture of wood and products of wood	sec7	2.04	1.83	3.19
Manufacture of publishing and printing	sec9	1.91	1.63	3.04
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	1.79	1.42	2.76
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	2.02	1.75	3.14
Manufacture of domestic appliances	sec17	2.20	1.99	3.40
Manufacture of electrical and machinery and apparatus	sec18	2.10	1.84	3.24
Manufacture of transport equipment	sec19	1.89	1.60	2.98
Construction	sec21	1.43	1.28	2.60
Other business activities	sec31	2.04	1.85	3.26

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.65. Changes in exports compared to the baseline (%)**

Sectors		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-1.46	-1.58	-0.36
Coal sector	sec2	-4.22	-7.75	-9.52
Oil sector	sec3	2.46	2.27	2.33
Natural gas sector	sec4	1.84	2.20	3.17
Manufacture of food products and beverages; tobacco	sec5	-1.69	-1.71	-1.55
Manufacture of textile and leather products	sec6	0.67	1.12	1.51
Manufacture of wood and products of wood	sec7	0.13	0.30	0.53
Manufacture of paper and paper products	sec8	-0.17	-0.11	0.01
Manufacture of publishing and printing	sec9	-1.06	-0.91	-0.79
Manufacture of chemicals and chemical products	sec10	-1.37	-1.61	-1.48
Manufacture of pharmaceutical products and cosmetics	sec11	-0.17	-0.21	-0.15
Manufacture of rubber and plastic products	sec12	-0.44	-0.40	-0.29
Manufacture of glass and glass products	sec13	-0.47	-0.45	-0.32
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-2.69	-3.09	-3.27
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-1.85	-2.40	-2.48
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.58	0.44	1.47
Manufacture of domestic appliances	sec17	2.37	3.58	3.94
Manufacture of electrical and machinery and apparatus	sec18	-0.09	0.07	0.26
Manufacture of transport equipment	sec19	-0.27	-0.60	-0.02
Electricity, gas and water supply	sec20	-0.82	-1.04	-1.46
Construction	sec21	-0.83	-0.66	-0.55
Hotels and restaurants; activities of travel agencies	sec23	-0.04	0.13	0.32
Transport via railways	sec24	-4.22	-8.61	-11.09
Other land transport; transport via pipelines	sec25	-1.27	-1.63	-1.90
Water transport	sec26	-3.01	-4.09	-4.83
Air transport	sec27	-3.81	-4.67	-5.16
Post and telecommunications	sec28	1.06	1.51	1.85
Financial intermediation	sec29	-0.62	-0.09	0.41
Other business activities	sec31	-0.14	0.17	0.42
Other community, social and personal service activities	sec35	-2.08	-1.96	-1.83

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.66. Changes in imports compared to the baseline (%)**

Commodities		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	0.04	0.17	-0.36
Coal sector	sec2	-1.83	-2.32	-3.13
Oil sector	sec3	-8.22	-9.07	-9.97
Natural gas sector	sec4	-2.89	-3.37	-4.79
Manufacture of food products and beverages; tobacco	sec5	1.05	1.22	1.34
Manufacture of textile and leather products	sec6	-0.18	-0.24	-0.22
Manufacture of wood and products of wood	sec7	0.34	0.26	0.62
Manufacture of paper and paper products	sec8	0.04	0.17	0.35
Manufacture of publishing and printing	sec9	-0.52	-0.41	-0.32
Manufacture of chemicals and chemical products	sec10	-0.07	-0.02	0.06
Manufacture of pharmaceutical products and cosmetics	sec11	0.72	0.81	0.96
Manufacture of rubber and plastic products	sec12	-0.24	-0.34	-0.30
Manufacture of glass and glass products	sec13	0.20	0.17	0.33
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	1.04	0.97	1.24
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	0.25	0.16	0.41
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.85	1.59	2.78
Manufacture of domestic appliances	sec17	0.31	0.48	0.74
Manufacture of electrical and machinery and apparatus	sec18	0.44	0.35	0.81
Manufacture of transport equipment	sec19	0.91	0.66	1.33
Electricity, gas and water supply	sec20	-2.64	-2.93	-4.48
Construction	sec21	2.27	1.81	2.33
Hotels and restaurants; activities of travel agencies	sec23	0.13	0.10	0.18
Transport via railways	sec24	3.67	10.63	13.35
Other land transport; transport via pipelines	sec25	-0.38	-0.10	-0.33
Water transport	sec26	-0.24	-0.08	-0.42
Air transport	sec27	-0.04	0.30	-0.96
Post and telecommunications	sec28	-1.77	-2.15	-2.39
Financial intermediation	sec29	-0.21	-0.77	-1.05
Other business activities	sec31	0.16	-0.22	-0.02
Other community, social and personal service activities	sec35	-0.92	-0.95	-0.86

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.67. Changes in investments carried out in the sectors compared to the baseline (%)**

Sectors		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	1.31	1.93	1.88
Coal sector	sec2	-0.74	-1.05	-2.05
Oil sector	sec3	-2.29	-2.15	-2.90
Natural gas sector	sec4	0.54	0.94	0.73
Manufacture of food products and beverages; tobacco	sec5	1.47	2.31	2.27
Manufacture of textile and leather products	sec6	1.64	2.39	2.39
Manufacture of wood and products of wood	sec7	1.05	1.83	1.70
Manufacture of paper and paper products	sec8	0.98	1.67	1.56
Manufacture of publishing and printing	sec9	1.13	0.66	0.57
Manufacture of chemicals and chemical products	sec10	0.89	1.55	1.35
Manufacture of pharmaceutical products and cosmetics	sec11	1.28	2.41	2.30
Manufacture of rubber and plastic products	sec12	1.21	1.88	1.68
Manufacture of glass and glass products	sec13	0.97	1.63	1.41
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	1.39	2.06	1.75
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.24	0.10	-0.64
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	1.72	2.72	2.47
Manufacture of domestic appliances	sec17	1.47	2.32	2.34
Manufacture of electrical and machinery and apparatus	sec18	1.23	1.97	1.88
Manufacture of transport equipment	sec19	1.81	2.64	2.36
Electricity, gas and water supply	sec20	0.58	0.67	0.38
Construction	sec21	2.05	2.77	2.44
Wholesale and retail trade	sec22	0.69	1.33	1.07
Hotels and restaurants; activities of travel agencies	sec23	1.04	1.94	1.81
Transport via railways	sec24	0.61	-1.15	-3.68
Other land transport; transport via pipelines	sec25	0.35	0.56	0.05
Water transport	sec26	-0.73	-1.70	-3.68
Air transport	sec27	-1.46	-1.91	-3.13
Post and telecommunications	sec28	1.00	1.62	1.49
Financial intermediation	sec29	1.03	1.63	1.49
Real estate activities	sec30	0.63	1.57	1.57
Other business activities	sec31	1.25	1.89	1.72
Education	sec33	1.87	2.78	2.83
Health and social work	sec34	2.28	3.31	3.31
Other community, social and personal service activities	sec35	1.46	0.41	0.32

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.68. Changes in rental rate of capital compared to the baseline (%)**

Sectors		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-1.32	-1.42	-2.07
Coal sector	sec2	-7.51	-9.44	-11.17
Oil sector	sec3	-9.70	-10.99	-11.91
Natural gas sector	sec4	-3.37	-3.74	-4.56
Manufacture of food products and beverages; tobacco	sec5	-0.52	-0.62	-0.40
Manufacture of textile and leather products	sec6	-0.40	-0.42	-0.38
Manufacture of wood and products of wood	sec7	-1.52	-1.80	-1.52
Manufacture of paper and paper products	sec8	-1.84	-2.05	-1.94
Manufacture of publishing and printing	sec9	-4.07	-4.12	-4.10
Manufacture of chemicals and chemical products	sec10	-2.10	-2.51	-2.54
Manufacture of pharmaceutical products and cosmetics	sec11	-0.28	-0.55	-0.58
Manufacture of rubber and plastic products	sec12	-1.44	-1.86	-1.94
Manufacture of glass and glass products	sec13	-1.96	-2.38	-2.30
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-1.10	-1.76	-1.57
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-5.09	-6.56	-6.68
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	0.27	-0.33	0.69
Manufacture of domestic appliances	sec17	-0.51	-0.48	-0.40
Manufacture of electrical and machinery and apparatus	sec18	-1.25	-1.42	-1.34
Manufacture of transport equipment	sec19	0.11	-0.56	-0.03
Electricity, gas and water supply	sec20	-3.98	-4.48	-6.16
Construction	sec21	0.32	-0.46	-0.17
Wholesale and retail trade	sec22	-2.55	-3.06	-3.02
Hotels and restaurants; activities of travel agencies	sec23	-1.27	-1.53	-1.57
Transport via railways	sec24	-7.94	-13.22	-16.97
Other land transport; transport via pipelines	sec25	-4.16	-5.16	-6.15
Water transport	sec26	-8.95	-12.99	-15.25
Air transport	sec27	-9.29	-11.65	-13.42
Post and telecommunications	sec28	-1.95	-2.21	-2.34
Financial intermediation	sec29	-1.95	-2.23	-2.25
Real estate activities	sec30	-1.96	-1.92	-1.90
Other business activities	sec31	-1.44	-1.78	-1.66
Public administration and defence; compulsory social security	sec32	1.27	0.63	0.04
Education	sec33	0.44	0.48	0.55
Health and social work	sec34	1.52	1.42	1.41
Other community, social and personal service activities	sec35	-4.66	-4.71	-4.52

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Appendix 7.A

**Table 7.A.69. Changes in commodities prices net of taxes compared to the baseline (%)**

Commodities		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.77	-0.82	-1.19
Coal sector	sec2	-0.59	-0.08	0.13
Oil sector	sec3	-1.95	-2.07	-2.18
Natural gas sector	sec4	-1.26	-1.38	-1.55
Manufacture of food products and beverages; tobacco	sec5	-0.66	-0.73	-0.78
Manufacture of textile and leather products	sec6	-1.24	-1.46	-1.59
Manufacture of wood and products of wood	sec7	-1.00	-1.17	-1.18
Manufacture of paper and paper products	sec8	-1.00	-1.07	-1.09
Manufacture of publishing and printing	sec9	-0.87	-0.98	-1.03
Manufacture of chemicals and chemical products	sec10	-0.78	-0.77	-0.80
Manufacture of pharmaceutical products and cosmetics	sec11	-0.89	-0.87	-0.85
Manufacture of rubber and plastic products	sec12	-1.03	-1.15	-1.20
Manufacture of glass and glass products	sec13	-0.80	-0.90	-0.92
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.24	-0.24	-0.18
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.76	-0.77	-0.76
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.98	-1.09	-1.13
Manufacture of domestic appliances	sec17	-1.16	-1.32	-1.37
Manufacture of electrical and machinery and apparatus	sec18	-1.06	-1.18	-1.22
Manufacture of transport equipment	sec19	-0.86	-0.94	-0.97
Electricity, gas and water supply	sec20	-1.50	-1.62	-1.96
Construction	sec21	-0.41	-0.64	-0.60
Wholesale and retail trade	sec22	-1.56	-1.88	-1.97
Hotels and restaurants; activities of travel agencies	sec23	-0.97	-1.15	-1.24
Transport via railways	sec24	2.59	7.84	10.36
Other land transport; transport via pipelines	sec25	-0.66	-0.48	-0.51
Water transport	sec26	-0.81	-0.81	-0.82
Air transport	sec27	-0.72	-0.72	-0.83
Post and telecommunications	sec28	-1.55	-1.81	-1.96
Financial intermediation	sec29	-0.97	-1.25	-1.42
Real estate activities	sec30	-1.51	-1.51	-1.50
Other business activities	sec31	-1.00	-1.19	-1.24
Public administration and defence; compulsory social security	sec32	-0.65	-0.89	-1.05
Education	sec33	-1.23	-1.52	-1.71
Health and social work	sec34	-1.19	-1.38	-1.50
Other community, social and personal service activities	sec35	-0.83	-0.95	-1.00

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*

## Detailed results of the policy simulations

**Table 7.A.70. Changes in price of domestic output compared to the baseline (%)**

Sectors		Neutral scenario		
		2004	2005	2006
Agriculture, forestry and fishing	sec1	-0.75	-0.80	-1.18
Coal sector	sec2	-0.97	-1.04	-1.13
Oil sector	sec3	-2.40	-2.67	-2.88
Natural gas sector	sec4	-1.74	-1.98	-2.37
Manufacture of food products and beverages; tobacco	sec5	-0.48	-0.55	-0.61
Manufacture of textile and leather products	sec6	-1.09	-1.29	-1.44
Manufacture of wood and products of wood	sec7	-0.95	-1.10	-1.13
Manufacture of paper and paper products	sec8	-0.97	-1.06	-1.09
Manufacture of publishing and printing	sec9	-0.81	-0.93	-1.00
Manufacture of chemicals and chemical products	sec10	-0.73	-0.81	-0.89
Manufacture of pharmaceutical products and cosmetics	sec11	-0.69	-0.79	-0.84
Manufacture of rubber and plastic products	sec12	-0.94	-1.10	-1.17
Manufacture of glass and glass products	sec13	-0.74	-0.91	-0.97
Other mining and quarrying; manufacture of other non-metallic mineral products	sec14	-0.04	-0.17	-0.15
Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	sec15	-0.78	-0.86	-0.88
Manufacture of general purpose machinery; manufacture of special purpose machinery	sec16	-0.84	-0.96	-0.98
Manufacture of domestic appliances	sec17	-0.79	-0.81	-0.83
Manufacture of electrical and machinery and apparatus	sec18	-0.98	-1.08	-1.12
Manufacture of transport equipment	sec19	-0.77	-0.85	-0.89
Electricity, gas and water supply	sec20	-1.50	-1.62	-1.96
Construction	sec21	-0.41	-0.64	-0.60
Wholesale and retail trade	sec22	-1.56	-1.88	-1.97
Hotels and restaurants; activities of travel agencies	sec23	-0.96	-1.15	-1.24
Transport via railways	sec24	2.79	8.37	11.06
Other land transport; transport via pipelines	sec25	-0.66	-0.48	-0.51
Water transport	sec26	-0.81	-0.81	-0.82
Air transport	sec27	-0.73	-0.73	-0.84
Post and telecommunications	sec28	-1.54	-1.78	-1.93
Financial intermediation	sec29	-0.97	-1.25	-1.42
Real estate activities	sec30	-1.51	-1.51	-1.50
Other business activities	sec31	-0.99	-1.20	-1.25
Public administration and defence; compulsory social security	sec32	-0.65	-0.89	-1.05
Education	sec33	-1.23	-1.52	-1.71
Health and social work	sec34	-1.19	-1.38	-1.50
Other community, social and personal service activities	sec35	-0.82	-0.94	-1.00

*Note: All results, if not indicated otherwise, are presented as percentage changes relative to the baseline.*



## **Appendix 7.B**

### **Detailed results of the sensitivity analysis**

#### **7.B.1. Introduction**

In order to keep the presentation of the uncertainty and sensitivity analysis in chapter 7 concise, the *a priori* distributions corresponding to the parameter considered a source of uncertainty in RoMod are presented in this appendix, section 7.B.2 (see tables 7.B.1-7.B.9). Furthermore the detailed results regarding the Morris method (the screening exercise) are provided in section 7.B.3 (see tables 7.B.10, 7.B.12, 7.B.14, 7.B.16, 7.B.18, 7.B.20, 7.B.22, 7.B.24, 7.B.26, 7.B.28, 7.B.30, 7.B.32, 7.B.34, 7.B.36) together with the first-order effect indices and the total order effect indices derived according to the Sobol' method (see tables 7.B.11, 7.B.13, 7.B.15, 7.B.17, 7.B.19, 7.B.21, 7.B.23, 7.B.25, 7.B.27, 7.B.29, 7.B.31, 7.B.33, 7.B.35, 7.B.37).

## Appendix 7.B

### 7.B.2. List of the parameters subject to sensitivity analysis

**Table 7.B.1. Elasticities of substitution between labor and capital-energy composite for the *c* sectors<sup>142</sup>**

Notation	Sectors	Distribution	Range
$\sigma_{P1sec1}$	Agriculture, forestry and fishing	Uniform	[0.1, 0.7]
$\sigma_{P1sec5}$	Manufacture of food products and beverages; tobacco	Uniform	[0.1, 1.1]
$\sigma_{P1sec6}$	Manufacture of textile and leather products	Uniform	[0.1, 1.1]
$\sigma_{P1sec7}$	Manufacture of wood and products of wood	Uniform	[0.15, 1.15]
$\sigma_{P1sec8}$	Manufacture of paper and paper products	Uniform	[0.15, 1.15]
$\sigma_{P1sec9}$	Manufacture of publishing and printing	Uniform	[0.15, 1.15]
$\sigma_{P1sec10}$	Manufacture of chemicals and chemical products	Uniform	[0.1, 0.7]
$\sigma_{P1sec11}$	Manufacture of pharmaceutical products and cosmetics	Uniform	[0.1, 1.1]
$\sigma_{P1sec12}$	Manufacture of rubber and plastic products	Uniform	[0.1, 1.1]
$\sigma_{P1sec13}$	Manufacture of glass and glass products	Uniform	[0.15, 0.75]
$\sigma_{P1sec14}$	Other mining and quarrying; manufacture of other non-metallic mineral products	Uniform	[0.15, 0.75]
$\sigma_{P1sec15}$	Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	Uniform	[0.15, 0.75]
$\sigma_{P1sec16}$	Manufacture of general purpose machinery; manufacture of special purpose machinery	Uniform	[0.2, 1.2]
$\sigma_{P1sec17}$	Manufacture of domestic appliances	Uniform	[0.2, 1.2]
$\sigma_{P1sec18}$	Manufacture of electrical and machinery and apparatus	Uniform	[0.2, 1.2]
$\sigma_{P1sec19}$	Manufacture of transport equipment	Uniform	[0.2, 1.2]
$\sigma_{P1sec20}$	Electricity, gas and water supply	Uniform	[0.25, 1.25]
$\sigma_{P1sec21}$	Construction	Uniform	[0.25, 1.25]
$\sigma_{P1sec22}$	Wholesale and retail trade	Uniform	[0.3, 1.3]
$\sigma_{P1sec23}$	Hotels and restaurants; activities of travel agencies	Uniform	[0.3, 1.3]
$\sigma_{P1sec24}$	Transport via railways	Uniform	[0.15, 0.95]
$\sigma_{P1sec25}$	Other land transport; transport via pipelines	Uniform	[0.15, 0.95]
$\sigma_{P1sec26}$	Water transport	Uniform	[0.15, 0.95]
$\sigma_{P1sec27}$	Air transport	Uniform	[0.15, 0.95]
$\sigma_{P1sec28}$	Post and telecommunications	Uniform	[0.3, 1.3]
$\sigma_{P1sec29}$	Financial intermediation	Uniform	[0.3, 1.3]
$\sigma_{P1sec30}$	Real estate activities	Uniform	[0.1, 0.7]
$\sigma_{P1sec31}$	Other business activities	Uniform	[0.3, 1.3]
$\sigma_{P1sec32}$	Public administration and defence; compulsory social security	Uniform	[0.1, 0.7]
$\sigma_{P1sec33}$	Education	Uniform	[0.1, 0.7]
$\sigma_{P1sec34}$	Health and social work	Uniform	[0.1, 0.7]
$\sigma_{P1sec35}$	Other community, social and personal service activities	Uniform	[0.1, 0.7]

<sup>142</sup> As already mentioned in chapter 4, *c* sectors include all the production sectors except for coal sector, oil sector and extraction of natural gas sector.

## Detailed results of the sensitivity analysis

**Table 7.B.2. Elasticities of substitution between capital and energy composite for the *c* sectors<sup>143</sup>**

Notation	Sectors	Distribution	Range
$\sigma_{P2sec1}$	Agriculture, forestry and fishing	Uniform	[0.3, 1.3]
$\sigma_{P2sec5}$	Manufacture of food products and beverages; tobacco	Uniform	[0.45, 1.45]
$\sigma_{P2sec6}$	Manufacture of textile and leather products	Uniform	[0.45, 1.45]
$\sigma_{P2sec7}$	Manufacture of wood and products of wood	Uniform	[0.1, 0.7]
$\sigma_{P2sec8}$	Manufacture of paper and paper products	Uniform	[0.1, 0.7]
$\sigma_{P2sec9}$	Manufacture of publishing and printing	Uniform	[0.2, 0.8]
$\sigma_{P2sec10}$	Manufacture of chemicals and chemical products	Uniform	[0.3, 1.3]
$\sigma_{P2sec11}$	Manufacture of pharmaceutical products and cosmetics	Uniform	[0.3, 1.3]
$\sigma_{P2sec12}$	Manufacture of rubber and plastic products	Uniform	[0.3, 1.3]
$\sigma_{P2sec13}$	Manufacture of glass and glass products	Uniform	[0.1, 0.7]
$\sigma_{P2sec14}$	Other mining and quarrying; manufacture of other non-metallic mineral products	Uniform	[0.1, 0.7]
$\sigma_{P2sec15}$	Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	Uniform	[0.1, 0.7]
$\sigma_{P2sec16}$	Manufacture of general purpose machinery; manufacture of special purpose machinery	Uniform	[0.45, 1.45]
$\sigma_{P2sec17}$	Manufacture of domestic appliances	Uniform	[0.45, 1.45]
$\sigma_{P2sec18}$	Manufacture of electrical and machinery and apparatus	Uniform	[0.45, 1.45]
$\sigma_{P2sec19}$	Manufacture of transport equipment	Uniform	[0.45, 1.45]
$\sigma_{P2sec20}$	Electricity, gas and water supply	Uniform	[0.3, 1.3]
$\sigma_{P2sec21}$	Construction	Uniform	[0.3, 1.3]
$\sigma_{P2sec22}$	Wholesale and retail trade	Uniform	[0.3, 1.3]
$\sigma_{P2sec23}$	Hotels and restaurants; activities of travel agencies	Uniform	[0.3, 1.3]
$\sigma_{P2sec24}$	Transport via railways	Uniform	[0.1, 0.7]
$\sigma_{P2sec25}$	Other land transport; transport via pipelines	Uniform	[0.1, 0.7]
$\sigma_{P2sec26}$	Water transport	Uniform	[0.1, 0.7]
$\sigma_{P2sec27}$	Air transport	Uniform	[0.1, 0.7]
$\sigma_{P2sec28}$	Post and telecommunications	Uniform	[0.3, 1.3]
$\sigma_{P2sec29}$	Financial intermediation	Uniform	[0.3, 1.3]
$\sigma_{P2sec30}$	Real estate activities	Uniform	[0.15, 0.95]
$\sigma_{P2sec31}$	Other business activities	Uniform	[0.3, 1.3]
$\sigma_{P2sec32}$	Public administration and defence; compulsory social security	Uniform	[0.15, 0.95]
$\sigma_{P2sec33}$	Education	Uniform	[0.15, 0.95]
$\sigma_{P2sec34}$	Health and social work	Uniform	[0.15, 0.95]
$\sigma_{P2sec35}$	Other community, social and personal service activities	Uniform	[0.15, 0.95]

<sup>143</sup> As already mentioned in chapter 4, *c* sectors include all the production sectors except for coal sector, oil sector and extraction of natural gas sector.

## Appendix 7.B

**Table 7.B.3. Elasticities of substitution between the electricity and the non-electric energy composite for the *c* sectors<sup>144</sup>**

Notation	Sectors	Distribution	Range
$\sigma_{P3sec1}$	Agriculture, forestry and fishing	Uniform	[0.1, 0.7]
$\sigma_{P3sec5}$	Manufacture of food products and beverages; tobacco	Uniform	[0.1, 0.7]
$\sigma_{P3sec6}$	Manufacture of textile and leather products	Uniform	[0.1, 0.7]
$\sigma_{P3sec7}$	Manufacture of wood and products of wood	Uniform	[0.1, 0.7]
$\sigma_{P3sec8}$	Manufacture of paper and paper products	Uniform	[0.1, 0.7]
$\sigma_{P3sec9}$	Manufacture of publishing and printing	Uniform	[0.1, 0.7]
$\sigma_{P3sec10}$	Manufacture of chemicals and chemical products	Uniform	[0.1, 0.7]
$\sigma_{P3sec11}$	Manufacture of pharmaceutical products and cosmetics	Uniform	[0.1, 0.7]
$\sigma_{P3sec12}$	Manufacture of rubber and plastic products	Uniform	[0.1, 0.7]
$\sigma_{P3sec13}$	Manufacture of glass and glass products	Uniform	[0.1, 0.7]
$\sigma_{P3sec14}$	Other mining and quarrying; manufacture of other non-metallic mineral products	Uniform	[0.1, 0.7]
$\sigma_{P3sec15}$	Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	Uniform	[0.1, 0.7]
$\sigma_{P3sec16}$	Manufacture of general purpose machinery; manufacture of special purpose machinery	Uniform	[0.1, 0.7]
$\sigma_{P3sec17}$	Manufacture of domestic appliances	Uniform	[0.1, 0.7]
$\sigma_{P3sec18}$	Manufacture of electrical and machinery and apparatus	Uniform	[0.1, 0.7]
$\sigma_{P3sec19}$	Manufacture of transport equipment	Uniform	[0.1, 0.7]
$\sigma_{P3sec20}$	Electricity, gas and water supply	Uniform	[0.1, 0.7]
$\sigma_{P3sec21}$	Construction	Uniform	[0.1, 0.7]
$\sigma_{P3sec22}$	Wholesale and retail trade	Uniform	[0.1, 0.7]
$\sigma_{P3sec23}$	Hotels and restaurants; activities of travel agencies	Uniform	[0.1, 0.7]
$\sigma_{P3sec24}$	Transport via railways	Uniform	[0.1, 0.7]
$\sigma_{P3sec25}$	Other land transport; transport via pipelines	Uniform	[0.1, 0.7]
$\sigma_{P3sec26}$	Water transport	Uniform	[0.1, 0.7]
$\sigma_{P3sec27}$	Air transport	Uniform	[0.1, 0.7]
$\sigma_{P3sec28}$	Post and telecommunications	Uniform	[0.1, 0.7]
$\sigma_{P3sec29}$	Financial intermediation	Uniform	[0.1, 0.7]
$\sigma_{P3sec30}$	Real estate activities	Uniform	[0.1, 0.7]
$\sigma_{P3sec31}$	Other business activities	Uniform	[0.1, 0.7]
$\sigma_{P3sec32}$	Public administration and defence; compulsory social security	Uniform	[0.1, 0.7]
$\sigma_{P3sec33}$	Education	Uniform	[0.1, 0.7]
$\sigma_{P3sec34}$	Health and social work	Uniform	[0.1, 0.7]
$\sigma_{P3sec35}$	Other community, social and personal service activities	Uniform	[0.1, 0.7]

<sup>144</sup> As already mentioned in chapter 4, *c* sectors include all the production sectors except for coal sector, oil sector and extraction of natural gas sector.

## Detailed results of the sensitivity analysis

**Table 7.B.4. Elasticities of substitution between different non-electric energy inputs for the *c* sectors<sup>145</sup>**

Notation	Sectors	Distribution	Range
$\sigma_{P4sec1}$	Agriculture, forestry and fishing	Uniform	[0.15, 0.55]
$\sigma_{P4sec5}$	Manufacture of food products and beverages; tobacco	Uniform	[0.15, 0.55]
$\sigma_{P4sec6}$	Manufacture of textile and leather products	Uniform	[0.15, 0.55]
$\sigma_{P4sec7}$	Manufacture of wood and products of wood	Uniform	[0.15, 0.55]
$\sigma_{P4sec8}$	Manufacture of paper and paper products	Uniform	[0.15, 0.55]
$\sigma_{P4sec9}$	Manufacture of publishing and printing	Uniform	[0.15, 0.55]
$\sigma_{P4sec10}$	Manufacture of chemicals and chemical products	Uniform	[0.15, 0.55]
$\sigma_{P4sec11}$	Manufacture of pharmaceutical products and cosmetics	Uniform	[0.15, 0.55]
$\sigma_{P4sec12}$	Manufacture of rubber and plastic products	Uniform	[0.15, 0.55]
$\sigma_{P4sec13}$	Manufacture of glass and glass products	Uniform	[0.15, 0.55]
$\sigma_{P4sec14}$	Other mining and quarrying; manufacture of other non-metallic mineral products	Uniform	[0.15, 0.55]
$\sigma_{P4sec15}$	Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	Uniform	[0.15, 0.55]
$\sigma_{P4sec16}$	Manufacture of general purpose machinery; manufacture of special purpose machinery	Uniform	[0.15, 0.55]
$\sigma_{P4sec17}$	Manufacture of domestic appliances	Uniform	[0.15, 0.55]
$\sigma_{P4sec18}$	Manufacture of electrical and machinery and apparatus	Uniform	[0.15, 0.55]
$\sigma_{P4sec19}$	Manufacture of transport equipment	Uniform	[0.15, 0.55]
$\sigma_{P4sec20}$	Electricity, gas and water supply	Uniform	[0.15, 0.55]
$\sigma_{P4sec21}$	Construction	Uniform	[0.15, 0.55]
$\sigma_{P4sec22}$	Wholesale and retail trade	Uniform	[0.15, 0.55]
$\sigma_{P4sec23}$	Hotels and restaurants; activities of travel agencies	Uniform	[0.15, 0.55]
$\sigma_{P4sec24}$	Transport via railways	Uniform	[0.15, 0.55]
$\sigma_{P4sec25}$	Other land transport; transport via pipelines	Uniform	[0.15, 0.55]
$\sigma_{P4sec26}$	Water transport	Uniform	[0.15, 0.55]
$\sigma_{P4sec27}$	Air transport	Uniform	[0.15, 0.55]
$\sigma_{P4sec28}$	Post and telecommunications	Uniform	[0.15, 0.55]
$\sigma_{P4sec29}$	Financial intermediation	Uniform	[0.15, 0.55]
$\sigma_{P4sec30}$	Real estate activities	Uniform	[0.15, 0.55]
$\sigma_{P4sec31}$	Other business activities	Uniform	[0.15, 0.55]
$\sigma_{P4sec32}$	Public administration and defence; compulsory social security	Uniform	[0.15, 0.55]
$\sigma_{P4sec33}$	Education	Uniform	[0.15, 0.55]
$\sigma_{P4sec34}$	Health and social work	Uniform	[0.15, 0.55]
$\sigma_{P4sec35}$	Other community, social and personal service activities	Uniform	[0.15, 0.55]

**Table 7.B.5. Elasticities of substitution between capital and labor for the *l* sectors<sup>146</sup>**

Notation	Sectors	Distribution	Range
$\sigma_{L1sec2}$	Coal sector	Uniform	[0.1, 0.7]
$\sigma_{L1sec3}$	Oil sector	Uniform	[0.1, 0.7]
$\sigma_{L1sec4}$	Natural gas sector	Uniform	[0.1, 0.7]

<sup>145</sup> As already mentioned in chapter 4, *c* sectors include all the production sectors except for coal sector, oil sector and extraction of natural gas sector.

<sup>146</sup> As already discussed in chapter 4, *l* sectors include coal sector, oil sector and extraction of natural gas sector.

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**Table 7.B.6. Elasticities of substitution between imports and domestically produced goods**

Notation	Sectors	Distribution	Range
$\sigma_{Asec1}$	Agriculture, forestry and fishing	Uniform	[0.9, 1.9]
$\sigma_{Asec2}$	Coal sector	Uniform	[3.5, 4.5]
$\sigma_{Asec3}$	Oil sector	Uniform	[3.5, 4.5]
$\sigma_{Asec4}$	Natural gas sector	Uniform	[3.0, 4.0]
$\sigma_{Asec5}$	Manufacture of food products and beverages; tobacco	Uniform	[2.5, 3.5]
$\sigma_{Asec6}$	Manufacture of textile and leather products	Uniform	[1.1, 2.1]
$\sigma_{Asec7}$	Manufacture of wood and products of wood	Uniform	[1.3, 2.3]
$\sigma_{Asec8}$	Manufacture of paper and paper products	Uniform	[1.4, 2.4]
$\sigma_{Asec9}$	Manufacture of publishing and printing	Uniform	[0.9, 1.9]
$\sigma_{Asec10}$	Manufacture of chemicals and chemical products	Uniform	[1.2, 2.2]
$\sigma_{Asec11}$	Manufacture of pharmaceutical products and cosmetics	Uniform	[1.7, 2.7]
$\sigma_{Asec12}$	Manufacture of rubber and plastic products	Uniform	[1.3, 2.3]
$\sigma_{Asec13}$	Manufacture of glass and glass products	Uniform	[0.6, 1.6]
$\sigma_{Asec14}$	Other mining and quarrying; manufacture of other non-metallic mineral products	Uniform	[0.9, 1.9]
$\sigma_{Asec15}$	Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	Uniform	[2.5, 3.5]
$\sigma_{Asec16}$	Manufacture of general purpose machinery; manufacture of special purpose machinery	Uniform	[2.5, 3.5]
$\sigma_{Asec17}$	Manufacture of domestic appliances	Uniform	[2.5, 3.5]
$\sigma_{Asec18}$	Manufacture of electrical and machinery and apparatus	Uniform	[2.3, 3.3]
$\sigma_{Asec19}$	Manufacture of transport equipment	Uniform	[0.9, 1.9]
$\sigma_{Asec20}$	Electricity, gas and water supply	Uniform	[1.3, 2.3]
$\sigma_{Asec21}$	Construction	Uniform	[2.1, 3.1]
$\sigma_{Asec23}$	Hotels and restaurants; activities of travel agencies	Uniform	[0.9, 1.9]
$\sigma_{Asec24}$	Transport via railways	Uniform	[0.9, 1.9]
$\sigma_{Asec25}$	Other land transport; transport via pipelines	Uniform	[0.9, 1.9]
$\sigma_{Asec26}$	Water transport	Uniform	[2.5, 3.5]
$\sigma_{Asec27}$	Air transport	Uniform	[2.5, 3.5]
$\sigma_{Asec28}$	Post and telecommunications	Uniform	[2.5, 3.5]
$\sigma_{Asec29}$	Financial intermediation	Uniform	[2.5, 3.5]
$\sigma_{Asec31}$	Other business activities	Uniform	[2.5, 3.5]
$\sigma_{Asec35}$	Other community, social and personal service activities	Uniform	[2.5, 3.5]

## Detailed results of the sensitivity analysis

**Table 7.B.7. Elasticities of transformation in the CET function**

Notation	Sectors	Distribution	Range
$\sigma$ Tsec1	Agriculture, forestry and fishing	Uniform	[-4.25, -3.25]
$\sigma$ Tsec2	Coal sector	Uniform	[-3.7, -2.7]
$\sigma$ Tsec3	Oil sector	Uniform	[-3.7, -2.7]
$\sigma$ Tsec4	Natural gas sector	Uniform	[-3.3, -2.3]
$\sigma$ Tsec5	Manufacture of food products and beverages; tobacco	Uniform	[-3.2, -2.2]
$\sigma$ Tsec6	Manufacture of textile and leather products	Uniform	[-1.9, -0.9]
$\sigma$ Tsec7	Manufacture of wood and products of wood	Uniform	[-1.4, -0.4]
$\sigma$ Tsec8	Manufacture of paper and paper products	Uniform	[-1.3, -0.3]
$\sigma$ Tsec9	Manufacture of publishing and printing	Uniform	[-1.7, -0.7]
$\sigma$ Tsec10	Manufacture of chemicals and chemical products	Uniform	[-1.2, -0.2]
$\sigma$ Tsec11	Manufacture of pharmaceutical products and cosmetics	Uniform	[-1.1, -0.1]
$\sigma$ Tsec12	Manufacture of rubber and plastic products	Uniform	[-1.35, -0.35]
$\sigma$ Tsec13	Manufacture of glass and glass products	Uniform	[-1.2, -0.2]
$\sigma$ Tsec14	Other mining and quarrying; manufacture of other non-metallic mineral products	Uniform	[-2.7, -1.7]
$\sigma$ Tsec15	Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	Uniform	[-1.6, -0.6]
$\sigma$ Tsec16	Manufacture of general purpose machinery; manufacture of special purpose machinery	Uniform	[-2.7, -1.7]
$\sigma$ Tsec17	Manufacture of domestic appliances	Uniform	[-2.8, -1.8]
$\sigma$ Tsec18	Manufacture of electrical and machinery and apparatus	Uniform	[-2.7, -1.7]
$\sigma$ Tsec19	Manufacture of transport equipment	Uniform	[-2.4, -1.4]
$\sigma$ Tsec20	Electricity, gas and water supply	Uniform	[-2.6, -1.6]
$\sigma$ Tsec21	Construction	Uniform	[-2.7, -1.7]
$\sigma$ Tsec23	Hotels and restaurants; activities of travel agencies	Uniform	[-1.3, -0.3]
$\sigma$ Tsec24	Transport via railways	Uniform	[-1.1, -0.1]
$\sigma$ Tsec25	Other land transport; transport via pipelines	Uniform	[-1.1, -0.1]
$\sigma$ Tsec26	Water transport	Uniform	[-2.7, -1.7]
$\sigma$ Tsec27	Air transport	Uniform	[-2.7, -1.7]
$\sigma$ Tsec28	Post and telecommunications	Uniform	[-2.7, -1.7]
$\sigma$ Tsec29	Financial intermediation	Uniform	[-2.7, -1.7]
$\sigma$ Tsec31	Other business activities	Uniform	[-2.7, -1.7]
$\sigma$ Tsec35	Other community, social and personal service activities	Uniform	[-2.7, -1.7]

**Table 7.B.8. Other parameters of RoMod model subject to sensitivity analysis**

Notation	Description	Distribution	Range
beta	Wage curve parameter	Uniform	[-2.3, -1.3]
elasLS	Real wage elasticity of labor supply (labor supply curve)	Uniform	[0.05, 0.25]
frisch	Frisch parameter	Uniform	[-4.0, -3.0]

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**Table 7.B.9. Income elasticities of demand for commodities**

Notation	Commodities	Distribution	Range
eYsec1	Agriculture, forestry and fishing	Uniform	[0.3, 1.3]
eYsec2	Coal sector	Uniform	[0.75, 1.75]
eYsec3	Oil sector	Uniform	[0.75, 1.75]
eYsec4	Natural gas sector	Uniform	[0.75, 1.75]
eYsec5	Manufacture of food products and beverages; tobacco	Uniform	[0.75, 1.75]
eYsec6	Manufacture of textile and leather products	Uniform	[0.2, 1.2]
eYsec7	Manufacture of wood and products of wood	Uniform	[0.45, 1.45]
eYsec8	Manufacture of paper and paper products	Uniform	[0.75, 1.75]
eYsec9	Manufacture of publishing and printing	Uniform	[0.75, 1.75]
eYsec10	Manufacture of chemicals and chemical products	Uniform	[0.75, 1.75]
eYsec11	Manufacture of pharmaceutical products and cosmetics	Uniform	[0.75, 1.75]
eYsec12	Manufacture of rubber and plastic products	Uniform	[0.75, 1.75]
eYsec13	Manufacture of glass and glass products	Uniform	[0.65, 1.65]
eYsec14	Other mining and quarrying; manufacture of other non-metallic mineral products	Uniform	[0.65, 1.65]
eYsec15	Mining of metal ores; manufacture of basic metals; manufacture of fabricated metal products	Uniform	[0.65, 1.65]
eYsec16	Manufacture of general purpose machinery; manufacture of special purpose machinery	Uniform	[0.7, 1.7]
eYsec17	Manufacture of domestic appliances	Uniform	[0.75, 1.75]
eYsec18	Manufacture of electrical and machinery and apparatus	Uniform	[0.75, 1.75]
eYsec19	Manufacture of transport equipment	Uniform	[0.9, 1.9]
eYsec20	Electricity, gas and water supply	Uniform	[0.85, 1.85]
eYsec21	Construction	Uniform	[0.7, 1.7]
eYsec22	Wholesale and retail trade	Uniform	[0.7, 1.7]
eYsec23	Hotels and restaurants; activities of travel agencies	Uniform	[0.65, 1.65]
eYsec24	Transport via railways	Uniform	[0.65, 1.65]
eYsec25	Other land transport; transport via pipelines	Uniform	[0.65, 1.65]
eYsec26	Water transport	Uniform	[0.7, 1.7]
eYsec27	Air transport	Uniform	[0.7, 1.7]
eYsec28	Post and telecommunications	Uniform	[0.7, 1.7]
eYsec29	Financial intermediation	Uniform	[0.7, 1.7]
eYsec30	Real estate activities	Uniform	[0.7, 1.7]
eYsec31	Other business activities	Uniform	[0.7, 1.7]
eYsec32	Public administration and defence; compulsory social security	Uniform	[0.7, 1.7]
eYsec33	Education	Uniform	[0.7, 1.7]
eYsec34	Health and social work	Uniform	[0.7, 1.7]
eYsec35	Other community, social and personal service activities	Uniform	[0.7, 1.7]

## Detailed results of the sensitivity analysis

### 7.B.3. Detailed results of the Morris method and Sobol' method

**Table 7.B.10. Morris sensitivity measures for the equivalent variation (EV) (non-neutral VAT scenario)**

Parameters	EV (2004)		Parameters	EV (2005)		Parameters	EV (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
eYsec35	0.088	0.011	eYsec35	0.100	0.012	eYsec35	0.112	0.013
$\sigma$ P1sec35	0.088	0.031	$\sigma$ P1sec35	0.087	0.029	$\sigma$ P1sec35	0.087	0.027
eYsec1	0.064	0.014	eYsec1	0.063	0.012	$\sigma$ P1sec1	0.085	0.015
$\sigma$ P2sec35	0.052	0.031	$\sigma$ P1sec1	0.058	0.012	eYsec1	0.061	0.010
frisch	0.046	0.007	frisch	0.052	0.007	frisch	0.059	0.008
$\sigma$ P1sec1	0.035	0.011	$\sigma$ P2sec35	0.050	0.028	$\sigma$ P2sec35	0.047	0.026
eYsec30	0.033	0.005	eYsec5	0.033	0.010	eYsec5	0.038	0.010
elasLS	0.030	0.004	$\sigma$ P2sec30	0.030	0.005	$\sigma$ P2sec30	0.031	0.005
$\sigma$ P2sec30	0.028	0.005	eYsec30	0.027	0.005	$\sigma$ P1sec5	0.025	0.006
eYsec5	0.028	0.010	elasLS	0.023	0.004	eYsec30	0.021	0.006
$\sigma$ P1sec21	0.027	0.006	$\sigma$ P1sec5	0.021	0.006	eYsec23	0.019	0.005
$\sigma$ P2sec21	0.025	0.006	$\sigma$ P2sec21	0.019	0.004	eYsec11	0.017	0.002
$\sigma$ P1sec5	0.018	0.005	eYsec23	0.016	0.005	$\sigma$ Tsec1	0.015	0.002
eYsec11	0.015	0.002	eYsec11	0.016	0.002	$\sigma$ P2sec1	0.015	0.005
eYsec23	0.014	0.004	$\sigma$ P1sec21	0.015	0.004	elasLS	0.015	0.006
eYsec9	0.012	0.002	eYsec9	0.013	0.002	$\sigma$ P1sec28	0.014	0.003
$\sigma$ Tsec1	0.010	0.002	$\sigma$ Tsec1	0.012	0.002	eYsec9	0.013	0.002
$\sigma$ P2sec5	0.009	0.005	$\sigma$ P2sec1	0.012	0.004	$\sigma$ P2sec21	0.013	0.002
$\sigma$ P2sec1	0.009	0.003	$\sigma$ P1sec28	0.011	0.003	$\sigma$ P1sec30	0.011	0.003
$\sigma$ P1sec9	0.009	0.003	$\sigma$ P2sec5	0.010	0.005	$\sigma$ Asec1	0.011	0.001
$\sigma$ P1sec28	0.008	0.003	$\sigma$ P1sec9	0.009	0.003	$\sigma$ P2sec5	0.010	0.005
$\sigma$ P1sec23	0.007	0.003	$\sigma$ Asec1	0.009	0.001	$\sigma$ P1sec9	0.009	0.002
$\sigma$ Asec1	0.007	0.001	$\sigma$ P1sec30	0.008	0.003	$\sigma$ P1sec22	0.007	0.004
$\sigma$ P1sec30	0.006	0.002	$\sigma$ P1sec23	0.005	0.003	$\sigma$ P2sec20	0.007	0.003
$\sigma$ Asec5	0.005	0.001	$\sigma$ Asec5	0.005	0.001	$\sigma$ Asec5	0.006	0.001

**Table 7.B.11. First-order and total effect sensitivity indices obtained with N=256, with respect to the equivalent variation (non-neutral VAT scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
eYsec35	0.31	0.34	0.36	0.32	0.35	0.36	0.00	0.01	0.01
$\sigma$ P1sec35	0.26	0.22	0.18	0.30	0.25	0.20	0.04	0.03	0.02
eYsec1	0.16	0.14	0.10	0.17	0.14	0.11	0.00	0.00	0.00
$\sigma$ P1sec1	0.04	0.10	0.18	0.04	0.10	0.19	0.00	0.00	0.00
frisch	0.08	0.09	0.09	0.09	0.09	0.10	0.00	0.00	0.01
$\sigma$ P2sec35	0.07	0.05	0.04	0.11	0.09	0.06	0.04	0.03	0.03
elasLS	0.03	0.01	0.00	0.03	0.02	0.01	0.00	0.00	0.00

## Appendix 7.B

**Table 7.B.12. Morris sensitivity measures for the real GDP (non-neutral VAT scenario)**

Parameters	GDP (2004)		Parameters	GDP (2005)		Parameters	GDP (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
eYsec35	0.170	0.020	eYsec35	0.191	0.023	$\sigma$ P1sec1	0.251	0.044
eYsec1	0.132	0.034	$\sigma$ P1sec1	0.177	0.038	eYsec35	0.215	0.026
$\sigma$ P1sec35	0.118	0.044	eYsec1	0.125	0.028	eYsec1	0.115	0.022
$\sigma$ P1sec1	0.111	0.034	$\sigma$ P1sec35	0.116	0.041	$\sigma$ P1sec35	0.114	0.038
$\sigma$ P2sec35	0.071	0.044	frisch	0.081	0.013	frisch	0.093	0.015
elasLS	0.070	0.009	$\sigma$ P2sec35	0.067	0.040	$\sigma$ P2sec35	0.063	0.037
frisch	0.070	0.012	elasLS	0.053	0.010	$\sigma$ P1sec21	0.060	0.021
eYsec30	0.043	0.007	$\sigma$ P1sec21	0.046	0.017	eYsec5	0.051	0.016
$\sigma$ P1sec30	0.033	0.004	eYsec30	0.041	0.009	$\sigma$ P1sec30	0.046	0.006
$\sigma$ P1sec21	0.033	0.013	eYsec5	0.040	0.015	eYsec30	0.039	0.011
eYsec5	0.030	0.014	$\sigma$ P1sec30	0.039	0.005	elasLS	0.032	0.014
$\sigma$ P2sec30	0.024	0.005	eYsec23	0.026	0.007	eYsec23	0.030	0.008
eYsec23	0.022	0.007	$\sigma$ P2sec30	0.026	0.006	$\sigma$ P2sec21	0.029	0.006
$\sigma$ Tsec1	0.017	0.004	$\sigma$ P2sec21	0.022	0.005	$\sigma$ P2sec30	0.028	0.007
eYsec11	0.017	0.003	$\sigma$ Tsec1	0.022	0.005	$\sigma$ Tsec1	0.027	0.005
$\sigma$ P1sec9	0.016	0.005	eYsec11	0.019	0.003	eYsec11	0.021	0.003
$\sigma$ P2sec21	0.014	0.004	$\sigma$ P1sec9	0.016	0.004	$\sigma$ Asec1	0.020	0.003
beta	0.013	0.003	$\sigma$ Asec1	0.016	0.003	$\sigma$ P2sec1	0.019	0.015
$\sigma$ Asec1	0.013	0.003	$\sigma$ P2sec1	0.015	0.012	$\sigma$ P1sec28	0.018	0.004
$\sigma$ P2sec1	0.011	0.009	$\sigma$ P1sec28	0.014	0.004	$\sigma$ P1sec9	0.016	0.004
eYsec9	0.011	0.003	eYsec9	0.012	0.003	eYsec9	0.013	0.003
$\sigma$ P1sec28	0.010	0.004	$\sigma$ P2sec20	0.010	0.004	$\sigma$ P2sec20	0.013	0.005
eYsec3	0.008	0.004	beta	0.010	0.003	$\sigma$ P1sec5	0.011	0.005
$\sigma$ P2sec20	0.008	0.004	$\sigma$ P1sec5	0.009	0.004	$\sigma$ P2sec15	0.008	0.003
$\sigma$ P1sec31	0.008	0.002	eYsec3	0.007	0.004	$\sigma$ Asec5	0.008	0.001

**Table 7.B.13. First-order and total effect sensitivity indices obtained with N=256, with respect to the real GDP (non-neutral VAT scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
eYsec35	0.35	0.35	0.33	0.35	0.36	0.34	0.01	0.01	0.01
$\sigma$ P1sec1	0.12	0.25	0.39	0.13	0.26	0.39	0.01	0.01	0.01
eYsec1	0.21	0.15	0.09	0.22	0.15	0.10	0.01	0.01	0.00
$\sigma$ P1sec35	0.13	0.10	0.08	0.16	0.12	0.09	0.03	0.02	0.02
frisch	0.05	0.05	0.05	0.06	0.06	0.06	0.01	0.01	0.01
$\sigma$ P2sec35	0.03	0.02	0.01	0.06	0.04	0.03	0.03	0.02	0.02
elasLS	0.05	0.02	0.00	0.05	0.02	0.01	0.00	0.00	0.00

## Detailed results of the sensitivity analysis

**Table 7.B.14. Morris sensitivity measures for the equivalent variation (EV) (neutral VAT scenario)**

Parameters	EV (2004)		Parameters	EV (2005)		Parameters	EV (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
eYsec35	0.152	0.018	eYsec35	0.157	0.019	eYsec35	0.164	0.019
$\sigma$ P1sec35	0.098	0.036	elasLS	0.112	0.016	elasLS	0.131	0.017
elasLS	0.094	0.014	$\sigma$ P1sec35	0.095	0.032	$\sigma$ P1sec35	0.091	0.029
$\sigma$ P2sec35	0.062	0.040	$\sigma$ P2sec35	0.058	0.036	$\sigma$ P1sec1	0.065	0.006
eYsec5	0.041	0.006	$\sigma$ P1sec1	0.051	0.005	$\sigma$ P2sec35	0.055	0.032
$\sigma$ P1sec1	0.038	0.005	eYsec5	0.044	0.006	eYsec5	0.047	0.006
eYsec23	0.031	0.011	frisch	0.036	0.016	frisch	0.042	0.016
frisch	0.031	0.017	eYsec23	0.033	0.011	eYsec23	0.034	0.011
eYsec11	0.029	0.004	eYsec11	0.029	0.004	eYsec11	0.029	0.004
$\sigma$ P1sec23	0.028	0.012	$\sigma$ P1sec23	0.028	0.012	$\sigma$ P1sec23	0.028	0.011
$\sigma$ P2sec30	0.022	0.007	beta	0.023	0.006	beta	0.026	0.006
eYsec1	0.020	0.006	eYsec1	0.022	0.007	eYsec1	0.024	0.008
beta	0.019	0.005	$\sigma$ P2sec30	0.019	0.006	eYsec3	0.018	0.005
eYsec3	0.016	0.004	eYsec3	0.017	0.004	$\sigma$ P1sec5	0.017	0.004
eYsec9	0.016	0.003	$\sigma$ P1sec5	0.017	0.004	$\sigma$ P1sec22	0.017	0.008
$\sigma$ P1sec5	0.016	0.004	eYsec9	0.016	0.003	eYsec9	0.016	0.003
$\sigma$ P1sec9	0.015	0.004	$\sigma$ P1sec22	0.015	0.008	$\sigma$ P2sec30	0.016	0.005
$\sigma$ L1sec3	0.014	0.003	$\sigma$ L1sec3	0.015	0.003	$\sigma$ L1sec3	0.016	0.003
$\sigma$ P1sec22	0.014	0.007	$\sigma$ P1sec9	0.014	0.004	$\sigma$ P1sec9	0.013	0.003
eYsec6	0.012	0.003	eYsec6	0.012	0.003	eYsec6	0.013	0.004
$\sigma$ P1sec25	0.011	0.004	$\sigma$ P1sec25	0.011	0.004	$\sigma$ P1sec25	0.012	0.004
$\sigma$ P2sec1	0.009	0.003	$\sigma$ P1sec20	0.009	0.002	$\sigma$ P1sec20	0.010	0.002
$\sigma$ P1sec20	0.009	0.002	$\sigma$ P2sec1	0.009	0.002	eYsec18	0.009	0.002
eYsec18	0.008	0.002	eYsec18	0.009	0.002	$\sigma$ P2sec1	0.008	0.002
$\sigma$ P2sec23	0.008	0.004	eYsec30	0.008	0.005	eYsec30	0.008	0.005

**Table 7.B.15. First-order and total effect sensitivity indices obtained with N=256, with respect to the equivalent variation (neutral VAT scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
eYsec35	0.52	0.50	0.47	0.52	0.50	0.47	0.00	0.00	0.00
elasLS	0.21	0.26	0.30	0.21	0.25	0.30	0.00	0.00	0.00
$\sigma$ P1sec35	0.18	0.15	0.12	0.19	0.16	0.13	0.01	0.01	0.01
$\sigma$ P1sec1	0.04	0.06	0.08	0.04	0.06	0.08	0.00	0.00	0.00
$\sigma$ P2sec35	0.07	0.05	0.04	0.08	0.06	0.04	0.01	0.00	0.00

## Appendix 7.B

**Table 7.B.16. Morris sensitivity measures for the real GDP (neutral VAT scenario)**

Parameters	GDP (2004)		Parameters	GDP (2005)		Parameters	GDP (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
elasLS	0.240	0.027	elasLS	0.268	0.029	elasLS	0.297	0.031
$\sigma$ P1sec1	0.160	0.018	$\sigma$ P1sec1	0.180	0.019	$\sigma$ P1sec1	0.200	0.020
eYsec35	0.155	0.019	eYsec35	0.162	0.019	eYsec35	0.170	0.020
$\sigma$ P1sec35	0.113	0.042	$\sigma$ P1sec35	0.106	0.037	$\sigma$ P1sec35	0.100	0.033
$\sigma$ P2sec35	0.070	0.044	$\sigma$ P2sec35	0.063	0.039	beta	0.060	0.014
beta	0.048	0.012	beta	0.054	0.013	$\sigma$ P2sec35	0.057	0.034
eYsec5	0.046	0.005	eYsec5	0.049	0.006	eYsec5	0.052	0.006
eYsec1	0.041	0.015	eYsec1	0.045	0.015	frisch	0.049	0.018
frisch	0.039	0.017	frisch	0.044	0.017	eYsec1	0.049	0.016
eYsec23	0.037	0.010	eYsec23	0.038	0.010	eYsec23	0.040	0.011
eYsec11	0.023	0.003	$\sigma$ P1sec30	0.023	0.005	$\sigma$ P1sec30	0.026	0.005
$\sigma$ P1sec30	0.021	0.005	eYsec11	0.023	0.003	eYsec11	0.023	0.003
$\sigma$ P1sec23	0.019	0.010	$\sigma$ P1sec23	0.019	0.009	eYsec3	0.019	0.005
eYsec3	0.017	0.004	eYsec3	0.018	0.005	$\sigma$ P1sec23	0.018	0.009
$\sigma$ L1sec3	0.016	0.004	$\sigma$ L1sec3	0.017	0.004	$\sigma$ L1sec3	0.018	0.004
$\sigma$ P1sec9	0.016	0.004	$\sigma$ P1sec9	0.014	0.003	$\sigma$ P1sec9	0.012	0.003
$\sigma$ P2sec30	0.012	0.005	eYsec9	0.011	0.003	eYsec30	0.012	0.007
eYsec9	0.011	0.003	eYsec6	0.010	0.004	eYsec9	0.011	0.003
eYsec6	0.010	0.003	$\sigma$ P1sec25	0.010	0.004	eYsec6	0.011	0.004
$\sigma$ P1sec25	0.010	0.004	eYsec30	0.010	0.007	$\sigma$ P1sec25	0.010	0.004
$\sigma$ P1sec22	0.009	0.006	$\sigma$ P2sec30	0.010	0.004	$\sigma$ P1sec22	0.010	0.006
eYsec30	0.009	0.006	$\sigma$ P1sec22	0.010	0.006	eYsec28	0.009	0.003
eYsec28	0.008	0.003	eYsec28	0.008	0.003	eYsec18	0.008	0.002
$\sigma$ P1sec20	0.008	0.002	eYsec18	0.008	0.002	$\sigma$ P1sec20	0.008	0.002
eYsec18	0.008	0.002	$\sigma$ P1sec20	0.008	0.002	$\sigma$ P2sec30	0.007	0.003

**Table 7.B.17. First-order and total effect sensitivity indices obtained with N=256, with respect to the real GDP (neutral VAT scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
elasLS	0.48	0.51	0.53	0.48	0.51	0.53	0.00	0.00	0.00
$\sigma$ P1sec1	0.21	0.23	0.24	0.21	0.23	0.24	0.00	0.00	0.00
eYsec35	0.20	0.19	0.18	0.20	0.19	0.18	0.00	0.00	0.00
$\sigma$ P1sec35	0.08	0.06	0.05	0.09	0.06	0.05	0.00	0.00	0.00
$\sigma$ P2sec35	0.03	0.02	0.02	0.03	0.02	0.02	0.00	0.00	0.00

## Detailed results of the sensitivity analysis

**Table 7.B.18. Morris sensitivity measures for the equivalent variation (EV) (non-neutral excise scenario)**

Parameters	EV (2004)		Parameters	EV (2005)		Parameters	EV (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
eYsec1	0.520	0.091	eYsec1	0.584	0.098	$\sigma$ P2sec1	0.655	0.286
$\sigma$ P2sec1	0.480	0.198	$\sigma$ P2sec1	0.563	0.240	eYsec1	0.651	0.105
elasLS	0.360	0.053	eYsec3	0.398	0.035	eYsec3	0.478	0.045
eYsec3	0.328	0.027	elasLS	0.390	0.057	elasLS	0.417	0.062
$\sigma$ L1sec3	0.294	0.056	$\sigma$ L1sec3	0.344	0.064	$\sigma$ L1sec3	0.400	0.073
frisch	0.264	0.040	frisch	0.313	0.045	frisch	0.369	0.051
$\sigma$ P2sec30	0.211	0.041	$\sigma$ P2sec30	0.236	0.045	$\sigma$ P2sec30	0.264	0.051
eYsec30	0.171	0.023	$\sigma$ P2sec25	0.191	0.059	$\sigma$ P1sec1	0.261	0.172
$\sigma$ P2sec5	0.164	0.058	$\sigma$ P2sec5	0.186	0.065	$\sigma$ P2sec25	0.229	0.067
$\sigma$ P2sec25	0.157	0.051	$\sigma$ P1sec1	0.178	0.120	$\sigma$ P2sec5	0.210	0.072
$\sigma$ P2sec15	0.129	0.030	eYsec30	0.167	0.027	$\sigma$ P2sec15	0.192	0.041
$\sigma$ P1sec1	0.126	0.090	$\sigma$ P2sec15	0.158	0.035	eYsec5	0.182	0.083
eYsec5	0.123	0.067	eYsec5	0.151	0.075	eYsec30	0.163	0.032
$\sigma$ P2sec32	0.098	0.011	$\sigma$ P1sec22	0.121	0.087	$\sigma$ P1sec22	0.159	0.101
$\sigma$ P1sec32	0.091	0.022	$\sigma$ P2sec32	0.114	0.013	$\sigma$ P1sec32	0.135	0.031
$\sigma$ P1sec22	0.089	0.074	$\sigma$ P1sec32	0.112	0.026	$\sigma$ P2sec32	0.131	0.015
$\sigma$ P1sec21	0.088	0.023	$\sigma$ P2sec22	0.082	0.037	$\sigma$ P2sec22	0.102	0.042
$\sigma$ P1sec25	0.069	0.044	$\sigma$ P1sec30	0.077	0.017	$\sigma$ P1sec30	0.100	0.020
$\sigma$ P2sec22	0.064	0.032	$\sigma$ P1sec25	0.076	0.046	$\sigma$ P2sec20	0.092	0.030
$\sigma$ P2sec35	0.062	0.024	$\sigma$ P2sec20	0.074	0.025	$\sigma$ P2sec24	0.091	0.025
$\sigma$ P2sec20	0.058	0.020	$\sigma$ P2sec35	0.071	0.027	$\sigma$ P1sec25	0.084	0.049
$\sigma$ P1sec30	0.056	0.015	$\sigma$ P2sec24	0.070	0.022	$\sigma$ P2sec35	0.082	0.031
$\sigma$ P1sec31	0.056	0.012	$\sigma$ P1sec31	0.064	0.014	$\sigma$ P1sec28	0.079	0.027
eYsec35	0.052	0.009	$\sigma$ P1sec28	0.058	0.024	$\sigma$ P1sec31	0.072	0.017
$\sigma$ P2sec24	0.051	0.019	eYsec35	0.058	0.010	eYsec35	0.064	0.011

**Table 7.B.19. First-order and total effect sensitivity indices obtained with N=256, with respect to the equivalent variation (non-neutral excise scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
eYsec1	0.32	0.30	0.27	0.33	0.31	0.29	0.01	0.01	0.01
$\sigma$ P2sec1	0.28	0.29	0.29	0.32	0.33	0.33	0.04	0.04	0.04
eYsec3	0.12	0.13	0.14	0.12	0.13	0.14	0.00	0.00	0.00
elasLS	0.13	0.12	0.10	0.14	0.12	0.10	0.01	0.00	0.00
$\sigma$ L1sec3	0.11	0.12	0.12	0.11	0.12	0.12	0.00	0.00	0.00
$\sigma$ P1sec1	0.00	0.01	0.04	0.04	0.05	0.08	0.04	0.04	0.04

## Appendix 7.B

**Table 7.B.20. Morris sensitivity measures for the real GDP (non-neutral excise scenario)**

Parameters	GDP (2004)		Parameters	GDP (2005)		Parameters	GDP (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
eYsec1	1.107	0.236	eYsec1	1.227	0.244	eYsec1	1.353	0.250
eYsec3	0.900	0.081	eYsec3	1.103	0.105	eYsec3	1.338	0.135
elasLS	0.830	0.123	elasLS	0.880	0.129	$\sigma$ P2sec1	0.976	0.767
$\sigma$ P2sec1	0.696	0.569	$\sigma$ P2sec1	0.827	0.664	elasLS	0.923	0.138
frisch	0.465	0.073	frisch	0.571	0.087	$\sigma$ P1sec1	0.788	0.536
$\sigma$ L1sec3	0.434	0.095	$\sigma$ P1sec1	0.543	0.377	frisch	0.694	0.102
$\sigma$ P1sec1	0.385	0.279	$\sigma$ L1sec3	0.506	0.109	$\sigma$ L1sec3	0.586	0.125
$\sigma$ P1sec21	0.338	0.101	$\sigma$ P1sec21	0.453	0.128	$\sigma$ P1sec21	0.578	0.158
$\sigma$ P2sec25	0.297	0.067	$\sigma$ P2sec25	0.360	0.079	$\sigma$ P2sec25	0.431	0.092
eYsec30	0.276	0.040	$\sigma$ P2sec15	0.333	0.075	$\sigma$ P2sec15	0.398	0.087
$\sigma$ P2sec15	0.276	0.065	$\sigma$ P1sec30	0.310	0.031	$\sigma$ P1sec30	0.377	0.038
$\sigma$ P1sec30	0.252	0.026	eYsec30	0.306	0.049	eYsec30	0.339	0.061
$\sigma$ P2sec30	0.193	0.051	$\sigma$ P2sec30	0.222	0.059	eYsec5	0.266	0.145
beta	0.166	0.045	$\sigma$ P2sec24	0.203	0.035	$\sigma$ P2sec30	0.255	0.068
$\sigma$ P2sec24	0.163	0.030	eYsec5	0.196	0.123	$\sigma$ P2sec24	0.248	0.039
$\sigma$ P2sec22	0.143	0.031	beta	0.184	0.050	$\sigma$ P2sec22	0.218	0.044
eYsec5	0.139	0.104	$\sigma$ P2sec22	0.178	0.037	beta	0.201	0.054
$\sigma$ P2sec20	0.120	0.037	$\sigma$ P2sec20	0.151	0.046	$\sigma$ P2sec20	0.186	0.055
$\sigma$ P1sec31	0.116	0.023	$\sigma$ P1sec31	0.129	0.028	$\sigma$ P1sec22	0.160	0.118
$\sigma$ P2sec35	0.103	0.036	$\sigma$ P2sec27	0.126	0.008	$\sigma$ P2sec27	0.153	0.011
$\sigma$ P2sec27	0.102	0.006	$\sigma$ P1sec22	0.122	0.100	$\sigma$ P1sec31	0.143	0.033
eYsec35	0.095	0.018	$\sigma$ P2sec35	0.119	0.041	$\sigma$ P2sec35	0.136	0.046
$\sigma$ P1sec22	0.090	0.084	eYsec35	0.104	0.020	eYsec35	0.114	0.023
$\sigma$ P1sec25	0.084	0.052	$\sigma$ P1sec25	0.093	0.056	$\sigma$ P1sec25	0.102	0.059
$\sigma$ P2sec5	0.070	0.051	$\sigma$ P2sec31	0.081	0.013	$\sigma$ P1sec28	0.101	0.037

**Table 7.B.21. First-order and total effect sensitivity indices obtained with N=256, with respect to the real GDP (non-neutral excise scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
	eYsec1	0.34	0.31	0.27	0.36	0.32	0.29	0.02	0.02
eYsec3	0.21	0.24	0.26	0.22	0.24	0.26	0.00	0.00	0.00
$\sigma$ P2sec1	0.14	0.15	0.15	0.20	0.21	0.21	0.06	0.06	0.06
elasLS	0.16	0.13	0.11	0.17	0.14	0.11	0.01	0.00	0.00
$\sigma$ L1sec3	0.06	0.06	0.06	0.06	0.06	0.06	0.00	0.00	0.00
$\sigma$ P1sec1	0.00	0.03	0.08	0.07	0.10	0.15	0.08	0.07	0.07

## Detailed results of the sensitivity analysis

**Table 7.B.22. Morris sensitivity measures for the equivalent variation (EV) (neutral excise scenario)**

Parameters	EV (2004)		Parameters	EV (2005)		Parameters	EV (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
eYsec3	0.698	0.073	eYsec3	0.815	0.087	eYsec3	0.945	0.103
$\sigma$ P2sec1	0.672	0.186	$\sigma$ P2sec1	0.770	0.226	$\sigma$ P2sec1	0.874	0.269
$\sigma$ P1sec1	0.308	0.147	$\sigma$ P1sec1	0.404	0.178	$\sigma$ P1sec1	0.512	0.210
eYsec1	0.305	0.046	frisch	0.353	0.061	frisch	0.408	0.071
frisch	0.304	0.052	$\sigma$ L1sec3	0.343	0.070	$\sigma$ L1sec3	0.389	0.079
$\sigma$ L1sec3	0.301	0.061	eYsec1	0.334	0.051	eYsec1	0.366	0.058
$\sigma$ P2sec25	0.249	0.059	$\sigma$ P2sec25	0.294	0.065	$\sigma$ P2sec25	0.343	0.072
eYsec5	0.201	0.056	eYsec5	0.237	0.062	eYsec5	0.276	0.069
$\sigma$ P2sec5	0.197	0.046	$\sigma$ P2sec15	0.224	0.045	$\sigma$ P2sec15	0.262	0.051
$\sigma$ P2sec15	0.188	0.040	$\sigma$ P2sec5	0.221	0.051	$\sigma$ P2sec5	0.247	0.056
$\sigma$ P1sec5	0.175	0.050	$\sigma$ P1sec5	0.195	0.055	elasLS	0.234	0.058
$\sigma$ P2sec24	0.136	0.029	$\sigma$ P2sec24	0.161	0.031	$\sigma$ P1sec5	0.217	0.061
$\sigma$ P2sec22	0.122	0.046	elasLS	0.158	0.048	$\sigma$ P2sec24	0.189	0.034
eY1sec25	0.112	0.064	$\sigma$ P2sec22	0.148	0.051	$\sigma$ P2sec22	0.176	0.055
eYsec30	0.105	0.030	$\sigma$ P1sec25	0.133	0.069	$\sigma$ P1sec25	0.156	0.074
elasLS	0.091	0.040	eYsec30	0.103	0.036	$\sigma$ P1sec32	0.124	0.030
$\sigma$ P1sec35	0.083	0.017	$\sigma$ P2sec20	0.098	0.031	$\sigma$ P2sec20	0.115	0.035
$\sigma$ P2sec20	0.082	0.027	$\sigma$ P1sec32	0.095	0.023	$\sigma$ P1sec35	0.106	0.021
$\sigma$ P1sec24	0.078	0.036	$\sigma$ P1sec35	0.094	0.019	eYsec30	0.106	0.042
$\sigma$ P2sec30	0.075	0.021	$\sigma$ P1sec24	0.090	0.039	$\sigma$ P1sec24	0.104	0.041
$\sigma$ P1sec22	0.074	0.081	$\sigma$ P1sec22	0.084	0.089	$\sigma$ P2sec32	0.098	0.011
$\sigma$ P1sec32	0.070	0.018	$\sigma$ P2sec32	0.081	0.009	$\sigma$ P1sec21	0.094	0.024
$\sigma$ P2sec35	0.069	0.020	$\sigma$ P2sec35	0.079	0.023	$\sigma$ P1sec22	0.094	0.097
$\sigma$ P2sec32	0.066	0.007	$\sigma$ P2sec27	0.076	0.007	$\sigma$ P2sec27	0.092	0.008
$\sigma$ P2sec27	0.062	0.006	$\sigma$ P2sec30	0.076	0.021	$\sigma$ P2sec35	0.089	0.025

**Table 7.B.23. First-order and total effect sensitivity indices obtained with N=256, with respect to the equivalent variation (neutral excise scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
$\sigma$ P2sec1	0.42	0.40	0.38	0.44	0.42	0.40	0.02	0.02	0.02
eYsec3	0.40	0.40	0.40	0.40	0.40	0.40	0.00	0.00	0.00
$\sigma$ P1sec1	0.07	0.08	0.10	0.09	0.11	0.12	0.02	0.02	0.02
eYsec1	0.08	0.07	0.07	0.09	0.08	0.07	0.00	0.00	0.00
elasLS	0.01	0.02	0.04	0.02	0.03	0.04	0.00	0.00	0.00

## Appendix 7.B

**Table 7.B.24. Morris sensitivity measures for the real GDP (neutral excise scenario)**

Parameters	GDP (2004)		Parameters	GDP (2005)		Parameters	GDP (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
$\sigma P1sec1$	1.053	0.406	$\sigma P1sec1$	1.248	0.456	$\sigma P1sec1$	1.470	0.510
$eYsec3$	0.841	0.096	$eYsec3$	0.974	0.114	$eYsec3$	1.123	0.135
$\sigma P2sec1$	0.651	0.506	$\sigma P2sec1$	0.732	0.576	$\sigma P2sec1$	0.818	0.650
$eYsec1$	0.523	0.094	$eYsec1$	0.555	0.096	$eYsec1$	0.592	0.099
$\sigma L1sec3$	0.384	0.088	$\sigma L1sec3$	0.431	0.098	$elasLS$	0.589	0.133
$frisch$	0.349	0.066	$elasLS$	0.423	0.114	$\sigma L1sec3$	0.480	0.110
$\sigma P2sec25$	0.292	0.065	$frisch$	0.406	0.076	$frisch$	0.469	0.087
$\sigma P2sec15$	0.283	0.066	$\sigma P2sec25$	0.336	0.072	$\sigma P2sec25$	0.383	0.080
$elasLS$	0.273	0.099	$\sigma P2sec15$	0.327	0.075	$\sigma P2sec15$	0.374	0.084
$\sigma P1sec21$	0.191	0.047	$\sigma P1sec21$	0.240	0.055	$\sigma P1sec21$	0.291	0.065
$eYsec5$	0.179	0.067	$eYsec5$	0.216	0.076	$eYsec5$	0.256	0.086
$eYsec30$	0.164	0.035	$\sigma P2sec24$	0.183	0.035	$\sigma P2sec24$	0.208	0.038
$\sigma P2sec24$	0.159	0.032	$eYsec30$	0.182	0.041	$eYsec30$	0.205	0.048
$\sigma P2sec22$	0.141	0.028	$\sigma P2sec22$	0.165	0.031	$\sigma P2sec21$	0.197	0.019
$\sigma P2sec27$	0.104	0.008	$\sigma P2sec21$	0.147	0.015	$\sigma P2sec22$	0.192	0.033
$\sigma P1sec25$	0.104	0.062	$\sigma P2sec27$	0.123	0.010	$\sigma P2sec27$	0.143	0.012
$\sigma P2sec21$	0.102	0.012	$\sigma P1sec25$	0.121	0.066	$\sigma P1sec25$	0.139	0.069
$\sigma P1sec35$	0.100	0.022	$\sigma P2sec20$	0.115	0.035	$\sigma P2sec20$	0.132	0.039
$\sigma P2sec20$	0.099	0.031	$\sigma P1sec35$	0.110	0.024	$\sigma P1sec35$	0.122	0.026
$\sigma P2sec35$	0.087	0.026	$\sigma P2sec35$	0.096	0.028	$beta$	0.107	0.021
$\sigma P1sec31$	0.081	0.020	$\sigma P1sec31$	0.093	0.023	$\sigma P2sec35$	0.106	0.030
$\sigma P2sec31$	0.073	0.012	$\sigma P2sec31$	0.089	0.013	$\sigma P2sec31$	0.106	0.015
$\sigma P2sec30$	0.071	0.022	$beta$	0.077	0.017	$\sigma P1sec31$	0.105	0.027
$\sigma P1sec24$	0.068	0.035	$\sigma P1sec24$	0.076	0.037	$\sigma P1sec24$	0.086	0.039
$\sigma P2sec5$	0.062	0.044	$\sigma P2sec30$	0.076	0.024	$\sigma P2sec30$	0.082	0.026

**Table 7.B.25. First-order and total effect sensitivity indices obtained with N=256, with respect to the real GDP (neutral excise scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
$\sigma P1sec1$	0.34	0.35	0.36	0.40	0.41	0.42	0.06	0.06	0.06
$eYsec3$	0.26	0.26	0.25	0.26	0.26	0.25	0.00	0.00	0.00
$\sigma P2sec1$	0.17	0.16	0.15	0.24	0.22	0.21	0.07	0.06	0.06
$eYsec1$	0.12	0.10	0.08	0.12	0.10	0.08	0.01	0.00	0.00
$elasLS$	0.04	0.07	0.10	0.05	0.07	0.10	0.00	0.00	0.00

## Detailed results of the sensitivity analysis

**Table 7.B.26. Morris sensitivity measures for the equivalent variation (EV) (non-neutral subsidy scenario)**

Parameters	EV (2004)		Parameters	EV (2005)		Parameters	EV (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
eYsec1	0.068	0.016	eYsec1	0.168	0.038	$\sigma$ P1sec24	0.228	0.071
$\sigma$ P1sec24	0.058	0.019	$\sigma$ P1sec24	0.161	0.052	eYsec1	0.223	0.048
$\sigma$ P2sec30	0.037	0.006	$\sigma$ P2sec30	0.093	0.015	$\sigma$ P1sec1	0.140	0.030
eYsec30	0.033	0.004	eYsec30	0.073	0.010	$\sigma$ P2sec30	0.126	0.020
frisch	0.030	0.006	frisch	0.073	0.014	$\sigma$ P2sec24	0.110	0.045
elasLS	0.025	0.007	$\sigma$ P1sec1	0.073	0.021	frisch	0.100	0.017
$\sigma$ P1sec21	0.025	0.006	$\sigma$ P2sec24	0.071	0.033	eYsec30	0.084	0.012
$\sigma$ P1sec1	0.022	0.008	elasLS	0.061	0.017	elasLS	0.071	0.021
$\sigma$ P2sec24	0.021	0.012	$\sigma$ P1sec21	0.051	0.011	$\sigma$ P1sec25	0.058	0.024
eYsec24	0.018	0.005	$\sigma$ P1sec25	0.040	0.018	$\sigma$ P2sec15	0.057	0.013
$\sigma$ P2sec21	0.016	0.005	$\sigma$ P2sec15	0.037	0.009	$\sigma$ L1sec3	0.052	0.011
$\sigma$ P1sec25	0.015	0.007	$\sigma$ P2sec21	0.035	0.010	$\sigma$ P2sec1	0.050	0.017
$\sigma$ P2sec15	0.014	0.003	$\sigma$ L1sec3	0.034	0.008	$\sigma$ Tsec1	0.045	0.006
$\sigma$ L1sec3	0.013	0.003	eYsec24	0.034	0.012	$\sigma$ P1sec21	0.044	0.011
eYsec5	0.013	0.010	$\sigma$ P2sec1	0.032	0.011	eYsec5	0.041	0.030
$\sigma$ P2sec1	0.012	0.004	eYsec5	0.030	0.023	$\sigma$ P1sec5	0.038	0.015
$\sigma$ Tsec1	0.010	0.002	$\sigma$ Tsec1	0.029	0.004	eYsec24	0.037	0.015
$\sigma$ P1sec31	0.009	0.001	$\sigma$ P1sec31	0.024	0.003	$\sigma$ P2sec21	0.036	0.011
$\sigma$ P2sec5	0.009	0.004	$\sigma$ P2sec5	0.024	0.011	$\sigma$ P2sec20	0.035	0.013
eYsec3	0.009	0.001	eYsec3	0.023	0.003	$\sigma$ P1sec31	0.033	0.005
$\sigma$ P2sec25	0.008	0.004	$\sigma$ P1sec5	0.023	0.011	$\sigma$ P2sec5	0.033	0.015
$\sigma$ P2sec20	0.008	0.003	$\sigma$ P2sec20	0.022	0.009	eYsec3	0.032	0.003
$\sigma$ P1sec5	0.008	0.004	$\sigma$ P2sec25	0.022	0.011	$\sigma$ P2sec25	0.031	0.014
eYsec35	0.008	0.001	eYsec35	0.020	0.002	$\sigma$ Asec1	0.030	0.005
$\sigma$ P1sec20	0.007	0.001	$\sigma$ Asec1	0.019	0.004	$\sigma$ Asec24	0.030	0.014

**Table 7.B.27. First-order and total effect sensitivity indices obtained with N=256, with respect to the equivalent variation (non-neutral subsidy scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
eYsec1	0.40	0.34	0.30	0.41	0.35	0.31	0.01	0.01	0.01
$\sigma$ P1sec24	0.31	0.33	0.33	0.33	0.36	0.36	0.03	0.03	0.03
$\sigma$ P2sec30	0.12	0.11	0.10	0.12	0.10	0.10	0.00	0.00	0.00
$\sigma$ P2sec24	0.05	0.08	0.10	0.08	0.11	0.12	0.02	0.03	0.03
$\sigma$ P1sec1	0.04	0.06	0.11	0.05	0.07	0.12	0.01	0.01	0.01
elasLS	0.06	0.05	0.03	0.06	0.05	0.03	0.00	0.00	0.00

## Appendix 7.B

**Table 7.B.28. Morris sensitivity measures for the real GDP (non-neutral subsidy scenario)**

Parameters	GDP (2004)		Parameters	GDP (2005)		Parameters	GDP (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
eYsec1	0.138	0.039	eYsec1	0.341	0.095	eYsec1	0.446	0.117
$\sigma$ P1sec24	0.087	0.031	$\sigma$ P1sec1	0.229	0.068	$\sigma$ P1sec1	0.430	0.094
$\sigma$ P1sec1	0.070	0.027	$\sigma$ P1sec24	0.214	0.074	$\sigma$ P1sec24	0.289	0.096
elasLS	0.060	0.017	elasLS	0.142	0.040	$\sigma$ P2sec24	0.184	0.065
$\sigma$ P2sec24	0.052	0.021	$\sigma$ P2sec24	0.132	0.049	elasLS	0.162	0.049
$\sigma$ P1sec30	0.032	0.005	$\sigma$ P1sec21	0.087	0.032	$\sigma$ P1sec21	0.143	0.049
$\sigma$ P2sec30	0.031	0.007	$\sigma$ P1sec30	0.084	0.012	$\sigma$ P1sec30	0.126	0.018
$\sigma$ P1sec21	0.030	0.011	$\sigma$ P2sec15	0.082	0.018	$\sigma$ P2sec15	0.124	0.027
eYsec30	0.030	0.005	$\sigma$ P2sec30	0.081	0.019	$\sigma$ P2sec30	0.113	0.026
$\sigma$ P2sec15	0.029	0.007	frisch	0.072	0.016	frisch	0.104	0.022
frisch	0.027	0.006	eYsec30	0.071	0.012	eYsec30	0.087	0.014
$\sigma$ P1sec31	0.021	0.003	$\sigma$ L1sec3	0.055	0.013	$\sigma$ L1sec3	0.083	0.019
$\sigma$ L1sec3	0.020	0.005	$\sigma$ P1sec31	0.052	0.007	$\sigma$ Tsec1	0.079	0.015
$\sigma$ P1sec25	0.020	0.010	$\sigma$ P1sec25	0.052	0.025	$\sigma$ P1sec25	0.075	0.034
eYsec3	0.020	0.002	$\sigma$ Tsec1	0.051	0.011	$\sigma$ P1sec31	0.070	0.010
$\sigma$ Tsec1	0.018	0.004	eYsec3	0.050	0.006	$\sigma$ P2sec20	0.069	0.024
$\sigma$ P2sec20	0.017	0.006	$\sigma$ P2sec20	0.046	0.017	eYsec3	0.068	0.008
eYsec35	0.016	0.002	$\sigma$ P2sec1	0.042	0.033	$\sigma$ P2sec1	0.065	0.052
$\sigma$ P2sec1	0.015	0.012	eYsec35	0.041	0.005	$\sigma$ Asec1	0.056	0.011
$\sigma$ P2sec25	0.014	0.006	$\sigma$ P2sec25	0.037	0.015	eYsec35	0.056	0.007
$\sigma$ Asec1	0.013	0.003	$\sigma$ Asec1	0.037	0.008	$\sigma$ P2sec25	0.053	0.021
beta	0.011	0.004	beta	0.027	0.009	$\sigma$ P2sec21	0.045	0.012
eYsec5	0.011	0.008	$\sigma$ P2sec21	0.027	0.008	eYsec24	0.034	0.020
$\sigma$ Asec24	0.009	0.006	eYsec5	0.026	0.017	eYsec5	0.034	0.017
$\sigma$ P2sec21	0.009	0.003	eYsec24	0.024	0.015	beta	0.033	0.012

**Table 7.B.29. First-order and total effect sensitivity indices obtained with N=256, with respect to the real GDP (non-neutral subsidy scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
eYsec1	0.46	0.43	0.36	0.48	0.45	0.38	0.02	0.02	0.02
$\sigma$ P1sec24	0.20	0.18	0.17	0.23	0.21	0.19	0.03	0.03	0.02
$\sigma$ P1sec1	0.10	0.16	0.29	0.12	0.18	0.30	0.02	0.02	0.02
$\sigma$ P2sec24	0.08	0.08	0.08	0.11	0.10	0.10	0.02	0.02	0.02
elasLS	0.09	0.08	0.05	0.09	0.07	0.05	0.00	0.00	0.00
$\sigma$ P2sec30	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00

## Detailed results of the sensitivity analysis

**Table 7.B.30. Morris sensitivity measures for the equivalent variation (EV) (non-neutral capital expenditures scenario)**

Parameters	EV (2004)		Parameters	EV (2005)		Parameters	EV (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
$\sigma P1sec1$	0.085	0.013	$\sigma P1sec1$	0.116	0.018	$\sigma P1sec1$	0.295	0.045
$eYsec1$	0.042	0.013	$eYsec1$	0.057	0.017	$eYsec1$	0.144	0.045
$\sigma P1sec22$	0.026	0.011	elasLS	0.033	0.012	elasLS	0.079	0.030
$\sigma P2sec21$	0.022	0.005	$eYsec30$	0.030	0.007	$eYsec30$	0.071	0.016
$\sigma P2sec20$	0.020	0.007	$\sigma P2sec20$	0.024	0.008	$\sigma P2sec20$	0.062	0.022
$\sigma P1sec21$	0.018	0.005	$\sigma P1sec22$	0.023	0.010	$\sigma P1sec22$	0.062	0.028
$\sigma P1sec24$	0.017	0.005	$\sigma P1sec24$	0.019	0.005	$\sigma P1sec24$	0.051	0.013
$eYsec30$	0.016	0.004	$\sigma P2sec21$	0.017	0.003	$\sigma P2sec21$	0.049	0.010
elasLS	0.015	0.008	$\sigma Tsec1$	0.017	0.002	$\sigma Tsec1$	0.044	0.006
$\sigma P2sec15$	0.014	0.004	$\sigma P2sec1$	0.016	0.006	$\sigma P2sec1$	0.040	0.015
$\sigma Tsec1$	0.014	0.002	$\sigma P2sec15$	0.015	0.004	$\sigma P2sec15$	0.040	0.010
$\sigma P2sec1$	0.013	0.005	$\sigma P1sec32$	0.015	0.007	$\sigma P1sec25$	0.037	0.009
$\sigma P1sec20$	0.011	0.003	$\sigma P1sec25$	0.014	0.004	$\sigma P1sec20$	0.034	0.008
$\sigma P1sec25$	0.011	0.003	$\sigma P1sec20$	0.013	0.003	$\sigma P1sec21$	0.032	0.009
$\sigma P1sec5$	0.010	0.004	$eYsec5$	0.012	0.005	$\sigma P1sec32$	0.031	0.015
$\sigma Asec1$	0.010	0.001	$\sigma Asec1$	0.012	0.002	$\sigma Asec1$	0.031	0.004
$\sigma P2sec5$	0.007	0.003	frisch	0.011	0.003	$eYsec5$	0.030	0.011
$eYsec5$	0.007	0.003	$\sigma P1sec21$	0.010	0.003	frisch	0.027	0.007
frisch	0.006	0.002	$\sigma P2sec32$	0.008	0.005	$\sigma P2sec5$	0.017	0.006
$\sigma P1sec31$	0.006	0.001	$\sigma P1sec31$	0.006	0.002	$\sigma P1sec5$	0.016	0.010
$\sigma P2sec24$	0.004	0.003	$\sigma P2sec5$	0.006	0.002	$\sigma P1sec31$	0.016	0.004
$\sigma P2sec30$	0.004	0.002	$eYsec3$	0.006	0.001	$\sigma P2sec32$	0.016	0.011
$eYsec20$	0.004	0.000	$\sigma P2sec24$	0.005	0.003	$eYsec3$	0.015	0.003
$eYsec3$	0.004	0.001	$eYsec35$	0.005	0.001	$\sigma P2sec24$	0.014	0.008
$eYsec24$	0.003	0.000	$\sigma P1sec5$	0.005	0.003	$eYsec35$	0.013	0.003

**Table 7.B.31. First-order and total effect sensitivity indices obtained with N=256, with respect to the equivalent variation (non-neutral capital expenditures scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
$\sigma P1sec1$	0.72	0.73	0.73	0.73	0.74	0.74	0.01	0.01	0.01
$eYsec1$	0.18	0.18	0.18	0.19	0.19	0.19	0.00	0.00	0.00
elasLS	0.02	0.05	0.05	0.02	0.05	0.05	0.00	0.00	0.00
$\sigma P1sec22$	0.09	0.04	0.04	0.08	0.03	0.04	0.00	0.00	0.00

## Appendix 7.B

**Table 7.B.32. Morris sensitivity measures for the real GDP (non-neutral capital expenditures scenario)**

Parameters	GDP (2004)		Parameters	GDP (2005)		Parameters	GDP (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
$\sigma P1sec1$	0.272	0.043	$\sigma P1sec1$	0.352	0.054	$\sigma P1sec1$	0.902	0.139
$eYsec1$	0.097	0.034	$eYsec1$	0.128	0.044	$eYsec1$	0.326	0.113
$\sigma P2sec20$	0.040	0.013	$elasLS$	0.077	0.027	$elasLS$	0.182	0.069
$elasLS$	0.034	0.019	$\sigma P2sec20$	0.045	0.015	$\sigma P2sec20$	0.115	0.038
$\sigma P2sec15$	0.031	0.008	$\sigma P1sec21$	0.031	0.013	$\sigma P2sec15$	0.084	0.022
$\sigma P1sec24$	0.028	0.009	$\sigma P2sec15$	0.031	0.008	$\sigma P1sec24$	0.080	0.023
$\sigma P1sec22$	0.026	0.013	$\sigma P1sec24$	0.031	0.009	$\sigma P1sec21$	0.078	0.032
$\sigma Tsec1$	0.025	0.005	$\sigma Tsec1$	0.029	0.006	$\sigma Tsec1$	0.077	0.015
$\sigma P1sec21$	0.022	0.010	$eYsec5$	0.028	0.006	$eYsec5$	0.069	0.014
$eYsec5$	0.019	0.004	$\sigma P1sec22$	0.023	0.012	$\sigma P1sec22$	0.064	0.034
$\sigma Asec1$	0.019	0.003	$eYsec30$	0.022	0.007	$\sigma Asec1$	0.057	0.010
$\sigma P2sec1$	0.016	0.014	$\sigma Asec1$	0.022	0.004	$eYsec30$	0.052	0.017
$\sigma P1sec25$	0.015	0.005	$\sigma P2sec1$	0.020	0.017	$\sigma P2sec1$	0.051	0.044
$frisch$	0.014	0.003	$frisch$	0.020	0.004	$frisch$	0.049	0.009
$\sigma P1sec31$	0.014	0.003	$\sigma P2sec21$	0.019	0.004	$\sigma P2sec21$	0.048	0.009
$\sigma P1sec20$	0.014	0.004	$\sigma P1sec25$	0.018	0.005	$\sigma P1sec25$	0.047	0.014
$\sigma P2sec24$	0.013	0.005	$\sigma P1sec20$	0.016	0.005	$\sigma P1sec20$	0.040	0.012
$\sigma P2sec21$	0.013	0.003	$beta$	0.015	0.007	$\sigma P2sec24$	0.037	0.014
$eYsec30$	0.010	0.004	$\sigma P2sec24$	0.014	0.005	$beta$	0.036	0.018
$eYsec3$	0.007	0.001	$\sigma P1sec31$	0.013	0.003	$\sigma P1sec31$	0.035	0.008
$beta$	0.007	0.005	$eYsec3$	0.011	0.002	$eYsec3$	0.027	0.006
$eYsec35$	0.006	0.002	$eYsec35$	0.010	0.002	$eYsec35$	0.024	0.006
$\sigma P2sec16$	0.006	0.002	$eYsec23$	0.008	0.001	$eYsec23$	0.020	0.004
$eYsec23$	0.005	0.001	$\sigma P1sec30$	0.008	0.005	$\sigma P2sec16$	0.019	0.006
$\sigma P2sec25$	0.005	0.002	$\sigma P2sec16$	0.007	0.002	$\sigma P1sec30$	0.018	0.012

**Table 7.B.33. First-order and total effect sensitivity indices obtained with N=256, with respect to the real GDP (non-neutral capital expenditures scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
$\sigma P1sec1$	0.85	0.83	0.84	0.86	0.84	0.85	0.01	0.01	0.01
$eYsec1$	0.12	0.13	0.13	0.13	0.13	0.13	0.01	0.01	0.01
$elasLS$	0.01	0.04	0.03	0.02	0.04	0.03	0.00	0.00	0.00
$\sigma P1sec22$	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00

## Detailed results of the sensitivity analysis

**Table 7.B.34. Morris sensitivity measures for the equivalent variation (EV) (neutral combined scenario)**

Parameters	EV (2004)		Parameters	EV (2005)		Parameters	EV (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
$\sigma P2sec1$	0.680	0.192	eYsec3	0.782	0.080	$\sigma P2sec1$	0.916	0.286
eYsec3	0.672	0.068	$\sigma P2sec1$	0.779	0.236	eYsec3	0.895	0.093
$\sigma P1sec1$	0.335	0.148	elasLS	0.561	0.062	elasLS	0.833	0.089
frisch	0.328	0.055	$\sigma P1sec1$	0.502	0.183	$\sigma P1sec1$	0.572	0.210
elasLS	0.303	0.044	frisch	0.378	0.068	frisch	0.450	0.083
$\sigma L1sec3$	0.293	0.059	$\sigma L1sec3$	0.349	0.070	$\sigma P2sec24$	0.434	0.113
$\sigma P2sec25$	0.267	0.064	$\sigma P2sec24$	0.335	0.090	$\sigma P2sec25$	0.404	0.090
eYsec5	0.257	0.047	$\sigma P2sec25$	0.334	0.077	$\sigma L1sec3$	0.401	0.078
$\sigma P1sec5$	0.236	0.052	eYsec5	0.309	0.050	eYsec5	0.389	0.049
$\sigma P2sec24$	0.219	0.058	$\sigma P1sec5$	0.291	0.063	$\sigma P1sec5$	0.361	0.072
$\sigma P2sec15$	0.196	0.041	$\sigma P2sec15$	0.275	0.055	$\sigma P2sec15$	0.306	0.059
eYsec1	0.195	0.042	$\sigma P2sec5$	0.208	0.044	$\sigma P2sec20$	0.294	0.088
$\sigma P2sec5$	0.182	0.040	$\sigma P1sec24$	0.190	0.126	$\sigma P1sec24$	0.288	0.158
$\sigma P2sec20$	0.143	0.045	$\sigma P2sec20$	0.184	0.056	$\sigma P2sec5$	0.214	0.044
eYsec35	0.128	0.016	eYsec1	0.173	0.050	beta	0.180	0.032
$\sigma P2sec35$	0.127	0.056	$\sigma P2sec22$	0.150	0.049	$\sigma P2sec22$	0.173	0.050
$\sigma P2sec22$	0.120	0.044	$\sigma P2sec35$	0.134	0.053	$\sigma P2sec35$	0.137	0.050
$\sigma P1sec25$	0.094	0.067	beta	0.127	0.022	$\sigma P1sec32$	0.126	0.029
beta	0.076	0.013	eYsec35	0.118	0.017	eYsec23	0.114	0.035
$\sigma P1sec32$	0.073	0.018	$\sigma P1sec25$	0.099	0.072	$\sigma P1sec31$	0.112	0.024
eYsec23	0.073	0.023	$\sigma P1sec32$	0.099	0.024	$\sigma P1sec23$	0.112	0.027
$\sigma P1sec23$	0.072	0.014	$\sigma P1sec23$	0.091	0.019	$\sigma P2sec27$	0.110	0.010
$\sigma P1sec24$	0.070	0.071	eYsec23	0.090	0.029	$\sigma P1sec21$	0.105	0.030
$\sigma P2sec27$	0.068	0.006	$\sigma P2sec27$	0.089	0.008	$\sigma P1sec15$	0.105	0.010
$\sigma P1sec15$	0.067	0.006	$\sigma P1sec15$	0.085	0.008	$\sigma P1sec25$	0.104	0.064

**Table 7.B.35. First-order and total effect sensitivity indices obtained with N=256, with respect to the equivalent variation (neutral combined scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
$\sigma P2sec1$	0.43	0.35	0.33	0.45	0.37	0.34	0.02	0.02	0.02
eYsec3	0.39	0.33	0.29	0.39	0.33	0.29	0.00	0.00	0.00
elasLS	0.09	0.19	0.27	0.09	0.19	0.27	0.00	0.00	0.00
$\sigma P1sec1$	0.09	0.13	0.11	0.11	0.14	0.12	0.02	0.02	0.01

## Appendix 7.B

**Table 7.B.36. Morris sensitivity measures for the real GDP (neutral combined scenario)**

Parameters	GDP (2004)		Parameters	GDP (2005)		Parameters	GDP (2006)	
	$\mu$	$\sigma$		$\mu$	$\sigma$		$\mu$	$\sigma$
$\sigma P1sec1$	1.161	0.397	$\sigma P1sec1$	1.626	0.446	elasLS	2.009	0.180
elasLS	0.817	0.099	elasLS	1.418	0.132	$\sigma P1sec1$	1.600	0.506
eYsec3	0.810	0.090	eYsec3	0.935	0.107	eYsec3	1.059	0.123
$\sigma P2sec1$	0.658	0.515	$\sigma P2sec1$	0.741	0.588	$\sigma P2sec1$	0.850	0.684
frisch	0.391	0.067	frisch	0.450	0.079	frisch	0.540	0.092
$\sigma L1sec3$	0.374	0.085	$\sigma L1sec3$	0.437	0.099	$\sigma L1sec3$	0.494	0.109
eYsec1	0.332	0.064	$\sigma P2sec15$	0.397	0.089	$\sigma P2sec25$	0.442	0.096
$\sigma P2sec25$	0.309	0.069	$\sigma P2sec25$	0.375	0.083	$\sigma P2sec15$	0.433	0.093
$\sigma P2sec15$	0.294	0.068	$\sigma P2sec24$	0.336	0.086	$\sigma P2sec24$	0.420	0.106
eYsec5	0.249	0.062	eYsec5	0.303	0.068	eYsec5	0.393	0.071
$\sigma P2sec24$	0.231	0.057	eYsec1	0.283	0.070	beta	0.393	0.069
$\sigma P1sec21$	0.213	0.054	beta	0.277	0.046	$\sigma P1sec21$	0.353	0.084
beta	0.160	0.025	$\sigma P1sec21$	0.264	0.063	$\sigma P2sec20$	0.296	0.093
$\sigma P2sec20$	0.158	0.050	$\sigma P2sec20$	0.197	0.061	$\sigma P1sec24$	0.208	0.124
eYsec35	0.153	0.020	$\sigma P2sec22$	0.169	0.030	$\sigma P2sec21$	0.196	0.023
$\sigma P2sec35$	0.150	0.065	$\sigma P2sec21$	0.155	0.017	$\sigma P2sec22$	0.191	0.030
eYsec30	0.149	0.039	$\sigma P2sec35$	0.154	0.061	$\sigma P1sec31$	0.172	0.036
$\sigma P2sec22$	0.140	0.027	eYsec30	0.149	0.046	$\sigma P2sec27$	0.167	0.015
$\sigma P2sec27$	0.111	0.009	eYsec35	0.145	0.021	$\sigma P2sec35$	0.153	0.057
$\sigma P1sec31$	0.101	0.023	$\sigma P2sec27$	0.139	0.012	eYsec30	0.135	0.057
$\sigma P2sec21$	0.099	0.014	$\sigma P1sec24$	0.139	0.102	eYsec23	0.128	0.039
$\sigma P1sec25$	0.089	0.063	$\sigma P1sec31$	0.128	0.029	eYsec35	0.127	0.021
$\sigma P1sec5$	0.079	0.053	eYsec23	0.098	0.032	$\sigma P1sec15$	0.111	0.019
eYsec23	0.078	0.027	$\sigma P1sec25$	0.093	0.067	eYsec1	0.105	0.079
$\sigma P1sec15$	0.073	0.010	$\sigma P1sec15$	0.091	0.014	$\sigma P2sec31$	0.102	0.014

**Table 7.B.37. First-order and total effect sensitivity indices obtained with N=256, with respect to the real GDP (neutral combined scenario)**

Parameters	First-order sensitivity indices ( $S_i$ )			Total effect sensitivity indices ( $S_T$ )			$S_T - S_i$		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
$\sigma P1sec1$	0.36	0.38	0.26	0.41	0.41	0.29	0.05	0.03	0.02
elasLS	0.24	0.35	0.49	0.24	0.35	0.49	0.00	0.00	0.00
eYsec3	0.21	0.15	0.13	0.21	0.15	0.13	0.00	0.00	0.00
$\sigma P2sec1$	0.15	0.10	0.10	0.20	0.13	0.12	0.05	0.03	0.02

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Het economische transitieproces dat zich tegelijk met de implementatie van het *acquis communautaire* gedurende de toetredingsonderhandelingen met de Europese Unie (EU) heeft afgespeeld, en de toetreding van Roemenië tot de EU op 1 januari 2007 impliceren ingrijpende institutionele en economische veranderingen die zorgvuldig moeten worden doordacht. Het beantwoorden van de belangrijke vragen die door de toetreding worden opgeroepen, vereist modern, krachtig gereedschap. Omdat die institutionele en economische veranderingen talloze dynamische en complexe interacties tussen economische actoren en sectoren te weeg brengen, kunnen deze vragen alleen beantwoord worden in een consistent kader dat op de economie als geheel betrekking heeft. Het algemene evenwichtsmodel dat in deze studie is ontwikkeld, reikt dat noodzakelijke gereedschap aan.

In *hoofdstuk 2* wordt een historisch perspectief geschetst van de recente economische evolutie van Roemenië dat het proces van voorbereiding op de toetreding tot de EU benadrukt. Het overzicht van fiscale en budgettaire ontwikkelingen illustreert de aanzienlijke vooruitgang die in 2004 op fiscaal gebied is geboekt door het invoeren van nieuwe belastingwetgeving. De evolutie van elk van de belangrijkste belastingenvormen (inkomstenbelasting, premie volksverzekeringen, vennootschapsbelasting, BTW, accijnzen en importheffingen) wordt geanalyseerd waarbij de nadruk wordt gelegd op het proces van harmonisatie van belastingen (in het bijzonder BTW en accijnzen) zoals gestipuleerd in hoofdstuk 10 (Belastingen) van het *acquis communautaire*, op de hoge wettelijke premies van de volksverzekeringen die ultimo 2003 ten uitvoer werden gebracht en op de noodzaak tot een belangrijke verlaging ervan om de prikkel tot belastingontduiking te verminderen. Op het gebied van de openbare uitgaven wordt de noodzaak tot het afschaffen van subsidies op openbaar vervoer besproken, evenals de moeilijkheden waaraan het stelsel van sociale zekerheid het hoofd moet bieden. Tegelijkertijd wordt, met het oog op de voorbereiding op de toetreding tot de EU, de noodzaak tot het verhogen van kapitaaluitgaven aan infrastructurele projecten benadrukt.

Het conceptuele kader van de toegepaste algemene evenwichtsanalyse (“computable general equilibrium”, afgekort tot CGE) wordt in *hoofdstuk 3* ontwikkeld. Er wordt getoond dat deze analyse in staat is om beleidsmakers te ondersteunen bij het evalueren van de effecten van verschillende fiscaal-budgettaire maatregelen. Er

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wordt een classificatie van gangbare CGE modellen gegeven, waarbij ingedeeld wordt naar theoretische achtergrond, incorporatie van dynamiek en naar technieken die gebruikt worden om de parameters te bepalen. Op grond van deze classificatie wordt de grote verscheidenheid aan CGE modellen en het brede spectrum aan toepassingen ervan geïllustreerd. Het overzicht van CGE modellen laat zien dat het gedesaggregeerde model dat in deze studie wordt gepresenteerd het eerste van dit soort is dat voor de Roemeense economie is ontwikkeld. Het laat ook zien dat het aantal CGE modellen dat zich richt op economieën van transitielanden relatief gering is.

De theoretische grondslagen van het CGE model voor de Roemeense economie (RoMod) worden in *hoofdstuk 4* besproken. We presenteren de gedrag - en definitievergelijkingen voor elke institutionele sector (de bedrijven, het huishouden, de overheid en het buitenland) en we geven de vergelijkingen voor het investeringsgedrag, de prijsvorming, de arbeidsmarkt en de overige macro-economische indicatoren. De analytische beschrijving begint met de statische versie van het model met een focus op de reële kant van de economie.

Er worden in RoMod 35 productiesectoren onderscheiden die elk één goed produceren. De technische karakteristieken worden gemodelleerd door vertakte productiestructuren die expliciet kapitaal, arbeid en vier soorten energiedragers (steenkool, aardolie, aardgas en elektriciteit) bevatten. De belangrijkste bronnen van inkomen van het huishouden zijn gespecificeerd, terwijl de consumptie is gedesaggregeerd naar de 35 goederen. De welvaartswinsten en -verliezen van het huishouden, veroorzaakt door fiscale beleidsmaatregelen, worden met behulp van de methode van de equivalente variatie (EV) in inkomen gekwantificeerd.

De structuur van belastingen en subsidies wordt gedetailleerd gemodelleerd, zowel op het niveau van sectoren als op niveau van de goederen. De sector overheid brengt enerzijds “publieke dienstverlening” als productiesector voort, waarbij gebruik wordt gemaakt van kapitaal, arbeid, energie en intermediaire leveringen. Anderzijds worden belastingen en premies geïnd (inkomstenbelasting, premies volksverzekeringen, vennootschapsbelasting, BTW, accijnzen, importheffingen en belasting op productie). Deze opbrengsten worden uitgegeven aan inkomensoverdrachten aan bedrijven en huishoudens (inclusief rentebetalingen over de overheidsschuld), subsidies op consumptie en productie, aankopen van consumptiegoederen en aan kapitaaluitgaven. Deze beide overheidsactiviteiten worden via de levering van de productiesector “publieke dienstverlening” aan de sector overheid met elkaar verbonden. Tevens worden primaire en conventionele budgettaire tekorten afgeleid.

De belangrijkste elementen van de betalingsbalans worden toegelicht in de verhandeling over de sector buitenland. Er wordt verondersteld dat er beperkte substitutiemogelijkheden zijn tussen binnenlands geproduceerde en geïmporteerde goederen en dat er onvolledige transformatiemogelijkheden zijn tussen goederen geproduceerd voor de binnenlandse markt en voor de exportmarkt.

De binnenlandse prijzen, evenals import - en exportprijzen in de lokale muntsoort zijn inclusief de handels - en transportmarges voor elk goed.

Arbeidsaanbod en werkloosheid worden endogeen gespecificeerd.

In de recursief -dynamische versie van het model wordt de endogene bepaling van investeringen en de accumulatie van kapitaal uitgelegd. De verwachte “rate of return” wordt in elke sector, met uitzondering van “publieke dienstverlening”, gespecificeerd als een inverse logistische functie van de proportionele groei in de kapitaalgoederenvoorraad van die sector. Investerings in de publieke dienstverlening zijn gelijk aan de kapitaaluitgaven van de overheid. De accumulatie van de binnenlandse en buitenlandse overheidsschuld wordt eveneens verklaard.

De constructie van de “Social Accounting Matrix” (SAM) van 2000 voor Roemenië wordt in *hoofdstuk 5* beschreven. Deze is gebaseerd op de methodologie van de ESA 95 die in 1998 door het Roemeense Nationale Instituut voor de Statistiek is ingevoerd. Dit betekende een belangrijke stap in de richting van de harmonisatie met de EU. Gegeven het gebrek aan bepaalde data worden een aantal veronderstellingen en beperkingen benadrukt. De SAM dient twee doelen: ten eerste is het mogelijk om in een consistent kader een analyse te maken van structurele verbanden die tussen de verschillende economische actoren bestaan en ten tweede is de SAM de database van RoMod .

Het kalibreren van het model wordt gedetailleerd in *hoofdstuk 6* gepresenteerd. Er wordt op een aantal zwakheden gewezen: de onbetrouwbaarheid van parameterwaarden, de afhankelijkheid van de kwaliteit van het model van de keuze van het referentiepunt (SAM 2000) en de beperkingen die op de structuur van het model wordt opgelegd door het kalibreren zelf. Na een bespreking van de voor- en nadelen van andere methoden om de parameters van een CGE model te schatten, blijkt de aanpak van het kalibreren toch de meest geschikte te zijn in een situatie waarin, zoals in Roemenië, slechts heel korte datareeksen beschikbaar zijn. Vervolgens wordt het kalibreren van de parameters van RoMod besproken. We gebruiken data uit de SAM 2000, evenals waarden voor de elasticiteiten. Bij gebrek aan econometrische schattingen van de meeste elasticiteiten voor Roemenië worden we gedwongen om gebruik te maken van schattingen voor andere landen. Deze aanpak brengt noodzakelijkerwijze met zich mede dat er een gevoeligheidsanalyse moet worden uitgevoerd om de robuustheid van de uitkomsten van het model met betrekking tot de keuze van de parameterwaarden vast te stellen.

De keuze van het gestage groeipad (“steady-state”) dat als basisscenario voor RoMod dient, wordt in *hoofdstuk 7* uitgelegd. Voor elk van de vijf belangrijkste fiscaal-budgettaire beleidsscenario’s worden gedetailleerde sociaal-economische en sectorale effecten gegeven. De eerste twee scenario’s bestaan uit de afschaffing van vrijstellingen van BTW, de invoering van de voor de EU geldende BTW-tarieven op bepaalde goederen en diensten, conform Annex H van de “Sixth Council Directive” (77/388/EEC), en de verhoging van de accijnzen op minerale oliën. Beide scenario’s streven naar de belastingharmonisatie zoals gestipuleerd in de *acquis communautaire*. Het doel van de volgende twee scenario’s is de herstructurering van overheidsuitgaven en bestaan uit het afschaffen van de directe subsidies op openbaar vervoer en een verschuiving van lopende uitgaven naar kapitaaluitgaven. Het vijfde scenario, ten slotte, is de combinatie van belastingharmonisatie en herstructurering van de overheidsuitgaven, zoals gepresenteerd in de eerste vier scenario’s, en geeft

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daarom het totale effect van de fiscaal-budgettaire maatregelen. Het maakt bovendien een taxatie van de duurzame houdbaarheid van de verlaging van de premies van de volksverzekeringen die de regering voor 2005-2006 beoogt in haar Pre-toetredingsprogramma van 2003.

Alle scenario's duiden op korte termijn op een aantal negatieve effecten op sectoraal niveau (in termen van winstgevendheid) en op welvaartsverliezen. Het effect op bruto binnenlands product (BBP) blijkt echter verwaarloosbaar te zijn. Op lange termijn tonen alle scenario's, met uitzondering van de verhoging van de accijnzen op minerale oliën, welvaartswinsten aan. Deze worden grotendeels bereikt via een stijging in de particuliere investeringen en een toename van kapitaalinkomens van huishoudens.

In dit hoofdstuk wordt ook de robuustheid van de keuze van de waarden van de modelparameters met betrekking tot de resultaten van de vijf beleidsscenario's geïllustreerd. Eerst wordt de methode van Morris voorgesteld om die parameters uit een grote lijst te selecteren die de meeste variabiliteit in de uitkomsten van het model, gemeten met de equivalente variatie (EV) van inkomens en het BBP in constante prijzen, veroorzaken. Door het rangschikken van parameters naar de invloed op resultaten levert deze methode een kwalitatieve indicatie op tegen lage rekenkosten. Vervolgens wordt de variantiedecompositiemethode van Sobol' gebruikt voor de gevoeligheidsanalyse. Vanwege de hoge rekenkosten worden alleen de invloedrijkste parameters, bepaald volgens de methode van Morris, in beschouwing gekomen.

Het gebruik van de methoden van Morris en Sobol' is een noviteit op het gebied van CGE modellen. Ze tonen allebei aan dat, hoewel veel parameters die een belangrijke invloed uitoefenen op de uitkomsten van het model *a-priori* verwacht werden, er nog vele anderen waren die zonder een dergelijke exercitie niet zouden zijn opgespoord.

De grote onzekerheid in parameterwaarden in beschouwing nemend, zijn de resultaten van de beleidsscenario's robuust met betrekking tot het BBP in constante prijzen. Wat betreft de EV in inkomen wordt in een aantal scenario's echter wat gematigde spreiding waargenomen. De methode van Sobol' wordt dan gebruikt om die parameters te identificeren die door het verkleinen van de spreidingsbreedte van de onzekerheid de grootste reductie in de variantie van de EV te weeg brengen. Toekomstig onderzoek dient zich dan ook te richten op een verbetering van het schatten van deze parameters.

In hoofdstuk 1 zijn een aantal onderzoeksvragen geformuleerd. Deze studie biedt als antwoord een consistent kader dat beleidsmakers in Roemenië kan ondersteunen bij het evalueren van een breed spectrum aan fiscaal-budgettaire maatregelen. Zij levert een bijdrage aan de discussie over de sociaal-economische kosten van de aanpassing van de belastingwetgeving en de herstructurering van de openbare uitgaven. Dit gebeurt door een aantal pre-toetredings beleidsscenario's door te rekenen met behulp van een toegepast algemeen evenwichtmodel (CGE). Zij geeft tevens een analyse van de structurele verbanden die tussen de verschillende economische actoren bestaan, waardoor er een beter begrip is ontstaan van de werking van de Roemeense economie.

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