Enhanced Cooperation in Corporate Taxation

ISBN: 9789036102582

Cover design: Crasborn Graphic Designers bno, Valkenburg a.d. Geul

This book is no. **512** of the Tinbergen Institute Research Series, established through cooperation between Thela Thesis and the Tinbergen Institute. A list of books which already appeared in the series can be found in the back.

Enhanced Cooperation in Corporate Taxation

Vergaande Samenwerking op het gebied van de Vennootschapsbelasting

PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Erasmus Universiteit Rotterdam
op gezag van de rector magnificus

Prof.dr. H.G. Schmidt

en volgens besluit van het College voor Promoties.

De openbare verdediging zal plaatsvinden op

donderdag 29 september 2011 om 15.30 uur

door

Hendrik Vrijburg
geboren te Rottevalle.

Promotiecommissie

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Foar ús heit, Willem Vrijburg

Preface

This thesis is the product of a lot of hard work during an intense four-year period and skills acquired during a two-year research master. I would not have been able to finish the thesis without the help of my close colleagues, friends and family.

To start, I want to thank my colleagues and the staff at Tinbergen Institute (TI) and the Fiscal Economic Institute (FEI) for offering excellent facilities that supported me during the process of writing this thesis. Especially the indoor soccer team at TI I appreciated much. The colleagues at FEI, next to their pleasant companion, broadened my view on taxation issues. I hope to work at the department for some years to come. I also want to thank the CPB Netherlands Bureau for Economic Policy Analysis for providing the opportunity, and the facilities, to visit CPB on a regular basis.

I want to thank my supervisor Ruud de Mooij. He suggested the topic of this thesis: enhanced cooperation. In the first three years of the writing process we had contact every week and discussed many ideas and results related to enhanced cooperation. This resulted in the first three chapters of this thesis. Besides his contributions to my thesis, I learned a lot from Ruud on the economics of taxation and teaching. These lessons will be of great benefit to me later on in my career. I enjoyed working with you a lot.

Unfortunately for me, Ruud left for a job at the IMF in the United States. I am very grateful to Leon Bettendorf to fill his space. Leon had an invaluable influence on the remaining chapters of my thesis, Chapters 5 and 6, which he co-authored. Leon helped me to focus my discussion, preventing me from following the abundance of ideas that always come up while writing. Without his help, the chapters would not have been finished in time. Besides work, I also had lots of fun during our conversations. Thanks for your cooperation and I hope we will produce numerous papers in the future.

Next to Leon, I also want to thank Albert van der Horst, who also works at CPB. Albert made a large contribution to this thesis because every chapter is discussed with him at some point in time. This improved the quality of the chapters substantially.

Although not directly involved in this thesis, three persons substantial influenced my development as an academic researcher. First of all Jenny Ligthart and Jan Jacobs

made me curious into doing economic research. They made sure I started the research master and continued my career in economic research. Our ongoing work has lead to my first academic publication, with the second being produced at the time of writing. Bas Jacobs his personality and thoughts are an important inspiration for my work in general. Bas has interesting ideas about almost every aspect of life, although his ideas concerning economics are the most relevant for this thesis and my work. Furthermore, both Jenny and Bas have commented on an earlier version of this thesis, comments which have improved the quality of the thesis and the subsequent papers. The enthusiasm of Bas, Jan and Jenny for the profession of being an academic economic researcher has been an inspiration for my current choices and will be in the future.

As my direct colleagues, Floris Zoutman and Aart Gerritsen have been an integral part of the process of writing this thesis. While enjoying a cup of coffee, we discussed various issues in the economics of taxation, philosophy, politics and whatever came across. Besides influencing my work and teaching, this made sure life at the university is fun! Next to that, we made some very memorable trips to conferences in Sweden and the United States. I hope we will continue to work together for some time to come. Rene Segers has been my roommate for more than two years. As our research interests are very dissimilar we talked about life in general which is of course much more interesting, and a welcome distraction from the serious business. In my final year at TI, Lukasz Gatarek made sure, when we met occasionally, that I will never forget the interesting history Poland.

I made it all the way until this point with the help and interest of my parents. They, and my parents-in-law, literally invested time in this PhD thesis by taking care of Thijs when I was occupied with deadlines. I thank them for that. I dedicate this thesis to my father, who can unfortunately not witness the result of my hard work in Rotterdam anymore. I know he would be proud of the result.

And to Marjan, my thanks for everything. She literally changed her life such that I could finish my PhD. Without her, I would not have so much fun in life and would, most likely, be an unhappy workaholic. I thank Thijs for making me happy every day after work. Due to Marjan and Thijs even the worst day at work ends happy for me.

Hendrik Vrijburg
Rotterdam, August 2011

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Chapter 1

Enhanced Cooperation in Corporate Taxation

1.1 Introduction and Motivation

In this thesis I study the harmful competition between national governments to attract multinational companies into their country, by designing a competitive corporate tax system. In particular, I study the solutions put forward by politicians to constrain this competition. Governments compete with each other for the investments of multinational companies to provide work for their citizens, or just because they want to tax the profits of these multinational companies. The thesis makes three main contributions. First, I try to measure, using a novel approach, how a change in the corporate tax system affects government finances in the country itself and in neighboring countries. Second, I develop a theory on how the government of a country changes its corporate tax system in reaction to changes in corporate tax systems abroad. Third, I analyse how solutions to constrain tax competition, affect corporate tax systems and welfare.

With respect to this latter issue, the thesis studies the prospects of an interesting new policy initiative which is labeled in popular terms "*Europe in two speeds.*" The idea is that a (partially) unified system of corporate taxation in a subgroup of European countries can be achieved, whereas the remaining countries in the European Union (EU) are free to choose their own corporate taxation policy. In the Treaty of the European Union (TEU) this is called an *Enhanced Cooperation Agreement* (ECA). However, before delving deeper into the subject, let me first stress the relevance of the topic of corporate tax competition through some numbers, popular arguments, and a brief historical perspective on the initiatives by the European Commission (EC) to constrain corporate tax competition.

1.2 Corporate Tax Competition

The 27 countries that form the EU as we know it at the time of writing, have 27 different systems of taxation. This because every country has the legal power to choose its own tax system and gratefully uses this power. The tax systems consist out of, amongst others: taxes on labor income, value added taxes, specific excises on certain goods (for example alcohol and gasoline) and a tax on incorporated firms: the corporate income tax.

This final category, taxes on incorporated firms, is the focus of this thesis. In short, all governments try to design their corporate tax system such that they attract firms and profits from abroad into their country.[1] Besides the large multinational companies, some of the smaller countries in the world, known as tax havens, benefit substantially from this phenomenon which is called tax competition. Politicians from all other countries claim that they lose substantial tax revenues and fear for future developments. Especially during the current fiscal crises, this is a troublesome development as the corporate tax is an important source of revenue for the EU members states, constituting between 5 and 15 percent of total tax revenues.[2]

To understand the discussions in this thesis, it is important to recognize that the corporate tax consist out of two components. The tax law defines both the legal tax base, which determines the part of income subject to taxation, and the tax rate that is applied to this tax base. Taxes paid to the government are equal to the tax base multiplied by the tax rate. The tax base for the corporate tax equals income of the firm minus its operating and interest costs. Exactly what operating and interest costs are deductible is determined by the tax law and differs by country. Furthermore, also the tax rate applied by the government differs between countries.

The ongoing process of globalization from the 1980s onwards has put pressure on the corporate tax systems. As barriers to trade lowered, at least within the EU, companies have more freedom in choosing their investment location. This implies that corporations are increasingly sensitive to the tax rules in the country of a prospective investment location. Furthermore, increased mobility of capital and financial innovations have increased the opportunities to reduce the tax bill via financial constructions. Both developments imply that, from the perspective of the government, the corporate tax base has become more elastic over time leading to lower corporate tax rates over time. This average reduction in

[1] This sentence ignores a number of important other objectives that determine the corporate tax system in a country, for example: the back-stop of function the corporate income tax, the benefits-principle of the corporate income tax and political constraints. See the methodological notes at the end of this introduction for a short discussion.

[2] Based on 2007 OECD data on general government. Norway with the highest revenue (26 percent) is excluded due to massive oil revenues.

corporate tax rates is often labeled the tax competition dilemma. Each country lowers its tax rate, because it is afraid it will lose part of its corporate tax base to other countries if it does not follow the tax reductions that are, expected to be, planned abroad. To partly compensate for this, countries have on average broadened their tax base since the 1980s: stricter fiscal depreciation rules and more restrictions on the interest cost deductibility. Globalization and the related competition on fiscal rules have therefore affected both the statutory tax rate and the rules governing the corporate tax base.[3]

At the end of the day, all countries have lowered their (effective) tax rate and therefore have less tax revenue.[4] However, if all countries reduce their rate by the same amount, companies have not changed their investment and financial policies at all. This is the intrinsic dilemma, countries are caught in their expectations regarding the behavior of others, which in the end become true. Policymakers and economists fear that, in the long run, tax competition might erode corporate tax revenues and, in doing so, undermine the welfare state:

> "The losers of tax competition will be those who cannot escape and those who benefit from a large government sector. The first group includes immobile workers and landowners. They are the natural victims of the Tiebout equilibrium, since they will serve as the lenders of last resort to Europe's impoverished governments. The second group consists of the poor. The poor will lose because governments will no longer be able to maintain their current scales of redistribution.[Sinn (1990)]"

How to solve the tax competition dilemma? When reducing its tax rate to attract investments and profit from abroad, the government acts selfish. This because tax revenues are reduced in the other countries. This dilemma can only be overcome through cooperation. When the countries negotiate over a joint corporate tax system, they take the adverse effects of their tax policy on neighbors into account, and jointly decide on a corporate tax system that yields higher welfare. This is the first argument forwarded by economists and politicians in favor of tax harmonization (another word for cooperation, the terms are used interchangeably).

A second and third argument comes directly from the 27 different corporate income tax systems within the EU (see Eurostat, 2009). The average statutory tax rate in 2010 is equal to 23 percent but with a wide variation. Some countries have tax rates over

[3] Chapter 3 will elaborate on the development in corporate tax systems in OECD countries from the 1980's onwards.

[4] An effective tax rate is a summary measure of the tax code, which covers both the statutory tax rate and the fiscal rules that define the tax base. See Devereux, Griffith and Klemm (2002) for a discussion.

30 percent (Germany, France and Italy), while others have a rate below 15 percent (for example Ireland and Estonia). In general, larger countries have higher statutory tax rates compared to small countries, as will be explained in this thesis. Besides these differences in statutory tax rates, also the rules determining taxable income differ widely. For example, Belgium allows since 2006 an imputed return on equity to be deductible from income while all other countries tax the full return on equity. On the other hand, all European countries restrict the deduction of interest expenses to some degree.

All these differences in corporate taxation rules between EU countries in particular, and between countries in the world in general, affect multinational corporations in two important ways. First of all, as mentioned above, the investment decisions by the multinationals will be affected by the differences in taxation rules. This leads to an inefficient allocation of investments across countries, because decisions are not solely driven by fundamental differences in investment opportunities across countries, but partly by tax induced benefits. Second, firms spent resources on tax advisors in order to comply with 27 different tax laws in an efficient manner. These tax compliance costs are unproductive from a social point of view and could better be spent on activities with a higher social value. The inefficient allocation of investments and the tax compliance costs are the second and third argument forwarded by economists and politicians in favor of tax harmonization. This because a harmonization of corporate taxation rules across countries removes the relative advantage of investing in a particular country for taxation reasons: all have the same rules, investments are allocated efficiently across countries. Furthermore, if taxation rules are identical, firms might spent less resources on tax advisors and can use these resources in a socially more productive way.

Are there only advantages from tax harmonization? No, the advantages of tax diversity should not be ignored. Citizens from different countries might have different views on the optimal size of government. Citizens from countries that are more right-wing orientated like the United States, prefer a small government that can be financed with relatively low taxes. On the contrary, citizens from countries that are more left-wing orientated, like the Scandinavian countries, prefer a larger government that provides a reasonable standard of living for all citizens, financed by higher taxes on average. These heterogeneous preferences for optimal tax levels are reflected in heterogenous tax systems. Harmonization will impose an undesired uniformity from this point of view (see Cnossen (1990)). Furthermore, a school of thought from the public choice literature, see Brennan and Buchanan (1980), argues that governments have a tendency to grow too large from a welfare perspective. Such a government is labeled “Leviathan” in the public choice literature, it partly values personal objectives that are not aligned with the interest of

society. Therefore, competition between governments is needed to discipline politicians (see Salin (1990)). Cooperation between governments removes this disciplining force. Finally, decentralized policy making provides opportunities for governments to learn from each other. A large bureaucratic government is less likely, compared to smaller decentralized governments, to develop innovative efficient policies to solve new problems that arise when technological progress changes opportunities for firms and individuals to evade or avoid the tax law. This argument is often ignored in the corporate taxation literature, but might be important though (see Bovenberg and Tanzi (1990)).

The above arguments feature prominently in the literature already from the 1990s onwards. Bovenberg and Tanzi (1990) and Sinn (1990) expected that tax harmonization would be inevitable. In the 20 years that followed these publications, the arguments in favor and against corporate tax harmonization have not fundamentally changed (see Griffith, Hines and Sørensen (2010) and Nicodeme (2006) for recent reviews), a clear-cut conclusion is still missing though. The policy debate is even older. Already 50 years ago in 1962, the Ruding report concluded that some form of corporate tax harmonization is desirable. However, in the 50 years that followed this report, the member states have failed to come to an agreement on the future of corporate taxation within the EU. The following subsection provides a brief overview of the developments since the 1960s.

1.3 A brief History of Coordination Initiatives

Corporate income tax harmonization within the EU has a long history (see Easson (1992)). The first milestones are the reports by Neumark in 1962, Segré in 1966, and Van den Tempel in 1970. All three reports concluded that some degree of harmonization of the corporate income tax legislation is desirable. Neumark stressed the need to alleviate double taxation of the return on equity by introducing a split-rate system; Segré urged for the removal of taxes that work against an integrated capital market; and van den Tempel concluded that the EU should adopt a classical corporate income tax system instead of an imputation system or a split-rate system, mainly for reasons of simplicity. In the aftermath of each of the reports, the EC experienced that harmonization initiatives would be politically difficult, due to the unanimity requirement for tax policy decisions and an expected outflow of profits towards tax havens. The 1975 Draft Directive on Corporate Income Taxation by the EC reflects these concerns. The directive proposed an imputation system for the corporate income tax such that foreign capital owners are

refunded.[5] Furthermore, the report proposes a restricted range for statutory tax rates between 45-55 percent and a harmonized dividend withholding tax at 25 percent.

The more recent harmonization proposals start in 1992 with the Ruding Committee (see EC (1992)). This committee concluded that community action is necessary given large economic distortions due to differences in corporate income tax systems in the EU. However, national sovereignty should be taken into account at least until the Economic and Monetary Union (EMU) is completely finished. The committee proposed a number of policy directions. It proposed a lower bound on corporate income taxes around 30 percent and a maximum around 40 percent. Furthermore, tax-base harmonization should be achieved and harmful tax practices, like discriminating withholding taxes, should be abandoned (this latter point is also stressed by the OECD (1998)).

Only the final recommendation has been implemented in the EU as of 2010 with the agreement by the EU member states on a Code of Conduct on business taxation in 1998. The code stipulates that countries should not discriminate between industries in their tax laws. Specifically, they agreed not to discriminate between residents and non-residents; not to grant tax advantages to firms without substantial real economic activity within the borders of the country; not to depart from international standards in the definition of profit; and to apply transparent administrative procedures in enforcing taxation. A total of 66 "harmful" tax measures are identified and should be removed before 2008. See Eggert and Haufler (2006).

The Bolkenstein report in 2001 (EC (2001)) has given rise to the present view on corporate tax harmonization by the EC. In general, the report calls for a uniform set of rules regarding the definition of corporate taxable income across countries and postpones the initiatives on tax rate harmonization. Substantial welfare gains are expected from the former, while the latter is deemed not achievable in the medium term. The proposal of a Common Consolidated Corporate Tax Base (CCCTB) originates from this report. In short, under the CCCTB the consolidated profits of EU-wide operating multinationals will be divided across EU member states using a pre-determined formula. Each members state can subsequently apply an own statutory tax rate to its share in this the tax base. Important is the conclusion Jensen and Svensson (2004), who suggest that full cooperation between all member states is unlikely to materialize; enhanced cooperation between a subset of countries is the most likely route towards tax cooperation. This conclusion is not surprising since the political landscape has become ever more complicated because

[5]Under an imputation system a tax credit is provided, to the dividend recipient, for (part of) the corporate taxes already paid when calculating the personal income taxes on the capital income. This to alleviate double taxation, see Auerback, Devereux, and Simpson (2010).

harmonization initiatives are negotiated amongst an increasing number of member states (6 in 1960, 27 presently). As a result, harmonization initiatives have become less ambitious over time, meaning that they leave more and more room for unilateral corporate tax policy for the member states.

This policy direction is stressed in a number of recent communications by the EC. Monti (2010) states: "[w]ork towards a common definition of corporate tax bases replacing the plurality of rules existing in each of the Member States, dates back to 2001. The specific design of the proposal requires a careful attention, but the time seems mature to move forward." This advice is followed by EU Commissioner Algirdas Šemeta in his "Smart Tax Agenda for Europe" on June 29, 2010. Šemeta presented on March 16 2011 a proposal for base harmonization along the lines of the CCCTB (see EC (2011)). As there is strong opposition to this initiative (Ireland and the United Kingdom), Šemeta considers an ECA among a subgroup of countries instead of all 27 member states.[6] The developments in 2011 mark both the end of my review of the EU policy discussion and the starting point of my thesis.

1.4 Research Question and Summary

In this thesis I study the policy initiative of Commissioner Šemeta which is labeled in popular terms "*Europe in two speeds*," and in the Treaty of the EU as an Enhanced Cooperation Agreement (ECA). The idea is that a (partially) unified system of corporate taxation within a subgroup of European countries can be achieved, whereas the remaining countries in the EU are free to choose their own corporate taxation policy.

Commissioner Šemeta is right in that an ECA might be a first political step towards more tax cooperation. But the economic literature has not yet come to an agreement on the benefits from ECAs in terms of economic efficiency and increased welfare. Which countries will participate in an ECA? Do we expect welfare gains for the countries that participate? And what happens to welfare of those that do not participate?

To answer these questions, a theory must be developed that predicts how the participating governments (the insiders) will chose the unified system of corporate taxation, and how the non-participating governments (the outsiders) will react to this unified system of taxation. This because, as the reader can infer from the introduction above, it are the choices made by governments that are key to the problem of tax competition. Therefore, to understand how cooperation will improve welfare, one needs to understand these choices thoroughly.

[6] See "Controversieel EU-plan winsttaks," Financieel Dagblad, February 18, 2011.

The literature on corporate tax harmonization has largely side-stepped this issue that is fundamental to the discussion of the welfare gains fom cooperation between countries (see Chapter 2). The papers either study full harmonization, in which case there are no outsider countries, or assume that outsider countries raise their tax rates in response to an increase by the insider countries (this is called strategic complementarity in the economic literature). On the other extreme are papers that study enhanced cooperation in a very detailed model in which governments are not allowed to choose their own tax systems, the tax systems are exogenously determined by the authors.

This thesis takes a position in between these extremes. I allow governments to re-optimize their tax rates after an ECA is established (Chapters 4 and 6), they are allowed to either raise or lower their tax rates and I study the arguments underlying their choices (Chapter 4 and 5). Furthermore, I model countries that are asymmetric in population size. The differences in population size causes the governments of these countries to disagree on the optimal unilateral tax policy, this resembles the political struggles observed in the real world.

Before developing the theory, I try to estimate the impact a tax policy change in one country has on the government finances (the corporate tax base) of another country. This is important because the tax competition problem only exists if these interdependencies exist.

As mentioned, next to this introduction, the thesis consists of five chapters. Chapter 2 reviews the literature. Thereafter, first Chapter 3 presents empirical estimates stressing the cross-country tax spillovers in corporate taxation are important and hence tax competition exists. Based on this evidence, Chapters 4-6 develop theory on strategic tax setting and apply this to enhanced cooperation agreements while allowing countries to differ in size. The chapters are summarized in the following section.

Chapter 2: Review of the Literature

Chapter 2 provides an overview of the literature on corporate tax competition and enhanced cooperation agreements, where the focus is on the latter. Various authors have reviewed the literature on tax harmonization, but none have focused explicitly on enhanced cooperation within a subgroup of countries. After introducing the standard tax competition model with all its extensions and discussing the legal framework for creating an ECA within the EU, the chapter presents some lessons from the enhanced cooperation literature.

The chapter explains that enhanced cooperation leads to smaller welfare gains compared to harmonization between all countries because part of the gains from cooperation

are "exported" to outsider countries. Furthermore, the chapter explains that it might be impossible for countries to reach an agreement that is accepted by all countries. The key insight here is that each country has a unique "outside option". The gain from cooperation between all countries, the grand coalition, might well be smaller than the sum of payoffs from the best deviation strategies for all countries. In this case, it is impossilbe to buy-off all best-deviation strategies. This stresses the relevance of studying enhanced cooperation. We might never end up in the grand coalition after all.

Furthermore, the review stresses that the choices made by the insider and the outsider countries are crucial in determining the ultimate payoff from cooperation. The policy changes by the insiders must benefit the outsiders and vice versa to obtain an unambiguous welfare gain from coalition formation. In terms of tax competition this implies that corporate tax rates must be strategic complements, the standard assumption in the tax competition literature. Furthermore, after a coalition is established, it might be very hard to change it in the future. Coalition formation might be path-dependent.

Finally, Chapter 2 summarizes the results from a few simulation studies that cover coalitions between subgroups of countries. These studies show that the welfare gains from enhanced cooperation are smaller compared to the welfare gains from the grand coalition (0.05 percent of GDP compared to 0.20 percent of GDP). The welfare gains from implementing a CCCTB within a subgroup of countries are even close to zero. This is explained by the newly introduced distortions through the CCCTB which replace the old distortions under separate accounting. That is, the CCCTB makes profit-shifting between the participating countries impossible, but it induces firms to manipulate the formula that divides consolidated profits.

This final result, no gains from introducing the CCCTB, raises the question why the EC is interested in implementing the CCCTB. Are there important arguments missing? A first missing argument might be the tax compliance costs which are commonly assumed to be reduced through the implementation of the CCCTB. However, no consensus estimate exists in the economic literature and whether compliance costs go down is debatable. A second missing argument is discussed in the theoretical chapters in this thesis: strategic tax setting. But fist, Chapter 3 discusses empirical evidence on cross-border taxation spillovers.

Chapter 3: Is there Significant Cross-Country Income Shifting?

In Chapter 3 a macro-economic data set covering 19 OECD countries between 1983 and 2005 is used to study cross-country taxation spillovers in corporate taxation. As stressed before, corporate taxation spillovers are needed for the existence of corporate tax com-

petition itself. The chapter uses an econometric approach that is novel for the literature. The dependent variable in this study is corporate taxable income, a rough measure for the actual tax base for the government. This dependent variable is regressed on measures of the home corporate tax system and some measure of the corporate tax system of neighboring countries. Especially this latter variable is often neglected in the literature. Neglecting this variable might lead to an omitted variable bias. Furthermore, I correct for time persistency in the data, which is important, but also often neglected.

The chapter shows that indeed significant cross-country taxation spillovers exist for the statutory corporate tax rate. The results suggest a (negative) long-run elasticity of corporate taxable income in the range $0.86-1.56$. For marginal tax rates the cross-country taxation spillovers are much smaller or insignificant, in the range $0.35-0.5$. Surprisingly, the (positive) elasticity estimates following for the weighted foreign instruments are larger, in the range $1-2.5$ for the statutory rate and in the range $0.7-1.1$ for the marginal tax rate. This is surprising because I expected that the home corporate tax burden would measure both tax base erosion following from domestic distortions and tax base erosion from international reallocation of profits and capital. The foreign tax burden should only measure the latter source of tax base erosion. Potentially, the small data-set is key in explaining this finding, some important countries are missing. Furthermore, the addition of thin-capitalization rules to the panel might be important. However, the findings do stress the relevance of the study into corporate tax competition, which the following sections will delve into theoretically.

Chapter 4: Optimal Capital Tax after Enhanced Cooperation

An important limitation of the studies summarized in Chapter 2 is that tax policy before and after the formation of a coalition is either exogenously imposed or tax rates are assumed to be strategic complements cross-country (see for example Bucovetsky (2009) and Hoyt (1991)). For example, it is implicitly imposed when governments are assumed to maximize tax revenues (as in Bucovetsky (2009)). To see this, note that if a country has a government that wants to maximize tax revenues, this government is only interested in choosing a tax rate on the top of its Laffer curve.[7] Furthermore, the tax base of this country is increasing in the tax rate of any other country, due to an inflow of profits

[7]The term Laffer curve originates from the economist Arthur B. Laffer who argued that the taxes raised by the government of the United States where so high that a tax reduction would lead to an increase in tax revenues. The idea is that tax revenues are roughly speaking a parabolic function of the tax rate. At low tax rates tax revenues increase in the tax rate. However, at some point, a higher tax rate leads to so much base erosion that zero additional revenues remain, this is the top of the Laffer curve. Higher tax rates lead to lower tax revenues. See Rosen and Gayer (2008) p. 423, and Laffer (1979).

and/or capital (see Chapter 3). As a result, the Laffer curve of this country expands when a neighboring country increases its tax rate and, hence, it is optimal to choose a higher tax rate. This argument will return time and again in this thesis. It is the cause of endogenous tax elasticities for the government of a country, and underlies the argument of strategic complements between countries.

Assuming strategic complements is unfortunate as especially the choices made by insider and outsider countries are fundamental for the welfare gains from forming a coalition. Therefore, a closer look on this issue is important. Chapter 4 therefore assumes that the government maximizes welfare, which is a very reasonable assumption. In this case, in choosing its tax rate, the government not only cares about the tax revenues, but also on how the citizens value additional tax revenues. Assuming tax revenues are a normal good, the marginal social valuation of tax revenues is decreasing in tax revenues. When this is the case, the foreign tax increase will reduce the marginal social valuation of tax revenues, because tax revenues increase even when the government of the home country does not change its tax rate. This leads to an incentive to reduce the tax rate, which counter-acts the argument put forward from the perspective of a tax revenue maximizer. When the latter argument dominates, tax rates are strategic substitutes, whether this is the case is an empirical question that is not answered in this thesis. However, given that welfare maximization seems a very reasonable assumption it cannot at all be dismissed completely.

Thereafter, I use this argument in the classical asymmetric corporate tax competition model to study the formation of coalitions in a three country model where governments, unilaterally or cooperative, choose a unit-specific capital tax such that the welfare of a representative agent is maximized. This reveals a number interesting insights. First, I find that strategic complementarity dominates for countries that are initially close to the top of their Laffer curve, as this signals a high valuation for additional tax revenue at the margin. These countries are eager to increase their tax revenue. Countries that are initially far from the top of their Laffer curve are relatively satiated from tax revenues and are therefore more likely to reduce their tax rate when confronted with a broadening of the tax base.

Furthermore, when tax rates of insiders and outsiders are strategic substitutes, either the cooperating countries or the outsider country experiences a welfare loss following the formation of a coalition. The former occurs when the insider countries do not take into account that the outsider might reduce its tax rate upon the increase by the insiders. The latter occurs when they do take this into account, in this case they might even reduce their tax rate after they enter into a cooperation agreement.

Welfare gains are larger when large countries form a coalition as the internalized cross-country spillovers are larger in that case. But this larger welfare gain comes at the cost of a reduction in allocative efficiency. When large countries form a coalition, the tax differentials between insiders and outsiders are widened and the allocation of capital is worsened. The reverse holds in case small countries cooperate. The allocation of capital is improved but the aggregate welfare gains are smaller.

Chapter 5: Tax Competition with Two Corporate Tax Instruments

Chapter 4 employs a unit-specific capital tax whereas corporate tax policies are characterized by two parameters: a statutory tax rate and a definition of the tax base.[8] Given the interest by the EC in the harmonization of the tax base while leaving statutory tax rates uncoordinated, this distinction is relevant. Therefore, Chapter 5 develops a model with two countries that differ in population size, in which a government maximizes welfare by choosing two corporate tax instruments (the statutory tax rate and the definition of the tax base). The definition of the tax base is modeled as the fraction of the cost-of-capital that is tax deductible. I study both the optimal tax rates decided on by the governments, and how the governments respond to changes in the corporate tax system of their neighbor.

In accordance with the literature and empirical evidence, the two corporate tax instruments are substitutes in the optimal tax policy mix for the government of a particular country. This implies that when the government of a particular country, for some exogenous reason, decides to increase one of the two tax instruments, it will reduce the remaining tax instrument. The reason is that when a lower fraction of the cost-of-capital is tax deductible, firms will re-allocate capital to the other country. This lowers the tax base of the statutory tax rate. Following the, by now, familiar argument, this leads to a lower optimal statutory tax rate. Also the other way around the argument holds. The statutory tax rate determines the reduction in tax revenues that follows upon an outflow of capital. An increase in the statutory tax rate increases this reduction, this causes the government to choose a larger fraction for the tax-deductible cost-of-capital (a smaller distortion of marginal investment decisions).

Furthermore, in the absence of a decreasing marginal valuation of tax revenues, tax instruments are never substitutes across countries. In other words, upon an increase in either one of the tax rates of another country it is never optimal to reduce the tax rates

[8]Note the distinction between the definition of the tax base, this is something government decides on, and the tax base itself. The latter follows from the production decisions of firms and is the equivalent to the aggregate corporate taxable income that is used a dependent variable in Chapter 3.

at home. The intuition is that an increase in the foreign rate expands the tax base at home which implies that it is optimal to increase the home rate. Finally, small countries respond fiercer than larger countries. The intuition here is that upon a tax rate increase in a large country, the small country is confronted with a relative large inflow of capital or profits which triggers a relative fierce response. Whereas in the reversed situation the inflow of capital and profits is relatively small and hence triggers a small response. Finally, the conclusions from Chapter 4 carry over, the less the government is interested in raising additional tax revenues, the less fierce it will respond.

Chapter 6: Enhanced Cooperation with Two Corporate Tax Instruments

Chapter 6 uses the insights and the model from Chapter 5 to study coalition formation in a three country model where governments choose the corporate tax policy such that the tax revenue is maximized. Most importantly, the chapter gives some insights into how the proposal by the EC would affect corporate tax systems. Recall that the proposal by the EC states that a subgroup of countries might agree on a coordinated definition of their tax base, in the model this translates into a coordinated fraction of the cost-of-capital that is tax deductible. Statutory tax rates are left uncoordinated.

The chapter shows that coordination on only one out of the two tax instruments always yields less additional tax revenue compared to cooperation on both tax instruments. The reason for this is that, while the cooperating countries raise the coordinated tax rate, the un-coordinated tax rate is reduced. In case of the proposal by the EC, this implies that countries would allow a smaller fraction of the cost-of-capital to be tax deductible but they would also lower their statutory tax rates. Interestingly, the results presented show that coordination on the tax definition of the tax base might raise substantial tax revenues compared to coordination of statutory tax rates because, in the model, more revenue can be raised by allowing less generous tax deductions than from changing the statutory tax rate. Whether this assumption is reasonable is an empirical question.

The countries that decide not to join in with the proposal from the EC are expected to follow the cooperation countries and allow less generous tax deductions as well (cross-country complementarity). In addition, they raise their statutory tax rate. This because capital flows from the cooperating countries to the non-participants, which broadens the tax base for the statutory rate for non-participants. Note that both responses are predicted in Chapter 5. Interestingly, this implies that policy coordination of this type will lead to optimal European tax systems to move into the direction of a Comprehensive Business Income Tax (CBIT).

I must stress that I did not yet analyse the implications of introducing the CCCTB within this model. This is non-trivial as introducing the CCCTB would change all taxation spillovers within the model. I expect that it will lead to an outcome in between the case in which the definition of the tax base is coordinated and the case where both tax instruments are coordinated. This would suggest a substantial increase in tax revenues due to higher tax rates.

Note that this argument is not taken into account in the detailed simulation studies mentioned in Chapter 2. When currently corporate taxes are too low through tax competition, this can be the most important gain from tax policy coordination in the EU. Introducing welfare maximization might affect the conclusions through argument introduced in Chapter 4. Also the other lessons from Chapter 4 carry over. When large countries cooperate, the increases in tax revenues are larger. However, the allocation of capital becomes less efficient if two large country coordinate their tax base. Furthermore, if large countries coordinate their statutory tax rates, MNEs will spent more resources on profit-shifting.

1.5 Conclusions

This thesis studies how welfare in the EU is affected by the harmonization corporate tax systems in a subgroup of EU countries, for example via the CCCTB. To that end, I open the black-box of the tax competition model to understand how countries will change their tax policies after such a proposal is enacted. This is a fundamental determinant for the welfare gains from corporate tax harmonization via enhanced cooperation. The thesis shows that the harmonization of corporate taxes in a subgroup of EU countries does not yield an unambiguous welfare gain.

> "Trading of the efficiency gain from corporate tax harmonization against the resulting loss of national autonomy is a matter for politicians, but the economic analyst may help them to make informed decisions." [Sørensen, 2004b, p. 108]

This thesis contains a number of lessons that policymakers might take into account when making their decisions. I summarize them below.

First, the thesis shows that coordination of corporate taxes will influence optimal tax policies of both the cooperating countries and the non-cooperating countries. I show that substantial welfare gains might result from this re-optimization of the tax system. When tax instruments are strategic complements, the standard assumption in the literature, enhanced cooperation will unambiguously be welfare improving because all countries raise

their tax rates. These gains are not counted in most detailed simulation studies and thus might provide a source for a welfare gain from enhanced cooperation with a CCCTB.

However, the thesis stresses that when for some countries the marginal public valuation of tax revenue is decreasing in the level of tax revenue, strategic complementarity is not guaranteed. Cooperation might lead to reduced tax rates in either the cooperating countries or the outsiders to such a coordination agreement. There are only a few empirical studies into strategic tax setting with corporate taxation which provide insights into the correlation of corporate tax policies over time and across countries. These studies suggests that corporate tax policies are strategic complements on average. However, those studies do not inform us on the long run response to a major policy shock such as an ECA and do not exclude the possibility of some countries acting as a strategic substitute. The assumption that the marginal valuation of tax revenues is decreasing in tax revenues seems very reasonable given that public goods are normal goods. With respect to corporate taxation, it might be observe in the data when countries are confronted with a major policy shock that increases tax revenues in some countries substantially.

To summarize, the thesis shows that the government objective matters for strategic tax setting and therefore for the welfare gains from enhanced cooperation. The thesis shows that welfare maximization makes it less likely that tax harmonization agreements will be initiated. Recognize that when governments are tax revenue maximizers with respect to the corporate tax, tax rates will be too high from a welfare perspective. In this case, harmonization itself might deteriorate welfare whereas tax competition might improve welfare.

Second, efficiency arguments, an improved allocation of resources including lower compliance costs, are often used to defend corporate tax harmonization. But this thesis shows that enhanced cooperation does not guarantee an improved allocation of resources. The allocation of capital and profits will deteriorate when the large EU member states cooperate while the small countries decide on their tax policies unilaterally. Given that especially large countries benefit from coordination of tax policy, this raises doubt on the efficiency arguments in favour of enhanced cooperation.

Third, cooperating on a subset of corporate taxation instruments yields smaller increases in tax revenue compared to cooperation on all corporate taxation instruments. In addition, cooperation by all countries yields larger tax revenues compared to cooperation between a subset of countries. This suggests that the proposal by the EC as discussed above, does not yield substantial additional tax revenue. However, the thesis shows that enhanced cooperation on the definition of the corporate tax base might increase revenues substantial when the aggregate cost-of-capital is substantially larger than the aggregate

above normal return. The reason is that the aggregate cost-of-capital is the tax base for the definition of taxable income. The larger this aggregate cost-of-capital, the more attractive it is to harmonize the definition of tax base. The policy conclusion is that when politicians decide to cooperate, the should, ceteris paribus, cooperate on the broadest tax base.

Furthermore, some arguments call for caution when pursuing enhanced cooperation in corporate income taxes because the subgroup to be formed does not arise by coincidence. Especially, in case the average efficiency gains from cooperation are small, one should be suspicious if an agreement between a subgroup of countries comes through. The countries that stay out of the agreement most likely expect to benefit from this in the long-run. The formation of a coalition will create new vested interests. If an ECA is established, it implies that the members benefit from this agreement, this might signal a reluctance to change the agreement in the future. This leads to the so-called status quo bias. In this case, the ECA is not a first step towards a grand coalition of all countries. Instead, the ECA might be the end point of the harmonization process.

To end, I want to remark that the principle of subsidiarity should never be forgotten. The principle states that national governments should take care of policies unless the EU can do substantially better. To me, it is not clear that the EU will do substantially better in terms of taxing corporations. I might be in favour of a full EU-wide system of corporate taxation as such a system would improve the allocation of capital within the EU. The proposal by the EC is far from that, even multinational companies are free to decide whether they want to participate. The EC should be careful not to design a system that causes the winners of today's system of corporate taxation to become even bigger winners tomorrow and vice versa for the losers. Remember that whenever loopholes exist in a taxation system, smart individuals (either within companies or in government) will find them and take advantage. The current proposals, due to political pressure, have loopholes by definition because the winners of today want to be the winners tomorrow. The losers today should realize that they, most likely, will therefore still be the losers tomorrow.

1.6 Methodological Notes

Throughout this thesis I make some implicit assumptions that are both non-trivial and need some discussion.

1. First and foremost, the theoretical models in this thesis do not address the question whether capital income should be taxed at all. I simply assume that the capital

tax, or the corporate tax, is the marginal financing instrument for the government and should therefore be used. This is a standard assumption in the tax competition literature. Introducing lump-sum transfers would lead to the result that it is not optimal to use the capital at all, because lump-sum transfers do not have any economic distortions. To find positive optimal capital taxes in the presence of lump-sum transfers, I must include additional arguments in the model. Redistribution can be an argument for an optimal positive capital tax, both to complement redistribution through the labor income tax, and in performing a back-stop function to this labor income tax. This back-stop function of the capital tax is important in order to prevent income, that should be taxed under the labor tax, to be converted into capital income (see de Mooij and Nicodeme (2008)). As the thesis focuses on tax competition and the tax distortions between countries, I abstract from these considerations in the theoretical chapters of the thesis.

It is important to stress that also in a more detailed model in which the government maximizes welfare, the corporate tax will remain to be the marginal financing instrument for the government. This because, all tax instruments are marginal financing instruments on the margin for a welfare maximizing government. Assuming tax revenue maximization on account of the government, an assumption often made in the literature and in Chapter 6 of this thesis, is a simplification from the more general assumption of welfare maximization. Only in case a government is truly Leviathan this assumption is valid for describing the choices made by the government on the long run.

2. In this thesis, I model asymmetry by assuming that countries differ in population size (labor endowment). This implies that larger countries have a larger influence on the international capital market and have a larger share in the absolute volume of global profit. In particular, the multinationals modeled in Chapters 5 and 6 are in absolute size proportional to their population (because output is defined on a per-capita basis). These multinationals shift profits between countries. To be consistent, I decided to also model the probability that tax evasion is detected in per capita terms (see Chapters 5 and 6 for further discussion). This probability increases when the per-capita volume of profits shifted is increased. This implies that a larger multinational can shift a larger absolute volume of profit for the same expected (per capita) costs in terms of penalties. This assumption drives the asymmetric results in the chapters. When the other extreme position is taken, profit-shifting is penalized based on the absolute volume of profits shifted, the optimal corporate tax system

will feature low statutory tax rates in the larger countries. This is not in accordance with empirical evidence presented in Chapter 3. I therefore prefer the assumption used.

In addition, some papers in the literature study asymmetry in the endowment for capital. These papers compare tax policy in countries that for some exogenous reason have high capital endowments per capita. This does not affect the main arguments in the chapters qualitatively. Corporate tax policy would still be determined by the arguments presented. The same is true for asymmetries in the preference for public goods, it would not change the main arguments qualitatively. However, changing the source of asymmetry would affect the various equilibria quantitatively, and the resulting benefits from enhanced cooperation.

3. The theoretical chapters of this thesis focus on a three country model and assume that two of these countries, which are similar in size, cooperate. Cooperation is imposed exogenously. I study a three country model because for larger numbers of asymmetric countries the problem is hardly manageable. This problem is described by the "Bell " number, which describes all possible coalition structures that follow from a given number of countries. For two countries, there are only two coalition structures possible (singletons and the grand coalition). For three countries, there are five different ways in which coalitions can be formed. For four countries there are fifteen different combinations, for five countries fifty-two and for six countries already two-hundred and three.

   From these five different combinations, I exclude the coalition structures where a small and a large country end up in a coalition. Such a coalition would raise the question how two asymmetric countries choose their joint tax policy. This adds a new layer of complexity to the model. Intuitively, the optimal tax rate will be somewhere between the optimal policies of the cooperating countries, but strictly higher than the tax rate in the smallest country. It may now be the case that one of the two countries does not experience a welfare gain from this cooperation.

   Finally, in order to study the question why the countries would be interested in cooperation in the first place, or whether the coalition studied will not break down, one needs a dynamic model. I do not touch upon this issue in this thesis, but assume that the coalitions imposed are stable. See Brangewitz and Brockhoff (2011), and Itaya, Okamura, and Yamaguchi (2008 and 2010) for tax competition in a dynamic model, who prove that some coalitions are indeed stable. Stability in these models depends on the time preference parameter.

Chapter 2

Review of the Literature

2.1 Introduction

This chapter reviews the literature on corporate income tax harmonization from the perspective of the European Union (EU) with a focus on the prospects for an enhanced cooperation agreement (ECA) between a subset of countries instead of all 27 EU member states.[1]

As Chapter 1 explains, corporate tax competition erodes corporate tax revenues for the governments in industrialized countries. Therefore, politicians have put forward solutions to constrain this tax competition. Harmonization of corporate tax policy is needed to solve the problem. The latest proposal by the European Commission (EC) which suggests that an ECA between a subgroup of European countries might achieve the introduction of the common consolidated corporate tax base (CCCTB).[2] Under the CCCTB the definition of corporate taxable income is harmonized, but statutory corporate tax rates are left uncoordinated. A number of conclusions stress the relevance of the chapters in this thesis.

The literature on tax competition and tax harmonization is vast and the present review is therefore not complete.[3] The chapter contributes to the existing review studies with an extensive discussion of the literature on ECAs (sometimes referred to as coalition formation). Such a review is missing from the economic literature, but raises a number of important issues that are relevant in the European tax harmonization debate.

[1]This chapter is based on Vrijburg, H. (2010b), *50 years of EU corporate income tax harmonization initiatives: Is Enhanced Cooperation the solution?*, In P. Kavelaars and D. A. Albregtse, eds., Naar een Europese winstbelasting? (Kluwer), Deventer. I thank Leon Bettendorf, Bas Jacobs, Peter Kavelaars, Ruud de Mooij and Jenny Ligthart for helpful comments and suggestions.

[2]See for a discussion on the CCCTB Chapter 1 or below in Section 2.2.

[3]Review papers on the tax competition literature are Wilson (1999), Zodrow (2003), Wilson and Wildasin (2004) and Nicodeme (2006).

Let me stress that I will focus my discussion solely on competition and harmonization with respect to corporate income tax instruments. A large number of interesting topics are therefore excluded. For example, I do not touch upon the issue of spillovers in public goods, personal taxes on capital income, labor mobility or consumption-tax competition and I do not address the question whether capital income should be taxed at all.[4]

As we will see below, this review makes clear that the formation of an ECAs does not unambiguously lead to a welfare gain. Typically, the welfare gains from ECAs are much smaller than the welfare gain from a full harmonization of the corporate tax system between all countries in the same model. This is because part of the benefits from harmonization are exported to the countries that remain outside the ECA.

The final welfare gain depends, for example, on the participants in the coalition (the insiders) as opposed to the countries that stay out of the coalition (the outsiders). The participants must be able to achieve an improved allocation of capital or internalize taxation spillovers between themselves, otherwise cooperation is useless. Furthermore, the strategic policy response by the outsiders to the policy change by the insiders is important. Do the outsiders follow the policy change within the coalition or do they change their policy in the opposite direction? In the former case, the insiders enjoy and additional welfare gain, in the latter case, the insiders are effectively punished by the outsiders and might experience a welfare loss upon cooperation.

The review stresses that especially this final point is side-stepped in the tax competition literature. Most papers focus on the case where the government of every country only has one tax instrument at its possession, as opposed to the complex real world corporate tax systems. In addition, the standard assumption is that this single tax rate is a strategic complement to the tax rate of the governments in neighboring countries. This underscores the relevance of the chapters in the thesis, which focus primarily on the strategic tax game.

However, before arriving at the literature on ECAs, I will explain in Section 2.2 why the classical tax competition model with all its extensions does not find an unambiguous welfare gain. Thereafter, in Section 2.3, I will discuss the option of enhanced cooperation within the EU both from a legal and theoretical perspective. Final, Section 2.4 provides a short summary of the main findings in the literature.

[4]See Sørensen (2007) for a discussion whether capital income taxes should exist after all.

2.2 Cooperation between all Countries Unfeasible

The first part of the literature review introduces the standard tax competition model and numerous extensions of this standard model. I explain how a full tax harmonization agreement between all countries yields a welfare gain within this model, and why some countries might loose from tax harmonization. I also stress that the welfare gains computed in simulation studies are surrounded by uncertainty as a number of potentially important arguments have not been modeled. This inability to reach a conclusion in the theoretical literature explains the problems faced by politicians in their attempt to coordinate corporate taxation policies. Therefore, it is important to understand the forces at work.

Full Cooperation in the Classical Tax Competition Models

The early papers that study tax competition using the classical tax competition model, see a.o. Zodrow and Mieszkowsky (1986), Wilson (1986) and Hoyt (1991), find an unambiguous welfare gain from tax coordination. This conclusion is based upon a simple model where symmetric countries or jurisdictions are populated by identical citizens, who supply their labor inelastically to the labor market and own a capital endowment that is perfectly mobile across countries whereas labor is immobile. The citizens value both private and public goods. The public good is supplied by a welfare maximizing government that uses a unit-specific capital tax to finance the public goods.[5][6] Zodrow and Mieszkowsky (1986) and Wilson (1986) prove that the utility of citizens is higher when the governments of all countries coordinate their choice of the unit-specific capital tax in order to maximize the welfare of a representative agent compared to the case where each government makes its choice unilaterally. The coordinated tax rate is higher compared to the uncoordinated tax rate, which implies more public goods. The intuition for this result is that in choosing their tax rate unilaterally, individual government recognize that a higher tax leads to an outflow of capital, but they do not internalize that the outflow of capital benefits the citizens of other countries: there is a positive tax spillover. Therefore, they choose a tax rate that is too low from a social optimum point of view. By cooperating, this

[5]Tax competition models usually exclude non-distortionary taxes from the analysis. The literature itself does not provide a thorough motivation for this, although observations from actual practice confirm the widespread use of distortionary taxes while a head tax is available in principle. See the methodological notes to this thesis and Breuckner (2004) and Slemrod and Wilson (2009) for a discussion.

[6]The assumption of a unit-specific tax rather than an *ad valorem* tax is not crucial in case markets are perfectly competitive and hence the return to capital before taxes is fixed, see Lockwood (2004). The Nash equilibrium under the unit-specific tax is equivalent to the equilibrium under the *ad valorem* tax as both distort only the marginal investment decision. When countries have market power, this equivalence breaks down, but the same qualitative conclusions are obtained.

inefficiency is restored. As the countries are perfectly symmetric, cooperation results into a common gain (or surplus) that is divided equally among the citizens from all countries. Hoyt (1991) shows that the inefficiency of decentralized taxation becomes smaller if the number of countries decreases: the tax spillover is reduced.

Full Cooperation in an extended Model

In the remainder of this section, I present arguments to illustrate that cooperation need not be welfare improving for all countries involved when the model discussed above is generalized.

Let me start with two arguments that reduce the common gain from cooperation. First, ceteris paribus, an endogenous savings decision by individuals results in an aggregate cross-country tax base that is elastic in the average tax burden (see Bucovetsky and Wilson (1991) and Parry (2003)). When cooperation results in higher taxes, savings and investment will be reduced such that a ceiling on tax revenues exists. Second, cross-ownership of shares by investors causes a negative tax spillover: governments have an incentive to impose higher taxes to export part of their tax burden abroad. This negative tax spillover counter-acts the positive tax spillover in the classical tax competition model: unilateral tax policies are less inefficient (see Huizinga and Nielsen (1997) and Eijffinger and Wagner (2008)).

On the other hand, new benefits from cooperation arise if the model is extended with citizens that are heterogeneous in ability and a government, controlled by the median voter, that redistributes income towards the poor (less able) using distortionary taxes on labor and internationally mobile capital. Tax coordination reduces the excess burden of the use of these tax instruments and results in more redistribution (see a.o. Sinn (1990), Sørensen (2000), Sørensen (2004a)).

The classical tax competition model, as discussed in the previous section, is characterized by symmetric countries. Symmetry implies both that the spillovers are equally large for all countries involved and it ensures that the inhabitants of these countries have identical objectives: tastes are aligned. Asymmetries between countries lead to disagreement on the optimal common policy: each country has a unique optimal tax policy. For example, differences in the preference for public policy (including redistribution) implies that countries unilaterally prefer different tax levels. These differences in cross-country tax levels result in an inefficient allocation of resources across countries. In this case, harmonization of rates does not only yield a common gain in terms of increased economic efficiency or more public goods; it also imposes an undesirable uniformity upon the parties that join

the cooperative agreement. The net common gain from cooperation is ambiguous as a result (see Breuckner (2004)).

In general, asymmetries in endowments between countries result in a decentralized equilibrium where both a potential gain from cooperation exists, in terms of economic efficiency, and asymmetric welfare payoffs from decentralization: the resource-poor countries gain from attracting resources from the rich countries. For example, differences in population size introduces an asymmetry in the relative size of the tax spillover. The tax spillover is relatively small for large countries, the tax base is less elastic, and large for small countries. Unilateral optimal tax rates are therefore lower in small countries compared to large countries. Welfare is highest in small countries due to a massive, relative to its size, inflow of capital. From a global perspective, the tax differential creates an inefficient over-investment in the smaller country. Harmonization overcomes this inefficiency and allows a first-best public good supply. But very small countries might lose from tax cooperation agreements as harmonization is followed by a relatively large outflow of capital. The asymmetry has the potential to create a vested interest that breaks down the negotiation or requires the use of side payments to convince the unwilling party (see a.o. Bucovetsky (1991), Wilson (1991) and Kanbur and Keen (1993)).

Similarly, differences in capital endowments resulting in asymmetric capital positions have the potential to create vested interests: "rich" countries will invest in the "poor" countries until marginal products are equalized. Capital importing poor countries have an incentive to export part of their tax bill towards foreign capital owners by manipulating their 'terms of trade', the interest rate, by imposing a high tax (see a.o. Peralta and van Ypersele (2005, 2006)). Related are differences caused by agglomeration rents. A country in the economic core, i.e., it possesses agglomeration rents, will charge a relative high tax rate as these pure rents can be taxed at low economic cost: public goods provision is relatively cheap. On the other hand, a country in the periphery, i.e., without agglomeration rents, will charge a relative low rate in order to attract economic activity from the core country. In the end, both countries might gain from tax competition due to this asymmetry in endowments, such that both are unwilling to cooperate (see Baldwin and Krugman (2004)).

Finally, gains from cooperation are unsure in case of government failure. The classical tax competition model assumes that the government is benevolent and has no commitment problems. The government acts in the interest of its citizens and will not fool them now or in the future. However, when the government does not exclusively care about the interest of its citizens, but cares about its own (i.e. rent-seeking by a Leviathan government, see Edwards and Keen (1996)), some degree of tax competition is desirable to "tame

the Leviathan."[7][8] Without the disciplining force of tax base flight the government can freely extract resources from the citizens for its own benefit. A related argument, is that tax competition might help the government in solving a commitment problem regarding the future taxation of investments and savings (see Kehoe (1989) and Conconi, Perrone and Riezman (2008)). This argument follows when assuming that it is difficult to relocate investments in response to tax changes due to, for example, investments involve sunk costs. Governments have an incentive to set low taxes first and thus attract foreign investments and raise them after the investment is made. Expecting this, citizens will under-invest when the government is unable to convince them that it will not raise the taxes later. The fear of capital flight prevents the increase in tax rates in the future and provides therefore an effective commitment mechanism for the government. Tax coordination removes this disciplining mechanism and might lead to welfare losses. Finally, government failure is expected to be more likely the larger the distance to the voter, leading to a loss of information on preferences. Higher levels of government are therefore more likely to impose inefficient policies (see Dhillon, Perroni and Scharf (1999)).

Current EU Policy: constraining competition between all countries

The above studies focus on full harmonization of tax policy. But, following the recent publications by the European Commission (EC), such a full harmonization of all components of the corporate income tax in all EU member states is unlikely to unfold in the short run. Instead the EC tries to constrain competition between members by eliminating 'harmful tax practices '(see OECD (1998)) and CCCTB. Around both issues a theoretical literature has evolved. Eggert and Haufler (2006) present an overview. I will summarize the main lessons.

With respect to constraining harmful tax practices, it remains to be questioned whether it is wise to do so from an efficiency argument. The basic insight from second-best theory, is that restricting the freedom of agents need not imply a welfare improvement.[9] Ramsey-principles imply that an efficient tax system levies higher tax rates on inelastic tax bases compared to the more elastic tax bases. Once this is prohibited, the (non-cooperative)

[7]The term Leviathan government is used in the public choice literature to indicate a government that cares, besides the welfare of its citizens, about wasteful spending for the benefit of bureaucrats. Such a government will have the tendency to grow to large from a welfare perspective. See Brennan and Buchanen (1980) for a discussion.

[8]Interestingly, various papers assume a revenue maximizing government. This is a special case of both a Leviathan government and a welfare maximizing government. See for a discussion Janeba and Smart (2003).

[9]In the presence of existing distortions, policies that in isolation would increase efficiency can decrease it, and vice versa. See Rosen and Gayer (2008, p. 341) and Lipsey and Lancaster (1957).

tax system becomes less efficient by definition (see Keen (2001) and Bucovetsky and Haufler (2007)). However, when the aggregate cross-country tax base is elastic, a restriction on the use of tax instruments might raise revenues when this restriction expands the aggregate tax base for the countries involved (see Janeba and Smart (2003)).

With respect to a complete cross-country harmonization of the rules determining taxable income, the CCCTB, two steps can be identified. First, a common definition of taxable income must be decided upon. The literature on the choice of this common base by the cooperation countries is still scarce.[10] If the common base is a weighted average of the definition of taxable income of the member states, the common base will imply a broadening of the domestic tax base for some countries and a reduction for others.[11] To determine the change in welfare, the optimal response by the government in the setting of the remaining tax instruments is crucial. Generally, the statutory tax rate and the definition of taxable income within a country are substitutes for raising revenue: a country that broadens its tax base will therefore most likely lower its statutory rate (see Haufler and Schjelderup (2000), Devereux, Lockwood and Redoano (2008) and Chapter 4 of this thesis). Or more popular: competition is intensified on the remaining instruments which reduces the welfare gains from cooperation.

Second, the CCCTB replaces separate accounting (SA) with formula apportionment (FA). From the literature it is not clear whether replacing SA with FA is welfare enhancing (see a.o. McLure (1980), Gordon and Wilson (1986), Nielsen, Raimondos-Møller and Schjelderup (2001) and Eichner and Runkel (2011)). In case of SA, accounts terminate at the border and multinationals use transfer pricing and financial policies to minimize their EU (world) wide tax bill. Besides this, investment decisions are distorted if marginal tax rates differ across countries. In case of FA, an aggregate EU-wide tax base is divided between countries using a pre-determined formula depending on a combination of capital investments, employment and sales. Profit-shifting and investment distortions due to cross-country differences in taxation are prohibited. However, the multinationals recognize that their activities will modify the formula for dividing the EU-wide tax base. For example, when investment in a country is part of the formula, multinationals have an incentive to over-invest in low-tax countries: shifting paper profits is replaced with a new distortion on investment decisions. Tax competition can even be intensified as a result. However, Eichner and Runkel (2011) prove that, under a wide range of empirically relevant parameter values, competition under FA is less intense than competition under

[10] Chapter 6 of this thesis elaborates on this topic

[11] This assumption underlies the simulation studies perfomed by a.o. Bettendorf, van der Horst, Rojas-Romagosa (2007) and Bettendorf, Devereux, van der Horst and de Mooij (2009).

FA as tax spillovers are reduced. Furthermore, FA implies cross-country loss offset, which causes a net tax revenue loss for governments in the EU because losses can be off-set directly instead of over time (see Devereux and Loretz (2008)).

Simulation Studies

The wide range of arguments summarized above provides a confusing picture on the aggregate welfare effect of corporate income tax harmonization. Therefore, simulation analyses have been conducted with an increasing degree of institutional detail. First, when using a model close to the classical tax competition model, the welfare gain of coordinated capital income taxes is estimated in the range of 2-10 percent of tax revenue (see Wildasin (1989) and Parry (2003)). These estimates are, however, sensitive to the underlying parameters, which are hard to quantify for these stylized models.[12]

In a more refined model including multiple tax distortions and a welfare maximizing government (median voter) that intends to redistribute income towards the poor, the welfare gain from fully harmonized capital income taxes equals 1.42 percent of Gross Domestic Income (GDP), see Sørensen (2000, 2004a). The model used by Sørensen allows cross-country capital flows, cross-country ownership of assets, endogenous savings and labor supply decisions by households and endowment differences (human and non-human) between households.

The policy set of the government includes a labor income tax, a capital income tax, public consumption and productive government spending. The government chooses the capital tax rate such that the marginal gains from redistribution equal the marginal social costs in terms of lower saving and the capital outflow towards other countries.[13] As explained above, the latter is a tax spillover which leads individual governments to choose a capital tax rate that is too low from a global welfare perspective. The capital outflow implies that raising public revenues is costly for the government: the marginal cost of public funds is larger than unity. This induces the government to both raise the labor tax above the level that would be desirable from a global welfare perspective and to choose a relative low level of public consumption. The low capital tax rate and the high labor tax rate cause firms to substitute capital for labor, leaving output relatively unaffected. As productive public spending is complementary to both private capital and labor, it is relatively unaffected by tax competition in this setting. Over-investment in

[12]Important parameters are the elasticity of substitution between public and private goods, the weight attached to wasteful spending by a Leviathan government, the elasticity of the (aggregate) tax base and the number of countries.

[13]The capital outflow dominates the tax exportation argument that follows from cross-ownership of assets.

capital leads to more productive public spending, whereas a smaller labor stock leads to under-investment in productive public spending.

Hence, tax competition leads to relatively low capital taxes and high labor taxes, resulting in too little income redistribution and low public consumption relative to global tax coordination. Note that, as countries are symmetric, both capital-export neutrality (CEN) and capital-import neutrality (CIN) hold before and after tax harmonization. Tax harmonization does not improve the allocation of capital across countries.[14]

When the model is extended with a lump-sum transfer as the marginal source of finance for the government, public goods are supplied efficiently and the labor tax is reduced. As a result, the only cost from tax competition is too little income redistribution. After this modification, the welfare gain from cooperation declines until 0.94 percent of GDP.

After calibrating the model on a more realistic setting such that the different regions represent Northern Europe, Continental Europe, the United Kingdom (UK) and the United States (US) which differ in size and preference for redistribution, the welfare gain from coordination declines further: 0.32-0.10 percent of GDP. In this version of the model, CEN fails before countries cooperate on capital taxes as differences between countries lead to differing optimal unilateral tax policies. Part of the welfare gain from tax coordination therefore comes from an improved allocation of capital as CEN is achieved.

However, the model underlying these results still lacks country-specific institutional detail. In an attempt to provide a more accurate estimate of the surplus from cooperation, various scholars have recently developed models that contain a large number of EU and/or OECD member countries and more institutional detail (see Bettendorf, Gorter and van der Horst (2006), Sørensen (2004b) and Brøchner, Jensen, Svensson and Sørensen (2006)). This increased realism allows for profit-shifting by transfer pricing. However, the increased institutional detail comes at a cost: we need to assume that government policy is exogenous. It seems impossible to simulate a simultaneous strategic game between large numbers of countries. Furthermore, the models exclude all redistributive motives and decisions regarding the supply of public goods. The exogenously imposed tax policies differ substantially across the EU countries. The common gain from cooperation originates from removing these cross-country differences and represents therefore solely an improved allocation of resources.

[14]CEN states that domestic investors are indifferent between investing at home and investing abroad, the international allocation of capital is therefore not distorted, this is achieved under a pure residence-based tax. CIN states that all parties investing within a country face the same effective tax rate, the allocation of investments within a country is therefore not distorted, this always holds under source based taxes. See Griffith, Hines and Sørensen (2010).

From these papers, the complete harmonization of both rates and the definition of taxable income would generate a welfare gain in the range 0-0.2 percent of GDP.[15] The aggregate efficiency gain is small due to differences in personal capital income and labor income taxes across countries, and an elastic aggregate EU-wide capital stock.[16] Compared to full harmonization, the welfare gain of only a tax-base harmonization is even smaller: max 0.05 percent of GDP (see Brøchner *et al.* (2006)).

Besides being small, the aggregate welfare gain is asymmetrically distributed across countries, where some actually lose. Cooperation re-allocates EU-wide GDP instead of creating substantial new income; this creates winners and losers. The papers find that the countries that gain from harmonization in terms of tax revenue, lose in terms of welfare. This because GDP is negatively correlated with the average tax burden. Countries that are forced to broaden their tax base obtain more tax revenue but lose in terms of welfare, as the latter follows GDP.

This insight carries over to the final class of simulation studies that analyze the welfare effects of introducing the CCCTB (see See Bettendorf *et al.* (2007), Devereux and Loretz (2008) and Bettendorf *et al.* (2009)). In general, the welfare effects of introducing the CCCTB combined with harmonized rates in the EU are comparable to the previous studies: a maximum 0.15 percent of GDP. However, when the statutory rate is not harmonized the average welfare gain drops: a maximum 0.12 percent of GDP. Finally, when the common consolidated tax base is not compulsory but optional for large EU multinationals the welfare gain almost vanishes: a maximum 0.02 percent of GDP. When corporate income or labor income taxes, instead of lump-sum taxes, are used to finance the drop in tax revenues the welfare gains are even lower. The intuition behind these findings comes from two arguments. First, when only the tax base is harmonized, pre-existing differences in statutory corporate income taxes and personal income taxes remain. Second, present distortions from SA are replaced by new ones due to FA. The choice of formula is important in determining the winners and losers from this reform. In accordance with the previous studies, countries that are forced to broaden their tax base gain tax revenue but lose welfare and vice versa.

[15] This is exclusive of the reduction in compliance costs which is not modeled. No consensus estimate of compliance costs exists. Recent estimates suggest compliance costs between 2-4 percent of corporate income tax revenue, see Brøchner *et al.* (2006)

[16] Admittedly, smallness is not objectively established in this context. Estimated welfare effects of previous and anticipated EU action are all in the range of 0.5 - 1.9 percent of GDP, see Nicodeme (2006).

Summarizing

Once the assumptions of the classical tax competition models are relaxed, tax harmonization is not unambiguously welfare improving for all countries. The applied general equilibrium models with the highest degree of institutional detail predict small aggregate welfare gains from the current EU proposals. However, the studies ignore a number of important arguments: redistributional motives or rent-seeking by the government and endogenous optimal policy responses in the remaining tax instruments. The latter implies that the models only provide short-run predictions. Furthermore, the welfare gains are asymmetrically distributed such that not every country gains from cooperation.

When side payments are available this problem might be solved (see Kemp and Wan (1976)). The surplus can be shared such that every country is better off compared to the pre-coalition equilibrium. However, side payments are not always politically achievable or available. Would the Germans and French be prepared to bail out the Irish or Dutch for reforming their competitive tax systems? Therefore, studying the alternative option of an enhanced cooperation between a subset of countries is interesting.

2.3 Enhanced Cooperation in the European Union

Introduction

This section discusses the expected welfare effects of an enhanced cooperation agreement (ECA) between a subset of countries. First, I introduce the legal framework for introducing ECAs in the EU. Second, I discuss how coalitions are formed and what complications arise from a general perspective. Third, I focus on ECAs in stylized capital taxation models. Finally, simulation studies on the welfare effects of ECAs are discussed.

Legal Framework

An ECA is defined as cooperation between a subgroup of countries on a particular government policy while the remaining countries decide upon this policy autonomously. ECAs are institutionalized within the EU by the treaties of Amsterdam (1997) and Nice (2003) and modified by the treaty of Lisbon which is effective since 2009. An ECA must comply with a number of restrictions which are described in the Treaty of the European Union (TEU) and the Treaty of the Functioning of the European Union (TFEU). First, the ECA can only be initiated as a mechanism of last resort (Article 20 TEU). That is, only if a coalition of all EU member countries cannot be expected to be formed within a reasonable time span. Second, the minimum threshold for the number of participating member states

is nine (Article 20 TEU).[17] Third, the ECA is open for participation to all member states at all time against the entry restrictions imposed by the members of the ECA (Article 20 TEU, Article 328 TFEU). Fourth, the ECA must be formed such that a maximum number of member states are willing to participate (Article 328 TFEU). Fifth, the ECA must reinforce the process on integration within the EU and protect its interests (Article 20 TEU, Article 326 TFEU). So, the ECA is not allowed to undermine the single market, free trade, and fair competition, etc. Sixth, all EU member states are allowed to participate in the discussions concerning the ECA common policy, but only the participating member states take part in the voting (Article 20 TEU, Article 330 TFEU). Seventh, the voting procedure is the unanimity rule unless stipulated otherwise by the members of the ECA (Article 333 TFEU). Finally, the creation of an ECA requires a qualified majority in the council (Article 329 TFEU).[18]

ECA Formation: some General Lessons

Let me start with some important lessons from the literature on coalition formation. To form a coalition, the participating countries must agree on three, interrelated, issues. First, they must decide on the common policy to be implemented. This common policy defines the gains from cooperation. Second, they must decide on a sharing rule: a transfer scheme that stipulates how to divide the gains from cooperation. Third, the countries must agree on the coalition partners. Each partner to the coalition will bring its own preferences and endowments; this influences the payoff for the other members. It follows that in case of asymmetries between countries, a grand coalition between all countries need not be the outcome of a coalition formation process. This holds even when side-payments are available (see Burbidge, DePater, Myers and Sengupta (1997)). It might be impossible to devise a sharing rule that assigns to each country a payoff that is at least as high as the payoff from its best deviation strategy. When this occurs, the grand coalition is unstable as at least one country will be interested in opting out of the coalition. This finding stresses the relevance of studying the welfare implications of enhanced cooperation.

Two general questions arise. First, when will an ECA be welfare improving for both the participating countries and the outsider countries? A coalition is welfare improving for all countries when spillovers within the coalition are of the same sign as the spillovers between the coalition and the outsider countries (see Beaudry, Cahuc and Kempf (2000)).

[17] The treaties of Amsterdam and Nice stipulated a minimum of eight member states, the treaty of Lisbon modified this into 1/3 of the members states of the EU.

[18] In case the ECA concerns the common foreign and security policy unanimity is required (Article 330 TFEU). The treaty of Amsterdam stipulated that unanimity was required to approve any ECA. This implied a veto for every country such that an ECA was very hard to implement.

For this case, the change in policy by the coalition members, which internalizes within-coalition spillovers, is to the benefit of outsider countries.

Second, is an ECA a worthwhile policy direction when the gains from cooperation are uncertain? This question is answered by Bordignon and Brusco (2006), who find that an ECA might be a useful in-between step when there are large policy asymmetries between countries initially, the gains from cooperation are unsure, and adjusting the domestic policy to the ECA standard is costly. Countries with comparable initial policies can, by forming an ECA, reap the benefits of a level-playing field at relatively low cost. When in the future the gains from coordination turn out to be relatively large, outsiders can decide to join in: the ECA serves as a pilot group.

However, caution is required. The creation of a pilot group will establish new vested interests. The literature labels this the status quo bias. The choice of common policy by the ECA might influence a future global standard and therefore both welfare and the entry decision by outsider countries (see Alesina, Angeloni and Etro (2005)). After establishing the ECA, the initial ECA members might be reluctant to accept new-comers. The benefits from expanding the coalition must be traded off against changes in both the common policy and the sharing rule demanded by the new-comer. The ECA therefore has the potential of creating a status quo which influences future developments. It remains unsure whether the EU rules on ECA formation exclude such a status quo bias. After establishing the ECA, outsiders cannot be deterred entry. But the initial members will anticipate this and might choose their policy such that a re-negotiation is necessary from the perspective of new-comers before they are willing to enter.

Application to the Tax Competition Literature

The general arguments above can be supplemented by arguments more specific to the tax competition literature. Let me start with ECAs in the classical tax competition model (see Konrad and Schjelderup (1999) and Bucovetsky (2009)). Cooperation between a subset of countries is unambiguously welfare improving for both insiders and outsiders if the tax rates of the outsider countries and the union are strategic complements.[19] This conclusion reflects the general lessons above; the classical tax competition model is characterized by positive tax spillovers within the union and between the union and the outsider countries. The assumption on the strategic complementarity by governments is crucial; if this does not hold welfare losses appear for either insiders or outsiders. Chapter 4 elaborates on this issue.

[19]Strategic complementarity: when confronted with a tax rate increase in a neighboring country, the home government increases its own rate. In case of strategic substitutes the opposite holds.

In line with the previous section, a number of qualifications on the expected welfare gain from an ECA in corporate income taxation can be identified. First, what about the necessary common gain from cooperation? In this respect, especially the elastic aggregate tax base for the coalition should be stressed. An increased level of taxation within the coalition will lead to an outflow of profits and capital to the remaining countries. Ceteris paribus, the gain from cooperation will be smaller in case of an ECA compared to a full cooperation between all countries (see Parry (2003)).

Similar arguments hold in case the ECA decides to implement the CCCTB. For instance, at least in the short run, inward profit shifting from the rest of the world might increase the aggregate tax base after implementation of the CCCTB (see Riedel and Runkel (2007)). Total profit shifting between the partial union and the outsider country depends on the difference between the statutory tax rate of the outsider country and the effective tax rate in the coalition.[20] After FA is introduced, multinationals will re-allocate investment towards the low-tax coalition countries. This causes the effective tax rate of the coalition to be lower than the average pre-harmonization statutory tax rates of the countries that form the coalition: the incentive to shift profit out of the coalition decreases. This is all under the assumption that countries have not changed their statutory rates after the implementation of the CCCTB. However, in the long run the gain might disappear when statutory rates are adjusted. Even worse, when multinationals can still use a financing detour in an un-active affiliate in a low-tax country, profits will be shifted out of the coalition if the statutory tax rate is raised after the coalition is formed (see Gerard (2007)). Furthermore, coalition members might be reluctant to enforce the tax code as the revenues from enforcement must be shared among all coalition partners (Becker and Fuest (2007)). However, to the contrary, this reluctance to enforce the tax code might be welfare improving when the desire by multinationals to shift more profits leads intermediaries in tax haven countries to demand a higher price for their concealment services (see Slemrod and Wilson (2009)).[21]

Second, what does asymmetry imply for the welfare gains of an ECA? In general, the conclusions from the full cooperation literature carry over. Winners and losers from cooperation might arise as interests are not aligned. The formation of coalitions is difficult as every potential coalition member has a unique optimal deviation strategy and it might be impossible to find a sharing rule that overbids all these optimal deviation payoffs (Burbidge *et al.* (1997)).

[20] The effective tax rate being the weighted average statutory tax rate in the coalition, where the share of the respective country in the common tax base serves as the weighting factor.

[21] This argument depends on the assumed supply function of intermediaries, which is claimed to be positively sloped.

Asymmetries make certain coalitions more likely compared to others. For example, countries with similar policies are more likely to form a coalition as the costs of cooperation are relatively small (see Alesina *et al.* (2005)). As a second example, a coalition between larger countries yields larger common gains from cooperation compared to a coalition between small countries. Three arguments explain this result (see Chapter 4). First, the spillovers internalized by a coalition of small countries are relatively small compared to the spillovers internalized by larger countries. Second, the aggregate tax base of a coalition between small countries is found to be relatively elastic compared to the aggregate tax base of a coalition between larger countries. Third, in the model used in Chapter 4, the outsider in case of a coalition of small countries is more likely to reduce its tax rate in response to an increase in the tax rate by the coalition members (strategic substitutes) compared to the outsider in case of a coalition of large countries. Below I explain this finding.

Before explaining this finding, I want to stress that this argument highlights the relevance of the optimal tax responses. It highlights the issue of government behavior. How do governments change their optimal tax policies? This question becomes crucial when studying enhanced cooperation. The policy change by the outsiders determines the common gain for the insiders and vice versa.

In the standard tax competition model, the government maximizes welfare and fully commits to future policies. Due to symmetry between countries, tax rates are in general strategic complements. When symmetry is not imposed, tax rates need not be strategic complements though (see Chapter 4). A tax increase in a neighboring country provides two opposing incentives to the home government. First, tax revenues are increased due to an inward flow of profits or capital. This gives a welfare maximizing government the incentive to lower its tax rate to redistribute part of this increased tax revenue towards private consumption: the marginal valuation of tax revenue is reduced. Second, the broader tax base and the capital imported reduce the marginal cost of funds; it becomes cheaper to raise additional tax revenue. This latter argument gives an incentive to raise the tax rate. The former argument is more likely to dominate when public and private goods are imperfect substitutes and when the original tax policy is far from the top of the Laffer curve for the respective country. This second condition signals that tax competition does not constrain the country in obtaining a desirable level of tax revenue; the marginal valuation of additional tax revenue is relatively low.

Empirical evidence, see Devereux *et al.* (2008), supports the assumption of strategic complementarity, but only provides evidence on the average strategic reaction by the average country in the short run. Data limitations prevent sophisticated estimation of

strategic responses between different types of countries in case of major policy reforms such as the implementation of an ECA with CCCTB within the EU. It can therefore not be excluded that tax instruments of particular countries will act as a strategic substitute in the long run when confronted with such a major policy shock. The welfare gain for the cooperating countries will be lower than expected as a result.

Furthermore, the literature is silent on the welfare effects of enhanced cooperation when governments are of the Leviathan type. The creation of an ECA by Leviathan governments might be rewarding for both insiders and outsiders if tax rates of Leviathan governments are more likely to act complementary in a strategic game compared to benevolent governments. This implies that a subgroup of countries prefers a Leviathan government as outsider compared to a welfare maximizing government.

On the positive side, an ECA can be an attractive policy direction when the government has commitment problems (Conconi *et al.* (2008)). In this case, the government is unable to impose the welfare maximizing policy under full cooperation as consumers and investors make inefficient savings and investment decisions when they expect the government to raise taxes in the future. Full competition on the other hand might result in tax rates that are too low from a global welfare perspective. The ECA is a comfortable in-between choice.

Finally, as mentioned before, the literature does not cover an analysis including sophisticated expectations by the insiders regarding the strategic actions of outsiders now and in the future. Chapter 4 consider the case where the ECA acts as a Stackelberg leader with respect to the strategic tax setting of outsiders. These expectations enhance welfare in case of strategic complementarity. However, in case of strategic substitutes, outsiders might lose due to the creation of the ECA.

Simulation Studies with Computable General Equilibrium Models

Various simulation studies confirm the reservations with respect to the welfare effects of an ECA listed above. The model developed by Sørensen (2000, 2004a) discusses, besides cooperation between all countries (see Section 2.2), the welfare effect of an ECA between a subset of countries.

For the case of symmetric countries, an ECA between some of these countries yields a welfare gain of 0.075 percent of GDP compared to the 0.94 percent of GDP mentioned for full harmonization (see Sørensen (2004a) and Section 2.2). An ECA leads to a smaller welfare gain compared to full harmonization, due to an outflow of capital towards countries that do not participate in the ECA. Expecting this capital outflow, the cooperating countries will choose a lower capital tax, an hence redistribute less, compared to full har-

monization. The author illustrates this intuition by allowing imperfect capital mobility between the ECA and the rest of the world, this results in a higher welfare gain of 0.426 percent of GDP.

When the model is calibrated for an ECA between EU member countries and the US as an outsider (see Sørensen (2000)), the welfare gains are between 0.16-0.19 percent of GDP depending on the strategic change in tax policy by the US. In particular, if tax policy in the US is held constant, the welfare gain of forming an ECA equals 0.16 percent of GDP. Allowing the US to optimally adjust its tax policy to the change in tax policy in the EU results in a larger welfare gain of 0.19 percent of GDP. In this latter case, in view of strategic complementarity, the US decides to raise its tax rate following the increased tax rate by the ECA countries: strategic complementarity.

Four additional results are noteworthy. First, no ECA member loses from cooperating in this setting. Second, the outsider country, the US, gains from EU cooperation (0.16 percent of GDP). This gain materializes because increased capital taxation by the ECA members induces a flow of capital towards the US, which raises GDP and tax revenues. Second, within the coalition, especially net capital-importing countries with a strong preference for redistribution experience a large welfare gain. This results because, in case lump-sum transfers are available, tax harmonization mainly improves redistribution through higher capital taxes (see Section 2.2 above). Furthermore, net capital-importing countries (which are net interest payers) benefit from the reduced after-tax interest rate that follows higher capital taxes. Fourth, when the aggregate capital stock is more elastic, the gains from forming an ECA deteriorate as the total world capital stock is reduced after the increased capital taxes.

In a model with more institutional detail, the aggregate welfare gain from an ECA is even smaller: 0.05 percent of GDP compared to 0.20 percent of GDP under full harmonization (see Brøchner *et al.* (2006)). Again winners and losers occur due the absence of a large common gain from cooperation. Instead, the ECA exports some of the efficiency gain abroad and re-allocates pre-cooperation GDP.

Finally, the welfare effects of an ECA within the EU that imposes a CCCTB are close to zero on average for both insiders and outsiders (see Bettendorf, van der Horst, de Mooij and Vrijburg (2010)). There is a small net common gain from cooperation, for a number of different coalitions. Hence, cooperation results mainly in a redistribution of economic activity, creating winners and losers. When the losers decide to opt out the ECA, the gain for the winners declines, leading to adverse selection. It must be stressed though, that the above studies only measure the efficiency gain from an improved allocation of resources, the expected reduction in compliance costs is excluded.

Summary

The above discussion leads to the conclusion that, compared to the cooperation across all countries, enhanced cooperation leads to marginal welfare gains. The main argument for this result is that the potential efficiency gains from a partial harmonization of tax rates (either a subset of rates, a subset of countries, or a combination): a movement towards CEN but not completely, less profit shifting and/or a larger supply of public goods are small. Capital and profits are shifted towards the countries that do not participate in the ECA. Furthermore, Chapter 4 highlights that an ECA might lead to increased tax rate differentials, and therefore a movement away from CEN, when the coalition consists of the initial high-tax countries. Besides this, the welfare gains suggested by the simulation studies are uncertain as a number of important elements (for example, compliance costs) are excluded from the most detailed simulation analyses. Furthermore, strategic behavior by governments might introduce a status quo bias for future policy coordination and welfare losses for countries outside the coalition.

2.4 Conclusions

This chapter provides a review of the tax harmonization literature with a special focus on enhanced cooperation in corporate taxation. The policy relevance originates in the latest proposal by the European Commission (EC) which suggests that an ECA between a subgroup of European countries might achieve the introduction of the CCCTB. Under the CCCTB the definition of corporate taxable income is harmonized, but statutory corporate tax rates are left uncoordinated. A number of conclusions stress the relevance of the chapters in this thesis.

First of all, based on this review of the literature, I conclude that, based upon economic studies, the welfare gains from an enhanced cooperation agreement with CCCTB between a subset of EU countries are on balance expected to be small. These small welfare gains come from the following arguments. First, the welfare gains from enhanced cooperation are smaller than the welfare gains from cooperation between all countries. Part of the gains from cooperation are exported to the outsider countries. Second, the EU-wide introduction of the CCCTB introduces new economic distortions (the apportionment formula) that replace the old economic distortions. As a result, the allocation of capital across the EU is not substantial improved such that there is no large gain from cooperation. This implies that an ECA with CCCTB is reallocating welfare within the EU instead of improving welfare on average. Countries for which the CCCTB base is

broader than their current corporate tax base will obtain additional tax revenue but experience a reduction in GDP. The latter implies that welfare is reduced. The opposite holds for countries for which the CCCTB base is smaller than their current base. These asymmetrically distributed expected efficiency gains, which are relatively small on average, combined with the large number of countries negotiating and the difficulty to design perfect side-payments, lead to the expectation that it will be hard to reach an agreement in the near future. Even stronger, it might be impossible to design a rule for sharing the gains from cooperation such that every country prefers cooperation above the current situation.

This raises the question why the European Commission is still interested in the proposal. The answer might be in two missing arguments in the above studies. First off all, it is expected that introducing the CCCTB will reduce tax compliance costs for multinational firms. However, no consensus estimate on compliance costs exists in the empirical literature and it is unclear whether the CCCTB will reduce tax compliance costs. The second argument, the focus of this thesis, is that the studies do not allow the governments to re-optimize their corporate tax systems.

In light of the above literature review this might be an important argument. Recall that the review makes clear that the welfare gains from cooperation depend on the choices made by the insiders and outsiders from a coalition. Allowing governments to re-optimize their corporate tax systems might give room for a common gain from cooperation through internalized tax spillovers: more public goods as competition is less stringent. However, it might also lead to welfare losses instead of larger welfare gains. This stresses the relevance of Chapters 4, 5, and 6 which focus on the choice of an optimal corporate tax system and the interaction between countries. The next chapter will study the fundamental question whether taxation spillovers exist. The existence of such spillovers is key to the whole literature on tax competition.

Chapter 3

Is there Significant Cross-Country Income Shifting?

3.1 Introduction

3.1.1 Contribution

This thesis relies on the assumption that capital and profits are mobile across countries, such that the stocks of capital and profits depend on the tax policies of neighboring countries: tax spillovers exist. This chapter tries to estimate these tax spillovers using macro-economic data.[1] I use macro-economic data because government policy is dependent on the elasticities from a macro-economic perspective.[2] As I mentioned briefly in the introduction to this thesis in Chapter 1 and will discuss time and again below, the optimal tax rate decided on by the government depends on the size of the aggregate (macro) corporate income tax base. To see this, recognize that a one percentage increase in the tax rate leads to an additional tax revenue equal to this entire tax base. Hence, the larger this tax base, the more attractive an increase in the tax rate is.

However, increasing the tax rate leads to a reallocation of activities by firms. These reallocation of activities represent economic distortions. Economic distortions related to the corporate income tax can be disaggregated in both international leakages (e.g. profit

[1]This chapter is based on Vrijburg, H. (2010a), *Explaining Corporate Taxable Income: Is there significant cross-country income shifting?* IIPF conference paper, Uppsala. I thank Leon Bettendorf, Aart Gerritsen, Albert van der Horst, Bas Jacobs, Jenny Ligthart, Ruud de Mooij, Joana Pereira and Floris Zoutman for helpful comments and suggestions. I also benefited from comments of seminar participants at the Tinbergen Institute, the NAKE Research Day, the CPB Netherlands Bureau for Economic Policy Analysis, and the IIPF conference in Uppsala.

[2]See Feldstein (1995 and 1999) for an application of this argument to estimate the excess burden of the personal income tax.

shifting and cross-border investment flows, see the model developed in chapters 5 and 6) and domestic leakages (e.g. excessive debt financing, income shifting towards the personal income tax base and marginal investment flows, not modeled explicitly in chapters 5 and 6). The optimal corporate income tax system depends on both the international and the domestic leakages.

To obtain an estimate of the aggregate international leakages of corporate income taxation, I estimate the elasticity of corporate taxable income with respect to both the corporate tax burden of the home government and the weighted corporate tax burden of neighboring countries using data from 19 OECD countries between 1983 and 2005.[3] The elasticities of corporate taxable income with respect to the home tax burden include both the domestic and the international leakages of the corporate income tax. This opposed to the elasticities of corporate taxable income with respect to the foreign tax burden, which is expected to isolate the international leakages of the corporate income tax. The dependent variable in this study is aggregate corporate taxable income per capita, which is a rough measure of the actual corporate tax base of the government.

For the corporate income tax instruments of the home government, the results suggest a long-run elasticity of corporate taxable income in the range $0.86 - 1.56$ for the statutory tax rate. The elasticities for the marginal tax rate are substantially lower, in the range $0.35 - 0.5$. For the weighted foreign instruments the elasticities are larger, in the range $1 - 2.5$ for the statutory tax rate and in the range $0.7 - 1.1$ for the marginal tax rate.

The contributions to the literature are two-fold. First, by employing the weighted average corporate tax burden of the neighboring countries, an estimate of the international leakages of the corporate income tax burden is obtained. Even stronger, without this variable the estimates of the own tax burden are potentially biased as the tax competition literature claims that there is a positive correlation between the own and foreign tax burden: it is an omitted variable. Second, the persistency in macro-data is addressed explicitly using a dynamic specification. This is also important because both the tax base and the tax burden are persistent over time.

3.1.2 Relation to the Existing Literature

A vast empirical literature has attempted to estimate the sensitivity of corporate decisions to taxation for a particular decision margin. However, only few papers provide an overall picture. A notable exception is de Mooij and Ederveen (2003, 2008), who employ a

[3] I use the tax data provided by IFS. Countries included are: Austria, Australia, Belgium, Canada, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

meta-analysis to summarize the literature on each of the decision margins with a special attention to the international investment flows.[4] De Mooij and Ederveen compute for each of five decision margins (income shifting to the personal income tax base, financial policy, profit shifting, marginal investments, and discrete investments) the semi-elasticity of the corporate tax base with respect to corporate taxation. They find a semi-elasticity of: (i) -0.7 for income shifting; (ii) -0.15 for financial policy; (iii) -1.2 for profit shifting; (iv) -0.4 for marginal investment decisions, and; (v) -0.65 for discrete investment decisions. The estimates imply that corporate taxable income is especially sensitive to profit shifting after a change in the corporate tax burden.

A second related paper is Clausing (2007, 2008) who estimates the total excess burden on corporate taxation from a macro-economic perspective by using tax revenue in OECD countries between 1979 and 2002. The study by Clausing reveals that on average tax revenue is maximized at a statutory corporate tax rate around 33 percent, while for open or small countries the revenue-maximizing rate is somewhat lower. Furthermore, countries that exempt foreign taxes on dividends paid receive less corporate tax revenue compared to countries that operate a credit system. However, the study fails to fully explore the cross-section and time-dimension of the data, both of which are especially important in international corporate taxation where the literature emphasizes both cross-country profit and investment flows on the one hand and time trends in both the statutory tax rates and the definition of the tax base on the other hand. Finally, Clausing employs corporate tax revenues relative to GDP as the dependent variable, such that the elasticities might be under-estimated if corporate taxes reduce GDP.

Third, Buettner (2001) studies the fiscal spillovers between German municipalities using a dynamic specification. Buettner finds large significant cross-jurisdictional spillovers which suggest that the lower-tier governments in Germany are on the downward sloping part of their Laffer curve such that a reduction in the tax rate would lead to an increase in tax revenues.

Finally, Devereux (2006) describes developments in corporate taxation in the OECD over the period 1965-2005. Devereux employs the same data-set but does not control for the persistency of corporate taxable income explicitly and the presence of country fixed effects.

[4] A meta-analysis uses statistics to summarize a broad range of estimates from underlying empirical studies, see Stanley (2001) for a discussion.

3.1.3 Structure of the Chapter

In the following, Section 3.2 discusses the theoretical relationship between corporate taxable income and the corporate tax burden, Section 3.3 discusses the methodology used to estimate the elasticity of corporate taxable income with respect to the corporate tax burden, Section 3.4 discusses the data used in the analysis, Section 3.5 presents the results, and Section 3.6 concludes.

3.2 Corporate Taxable Income

The dependent variable in this study is aggregate corporate taxable income per capita in country i in year t (B_{it}). This variable is obtained by dividing corporate tax revenues by the (top) statutory corporate tax rate of the same country in the same year. In case all firms pays this top statutory tax rate, this measure should be equal to actual aggregate taxable income within the country. In case a large fraction of firms is taxed at a lower statutory tax rate, or a lower effective tax rate, I under-estimate the actual aggregate tax base.[5]

Before estimating the elasticities, this section discusses the components of aggregate corporate taxable income and their relationship with the policy instruments and the business cycle. I illustrate this discussion using a descriptive decomposition of aggregate corporate taxable income similar to Clausing (2007):

$$B_{it} = f_{it} * \Pi_{it} * CS_{it} * pcapGDP_{it}. \tag{3.1}$$

The first term (f_{it}) in Eq. (3.1) equals the taxable-income-to-operating-surplus ratio, it measures the fraction of corporate income that is taxed.[6] this ratio captures the changes in taxable income relative to operating surplus. These changes reflect tax avoidance (or evasion) through financing policies by firms or changes in government policies regarding the legal tax base.

[5] I did not find data yet that can validate my presumption that by far the largest part of corporate taxable income comes from firms in the highest bracket.

[6] Operating surplus is measured as mixed income plus the surplus from production before taking account of any interest, rent or similar charges payable or received on financial or tangible non-produced assets borrowed, rented or owned by the enterprize. The inclusion of mixed income in this definition implies that operating surplus is robust to changes in the degree of incorporation. Mixed income is defined as '[...] the surplus or deficit accruing from production by unincorporated enterprises owned by households; it implicitly contains an element of remuneration for work done by the owner, or other members of the household, that cannot be separately identified from the return to the owner as entrepreneur but it excludes the operating surplus coming from owner-occupied dwellings [see stats.oecd.org].'

To see this, note that the tax deductibility of interest on debt gives an incentive to both pure domestic and multinational companies to finance their activities with debt. As a result, Multinational Enterprises (MNEs) operate complex inter-company financing structures to reduce their world-wide tax bill.[7] From this argument, an increase in the domestic statutory corporate tax rate reduces aggregate corporate taxable income relative to operating surplus. On the other hand, an increase in the foreign statutory rate increases aggregate corporate taxable income at home.

Next to the financial policies of firms, government policies regarding the legal tax base, e.g. allowed fiscal depreciation, the tax treatment of losses and foreign earned income, influence corporate taxable income. Various papers present empirical evidence and a theoretical rationale for a simultaneous reduction in the statutory tax rates to induce inward profit shifting and a broadening of the definition of the taxable income to minimize the loss in tax revenue.[8]

This suggests that the reduction in statutory tax rates over time is accompanied by an increase in aggregate taxable income relative to operating surplus over time. Second, policies that allow firms to offset losses against profits in later years result in lower aggregate taxable income relative to operating surplus in years following an economic downturn. Finally, the exemption of foreign earned income will lower aggregate taxable income. Finally, tax rules are often in nominal terms. Inflation therefore might cause bracket creep as more firms end up in the higher income brackets.

The second term (Π_{it}) in Eq. (3.1) equals the operating-surplus-to-compensation-of-employees ratio. Changes in Π_{it} capture profit shifting due to over- or underreporting of the return to capital. Next to financial policies, MNEs use internal transfer-pricing policies to under-report (over-report) their operating surplus in high-tax (low-tax) countries (Bartelsman and Beetsma (2003) and Grubert (1998)). Transfer-pricing guidelines fail to perfectly control for this profit-shifting channel due to the absence of observed market prices, for example, of intangibles. Transfer pricing is in line with the expectation that aggregate taxable income is decreasing in the domestic corporate tax burden and increasing in the foreign corporate tax burden.

[7]Optimal financing policies by MNEs depend on domestic and foreign details of the tax law including whether an exemption or credit system is operated (see Hines and Rice (1994)), the thin-capitalization rules in place, and tax enforcement.

[8]See e.g. Devereux, Griffith and Klemm (2002) for empirical evidence and e.g. Haufler and Schjelderup (2000), Egger and Raff (2009) and Chapter 5 of this thesis for theoretical results. Devereux *et al.* (2008) both derives the result theoretically and finds empirical support.

The third term (CS_{it}) in Eq. (3.1) represents the compensation-of-employees-to-GDP ratio, reflecting the importance of corporations in total domestic product (GDP_{it}).[9] This ratio captures income shifting between the corporate sector and the non-corporate sector, see Gordon and Slemrod (2000) and De Mooij and Nicodeme (2008). Following these papers, differences in the degree of incorporation between countries are partly explained by the difference in effective tax rates for incorporated and unincorporated firms, however institutions (relative legal protection for incorporated firms) can be important as well.

The fourth term, nominal per capita Gross Domestic Product ($pcapGDP_{it}$), measures the total value of domestic economic activity relative to the number of residents. Changes in the business cycle, rate of inflation, and exchange rates will alter corporate taxable income. However, part of this variation might be related to tax policy itself, an issue that I will discuss below.

First, and foremost, economic activity is crucially affected by the tax-policy mix, an issue emphasized in the OECD study by Johannson *et al.* (2008). This study suggests that both the structure of tax policy (for example, indirect versus direct taxes) and the level of both corporate and personal income taxes are important in explaining economic activity within country i. The meta-analyses by de Mooij and Ederveen (2003) and (2008) confirm the effect of the corporate tax burden on investments.

Finally, for some OECD countries, notably Norway, revenues from natural resources are a substantial fraction of the revenues from corporate taxation. Revenues from natural resources do not influence our elasticities if tax rates and revenues from natural resources are strictly independent. However, this is unlikely, revenues from natural resources are a substitute for revenues out of taxation, suggesting lower taxes if revenues from natural resources are larger.

3.3 Methodology

This section discusses the econometric specification used to estimate the elasticities of corporate taxable income with respect to the marginal and statutory tax rate. First the dependent variable is introduced, thereafter three alternative specifications are discussed.

[9]Following the OECD, compensation of employees is defined as the total remuneration, in cash or in kind, payable by an enterprise to an employee in return for work done by the latter during the accounting period. No compensation of employees is payable in respect of work done by members of a household within an unincorporated enterprise owned by the same household. Compensation of employees does not include any taxes payable by the employer on the wage and salary bill, for example, a payroll tax. Such taxes are treated as taxes on production.

Dependent Variable

The dependent variable is aggregate corporate taxable income ($\boldsymbol{B}_{it}$) per capita measured in US dollars corrected for inflation, where $i = 1, ..., N$ and $t = 1, ..., T$ denote the country and year index, respectively. $\boldsymbol{B}_{it}$ is obtained by dividing aggregate corporate tax revenues by the (top) statutory corporate tax rate, the data are obtained from the OECD and IFS respectively (see Table 3.2). The dependent variable is defined in per-capita terms to take out scale effects with a variable that is exogenous to tax policy. Besides re-scaling the variable, the series must be measured in a common currency and price level to ensure that the series are comparable cross-country. This is important because series in different currencies can fluctuate for reasons different than, but potentially correlated with, tax policy. For the same reason, I correct for inflation. Therefore, aggregate corporate taxable income is converted using purchasing power parity (PPP) into US dollars of the year 2000.[10] Next I discuss the baseline specification and several extensions.

Baseline Specification

Corporate taxable income is explained using a measure of the corporate tax burden ($\boldsymbol{\tau}_{it}$); an interaction term between the corporate tax burden and an indicator variable that is equal to one for open economies ($\boldsymbol{O}_{it} \times \boldsymbol{\tau}_{it}$); additional fiscal variables ($\boldsymbol{F}_{it}$) and, variables intended to capture the size and profitability of the corporate sector ($\boldsymbol{X}_{it}$). This yields the following baseline specification:

$$\log(\boldsymbol{B}_{it}) = \delta_1 \log(\boldsymbol{\tau}_{it}) + \delta_2 \boldsymbol{O}_{it} \times \log(\boldsymbol{\tau}_{it}) + \log(\boldsymbol{F}_{it})\boldsymbol{\beta} + \log(\boldsymbol{X}_{it})\boldsymbol{\gamma} + \alpha_0 + \boldsymbol{\eta}_t + \boldsymbol{\varepsilon}_{it}, \quad (3.2)$$

where α_0 and $\boldsymbol{\eta}_t$ denote a constant and period-fixed effects, respectively. $\boldsymbol{\beta}$ ($\boldsymbol{\gamma}$) is a vector containing the estimated parameters for the fiscal (control) variables, and $\boldsymbol{\varepsilon}_{it}$ is assumed to be an iid error term. Below I shortly discuss the corporate tax burden, the additional fiscal variables and control variables; see Table 3.2 for an exact definition of the variables used. The coefficients δ_1 and δ_2 can be interpreted as elasticities as the model is defined in logarithms. Taking logarithms linearizes potential non-linear relationships in the data.

The corporate tax burden is measured using either the statutory corporate tax rate ($Stat.Rate$) or the effective marginal tax rate ($EMTR$). The latter measures the effective tax burden on the marginal unit of capital invested. The elasticity of taxable income with

[10] Conversion using exchange rates is an alternative to PPP transformation. However, PPP conversion is preferred as exchange rate conversion can by misleading on the actual size of economies due to exchange rate fluctuations. See OECD Website and documentation for further information.

respect to the corporate tax burden (δ_1) is expected to be negative and larger for open economies (δ_2 negative).

As additional fiscal variables ($\boldsymbol{F}_{it}$) the baseline specification includes the top personal income tax rate ($TOPINC$) to capture income shifting between the corporate and personal income tax base. Recall a higher personal income tax might lead to an increase in corporate taxable income because the degree of incorporation increases, see the term CS_{it} in Eq. (3.1). Furthermore, I add a dummy variable indicating whether a country features an exemption system for foreign corporate taxes paid ($Exemption$). Under an exemptions system, foreign earned profits are not due any taxes at home such that corporate taxable income is expected to be lower.

The size of the corporate sector differs across countries due to either differences in corporate tax policy, see Johannson *et al.* (2008), or exogenous causes, that are potentially correlated with tax policy. In the former case, a direct control for the size of the corporate sector leads to misleading conclusions regarding the elasticities. In the latter case, controls improve the estimate of the elasticities. For this reason, I estimate Eq. (3.1) with and without the $\boldsymbol{X}_{it}$ matrix. Included in the $\boldsymbol{X}_{it}$ matrix to control for the business cycle are economic growth ($Growth$) and the rate of unemployment ($Unemployment$). Furthermore, the level of real per capita GDP is included in $\boldsymbol{X}_{it}$ as rich countries are expected to have a larger corporate sector compared to poor countries.

Under the assumption that $\boldsymbol{\tau}_{it}$, $\boldsymbol{F}_{it}$ and $\boldsymbol{X}_{it}$ are exogenous, ordinary least squares (OLS) on Eq. (3.2) yields a consistent estimate of the coefficients. However, Eq. (3.2) only controls for common shocks to all countries and completely ignores the cross-section and time-dimension in the macro-panel. This creates the opportunity for a number of interesting extensions.

Country-Fixed Effects and Additional Controls

As a first extension, the constant (α_0) in Eq. (3.2) is replaced with country-fixed effects ($\boldsymbol{\alpha}_i$). If differences in corporate taxable income across countries can be explained with unobserved variables that are constant over time, the estimates in columns (1)-(8) are biased if these unobserved variables are correlated with tax policy. Examples of country-fixed effects are differing institutions, location-specific rents or treatment of foreign-earned corporate income (exemption system versus worldwide system) for as long as these differences are constant over time.

Besides country-fixed effects, some variables are missing from Eq. (3.2). First, the rate of fiscal depreciation allowed ($Dep.Allowances$) is added to $\boldsymbol{F}_{it}$ to capture the rate-

reducing-base-broadening policies discussed in Section 3.2. Ignoring the depreciation allowances might lead to over-estimation of the corporate-tax-base-to-statutory-rate elasticity. In case of the $EMTR$, the allowances are already taken account of implicitly and are therefore not included in the regression. Second, in years following an economic downturn loss compensation will cause a reduction in taxable income for some years. $Cycle(-1)$ is added to $\boldsymbol{F}_{it}$ to capture this effect. Finally, the unemployment rate is dropped as the effect of the economic cycle is already accounted for.

Cross-Country Income Shifting

As explained in Section 3.2, corporate taxable income is affected by the foreign tax burden as well. Therefore, to fully explore the cross-section dimension (cross-country income shifting) in the data, Eq (3.2) should be extended with the weighted foreign corporate tax burden:

$$\log(\boldsymbol{B}_{it}) = \delta_1 \log(\boldsymbol{\tau}_{it}) + \delta_2 \boldsymbol{O}_{it} \times \log(\boldsymbol{\tau}_{it}) + \delta_3 \log(\sum_{j=1}^{N} W_{ij,t}\boldsymbol{\tau}_{jt}) + \boldsymbol{\beta} \log(\boldsymbol{F}_{it}) + \boldsymbol{\gamma} \log(\boldsymbol{X}_{it}) + \boldsymbol{\alpha}_i + \boldsymbol{\eta}_t + \boldsymbol{\varepsilon}_{it}, \tag{3.3}$$

where $W_{ij,t}$ denotes an element of the spatial weights matrix $\boldsymbol{W}$, such that $\sum_{j=1}^{N} W_{ij,t}\tau_{jt}$ denotes the weighted tax rate of neighboring countries, which measures the foreign corporate tax burden.[11] Note that this variable might be an important omitted variable when it is missing, this because the tax competition literature (and the previous chapters in this thesis) claims that the corporate tax rates of country i are dependent on the corporate tax rates of country j. δ_3 captures the percentage change in domestic corporate taxable income after a 1 percent increase in the average foreign tax burden, it is expected to be positive. Columns (5)-(12) of Table 3.4 report the OLS estimates of Eq. (3.3).

Identifying δ_3 is not without problems though. As discussed in Section 3.2, the empirical literature supports the stylized fact of decreasing statutory rates and broadening of the legal tax base. Separating the effects of the downward trend in the foreign corporate tax burden from base-broadening, presents an econometric challenge. In addition, variation over time in tax policy for an individual country will be relatively small (see

[11] Weighted average tax rates are widely used in the strategic interactions literature to measure the foreign tax burden. Estimation is not feasible without the weighting matrix because there are otherwise too many parameters to be estimated. See amongst others: Case, Hines and Rosen (1993); Besley, Griffith and Klemm (2001); Altshuler and Goodspeed (2002); Evers, de Mooij and Vollebergh (2004); Egger, Pfaffermayer and Winner (2005a and 2005b); Devereux *et al.* (2008); and Jacobs, Ligthart and Vrijburg (2010).

Goolsbee (2004)). Therefore, identification will be mainly due to asymmetric changes in the weighted foreign tax burden between subsequent periods for different countries. This suggests that those weighting matrices that are both suggested by economic theory and generate sufficient asymmetric variation are preferred. For example, a weighting matrix that assigns equal weights to all countries is excluded.

Table 3.4 presents results for two different spatial weights matrixes.[12] The per capita GDP weights matrix is used for columns (5)–(8) of Table 3.4. The weight attached by country i to tax policy in country j at time t is given by:

$$W_{ijt} = \frac{1}{|GDPpc_{it} - GDPpc_{jt}|} / \sum_{j=1}^{N} \frac{1}{|GDPpc_{it} - GDPpc_{jt}|} > 0 \qquad \text{for } i \neq j, \tag{3.4}$$

and $w_{ii} = 0$, which signals that the matrix is row normalized. Country i attaches the largest weight at time t to the country that in per capita GDP terms is the most similar to country i. If countries converge over time, this will affect the weights. The intuition behind this matrix is that multinationals prefer to relocate their businesses to countries that are, besides tax policy, similar to country i. For columns (9)–(12) of Table 3.4 a geographical distance matrix is used with weights (constant over time):

$$W_{ij} = (1/d_{ij}) / \sum_{j=1}^{N} (1/d_{ij}) > 0 \qquad \text{for } i \neq j, \tag{3.5}$$

and $w_{ii} = 0$. The intuition behind this matrix is that multinationals are geographically constrained and are therefore more interested in geographically close neighbors as an alternative to country i. See, for example, Garretsen and Peeters (2009), who find that FDI from one country (the Netherlands) to another country is negatively correlated with distance. The major advantage of this weighting matrix is that it is truly exogenous, distance is not affected by tax policy.

A Dynamic Specification

Next to the cross-sectional dimension, the final, and preferred, specification takes the serial dependency of aggregate corporate taxable income explicitly into account. This serial dependency reflects the gradual adjustment of economic activity to shocks, this

[12] See Redoano (2007) for a discussion of various weight matrices used in the literature. The robustness of the results is checked using a number of alternative weights matrices. For example a matrix based on country-by-country FDI positions produces comparable results, while a uniform weighting matrix produces unrealistic estimates.

might be caused by transaction costs related to changing a firms policy. Extending Eq. (3.3) with the time-lag of B_{it} yields:[13]

$$\log(\boldsymbol{B}_{it}) = \lambda \log(\boldsymbol{B}_{i,t-1}) + \delta_1 \log(\boldsymbol{\tau}_{it}) + \delta_2 \boldsymbol{O}_{it} \times \log(\boldsymbol{\tau}_{it}) + \delta_3 \log(\sum_{j=1}^{N} W_{ij,t} \boldsymbol{\tau}_{jt}) + \tilde{\boldsymbol{\beta}} \log(\boldsymbol{F}_{it}) + \boldsymbol{\alpha}_i + \boldsymbol{\eta}_t + \boldsymbol{\varepsilon}_{it}. \quad (3.6)$$

For a consistent estimate of the parameters in Eq. (3.6), I must address the endogeneity of $B_{i,t-1}$. The econometric literature suggests the 1-step General Method of Moments (GMM) estimator following Blundell and Bond (1998) as the preferred estimator (see Windemeijer, Blundell and Bond (2000), Blundell and Bond (1999)).[14] Due to residual serial error correlation, the time lag of the fiscal tax base is instrumented using the second until sixth time-lag of the dependent variable. In addition, the fiscal variables are instrumented by their second till sixth time lag to exclude the potential bias due to endogeneity of fiscal policy. Finally, I use the forward orthogonal deviations transformation to remove the unit-specific effect from the data as this differencing method has proved to be the most efficient (see Hayakawa (2009)).[15]

Test Statistics

Various test statistics are reported. For the OLS regressions in Tables 3.3 and 3.4 a serial dependency test (see Wooldridge (2002)) is reported. Furthermore, for the fixed-effects models I report a Hausman test for: (i) the random-effects versus the fixed-effects model, and; (ii) testing endogeneity of the fiscal variables. The latter test is important as the assumption that fiscal policy is exogenous is not innocent. In the preceding chapters, I claimed the (mobility of the) tax base itself determines the optimal tax rate. Garretsen en Peeters (2007) confirm this relationship by proving that the mobility of capital (measured by FDI) is negatively related to the level of the effective corporate tax rate. For the dynamic model, I report the Sargan over-identifying test to investigate the va-

[13] Including the time-lag changes the interpretation of the coefficients into short-run effects. The long-run effects, for example, the long-run corporate-tax-base-elasticity ($\bar{\delta}_1$), is given by: $\bar{\delta}_1 = \tilde{\delta}_1/(1-\lambda)$.

[14] Notice that OLS on Eq. (3.6) is inconsistent due to correlation between the time-lag of the dependent variable and the country-fixed effects. Furthermore, the instruments used in the conventional GMM estimator following Arellano and Bond (1991) are found to be weak in the presence of high persistency ($\lambda \approx 1$).

[15] The advantage of forward orthogonal deviations is that it leaves residuals uncorrelated, whereas first-differencing results in serially correlated residuals.

lidity of the instruments and tests for additional first-order (FO) and second-order (SO) autocorrelation in the error term which render the GMM estimator inconsistent.

Table 3.1: Summary Statistics

	Overall				1985		1995		2005	
	Median	Coef.Var.	min	max	min	max	min	max	min	max
Tax Base	31.63	1.61	1.02	825.04	1.73	211.19	7.60	571.33	17.28	825.04
Millions of 2000 US Dollars					PT	JP	EL	US	CH	US
p/c Tax Base	1.64	0.97	0.17	16.98	0.17	2.67	0.44	5.23	1.15	16.98
Thousands of 2000 US Dollars per individual					PT	NO	DE	IE	DE	NO
Tax Rate	0.38	0.28	0.10	0.63	0.10	0.63	0.10	0.57	0.13	0.40
Percentage					IE	DE	IE	DE	IE	JP
Wtax Rate, per capita gdp matrix	0.37	0.19	0.17	0.58	0.38	0.53	0.29	0.52	0.27	0.37
Percentage					ES	IT	NL	CA	DE	FI
Wtax Rate, distance matrix	0.36	0.14	0.30	0.50	0.43	0.50	0.34	0.38	0.30	0.33
Percentage					PT	FI	DE	AT	SE	CA
Dep. Allowances	0.78	0.08	0.61	1.00	0.66	1.00	0.66	0.83	0.66	0.87
NPV as percentage of purchase price					PT	IE	AU	ES	AU	EL
EMTR	0.24	0.37	0.01	0.48	0.01	0.48	0.07	0.37	0.10	0.29
Percentage					IE	PT	IE	JP	IE	DE
TOPINC	0.47	0.34	0.10	0.84	0.13	0.77	0.13	0.60	0.13	0.52
Percentage					CH	PT	CH	NL	CH	NL
Cycle(-1)	0.00	1.04	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Dummy Variable					-	-	-	-	-	-
Growth	0.03	0.99	-0.06	0.15	0.05	0.09	-0.01	0.08	-0.06	0.06
Percentage					BE	NO	CH	IE	UK	NO
Unemployment	7.10	0.49	-0.89	19.50	0.79	17.80	3.05	18.40	4.05	10.70
Percentage					CH	ES	CH	ES	CH	DE
Per capita GDP	0.02	0.26	0.01	0.04	0.01	0.02	0.01	0.03	0.02	0.04
Thousands of 2000 US Dollars per individual					PT	CH	PT	US	PT	NO

3.4 Data

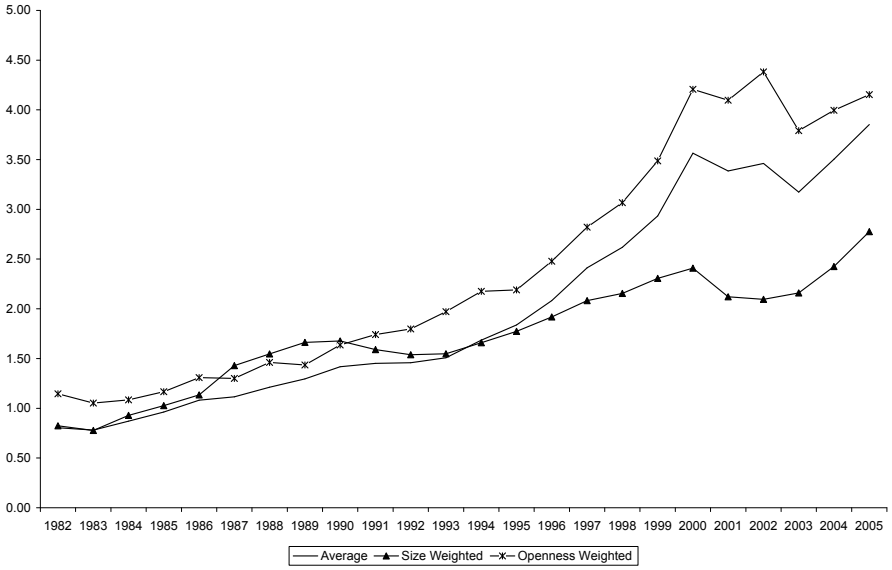
For the empirical analysis a balanced panel covering 19 OECD countries ($N = 19$) for the period 1983-2005 ($T = 23$) is employed. This leads to a total of 437 observations.[16] Table 3.2 presents the data definitions. Furthermore, Table 3.1 and Figures 3.1-3.6 give a first impression of the variables in the data-set. Table 3.1 provides summary statistics while the Figures report for each variable, the unweighted, size and openness weighted average, such that differing patterns between groups of countries can be illustrated.[17]

Figure 3.1 reveals that real corporate taxable income increases over time. This increase is sharper for small and open countries. Interestingly, Figure 3.2 shows that the statutory tax rates of especially small countries have decreased fast, providing descriptive support for the hypothesis that tax rates influence the size of taxable income. More specific,

[16]Countries included are: Austria, Australia, Belgium, Canada, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

[17]For the openness weighted series I use openness of country i, defined as the ratio of the sum of inward and outward FDI to GDP, relative to the average openness of countries, as a the weighting factor.

Figure 3.1: Corporate Fiscal Base, 1982-2005



the increasing trend is explained by the substantial increases in tax revenues in Ireland and Norway, both relatively small countries. In the former case, due the low tax rate for manufacturing firms, and in the latter case non-tax revenues are important. Furthermore, Belgium and the Netherlands both feature a relatively large tax base and a relatively high degree of openness.

Second, Figure 3.3 shows that taxable income relative to operating surplus is increasing and since the 90s large in small and open countries. The increasing trend can be explained

Figure 3.2: Statutory Tax Rates, 1982-2005

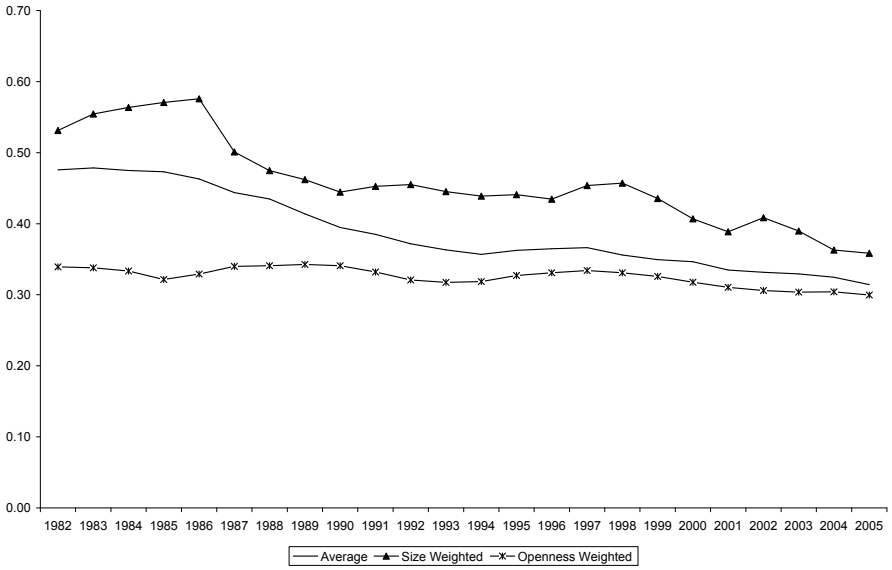
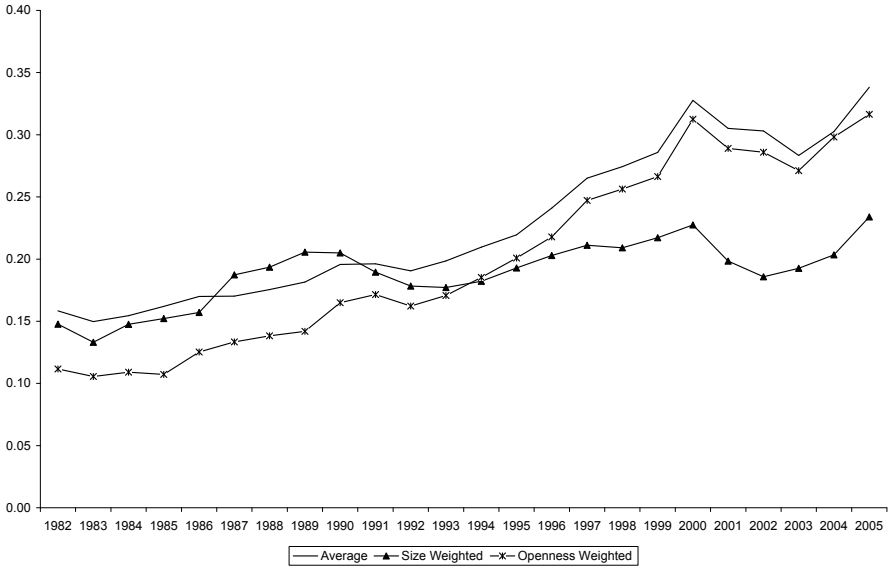


Figure 3.3: Fiscal-Base-to-Operating-Surplus-Ratio, 1982-2005



from the rate-cutting base-broadening policies emphasized in Section 3.2 and confirmed by the downward trend in the NPV of depreciation allowances presented in Table 3.1. The relative increase in small and open countries can be explained by inward profit shifting following low statutory tax rates in these countries potentially combined with excessive base broadening.

Third, operating surplus relative to compensation of employees in Figure 3.4 follows a mild increasing pattern and is relatively high in small and closed countries. This might

Figure 3.4: Operating-Surplus-to-Compensation-Employees-Ratio, 1982-2005

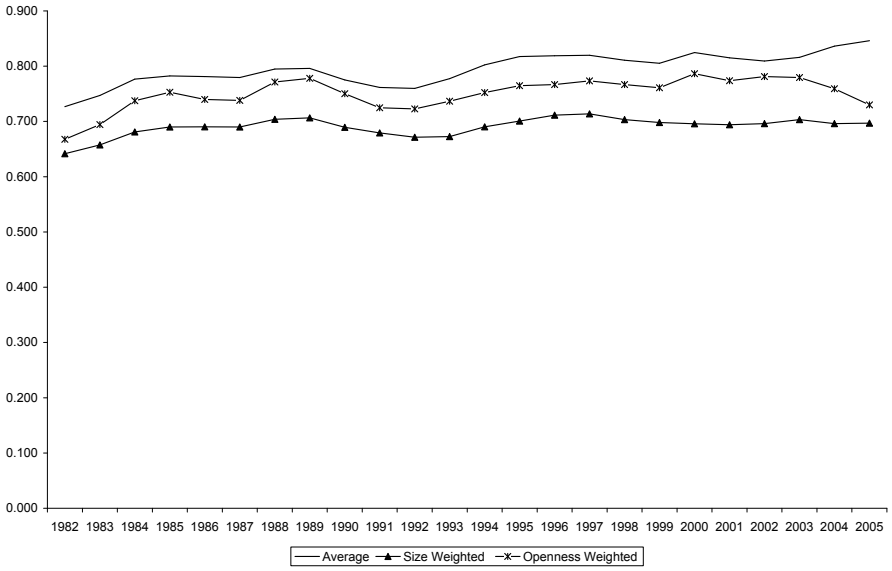
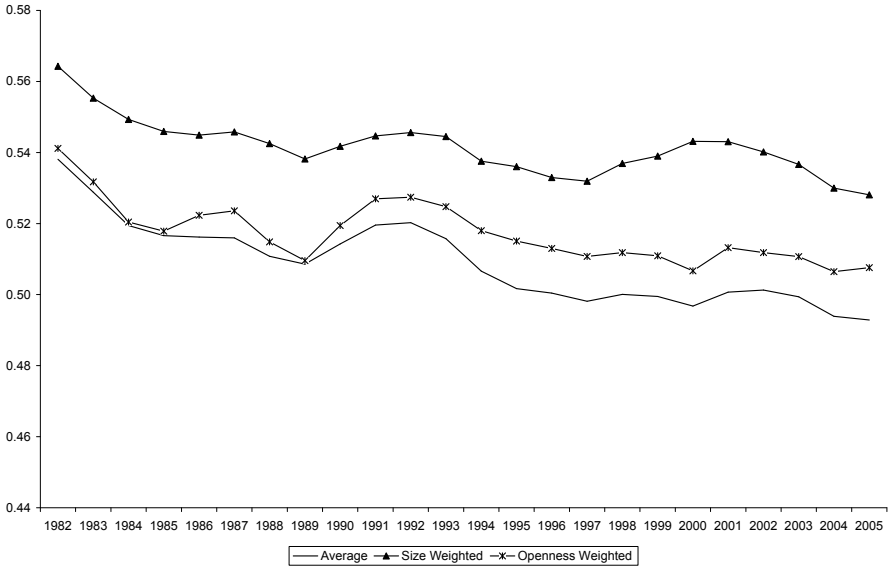


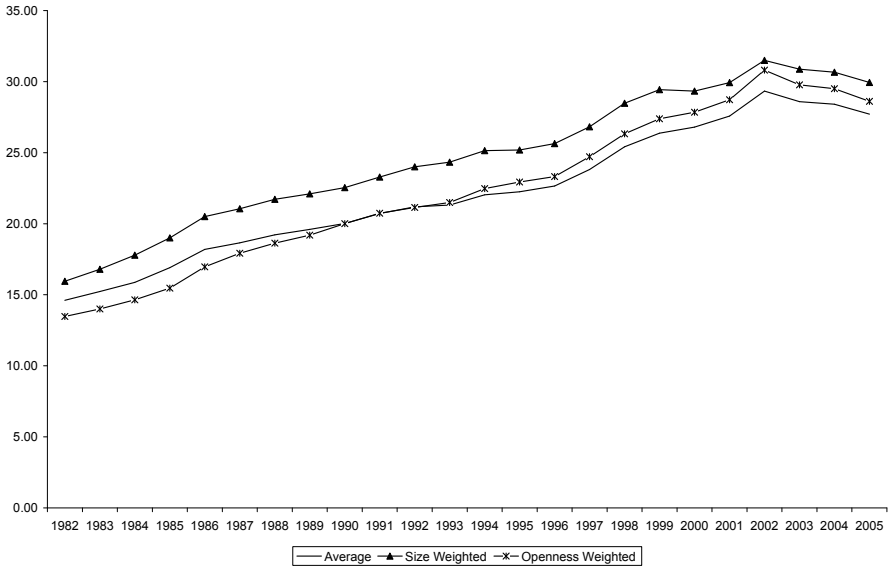
Figure 3.5: Compensation-Employees-to-GDP-Ratio, 1982-2005



reflect transfer-pricing activities as statutory tax rates in smaller countries are relatively low.

Fourth, compensation of employees relative to GDP in Figure 3.5 decreases slightly, expressing that in large and open countries the compensation of employees is relatively large. In the absence of large productivity differences in OECD countries this suggests income shifting towards the personal income tax base or profit shifting from large, and to a lesser extent open, economies to the smaller countries through the under-reporting of

Figure 3.6: Per Capita GDP, 1982-2005



the return to capital. Alternatively, institutional differences (for example labor unions) might influence the compensation of employees.

Figure 3.6 presents a consistent increase in per-capita-GDP over time, explaining the consistent increase in the per-capital-fiscal base. Larger and open economies are richer on a per capita basis compared to the smaller and closed economies.

3.5 Results

This section presents the results of estimating Eq. (3.2)-(3.6). Table 3.3 presents the results from Eq. (3.2). Thereafter, Table 3.4 presents the results of including additional variables, Eq. (3.3). Finally, the results from the dynamic specification, Eq. (3.6), are presented in Table 3.5. Results for both the statutory tax rate ($Stat.Rate$) and the effective marginal tax rate ($EMTR$) as measure of the corporate tax burden are included.

A general remark about the test statistics is informative. First off all, for the static specifications, the Wooldridge serial dependency test indicates significant residual serial error dependency. The dynamic specification in Table 3.5 controls for this serial dependency. Finally, the Hausman tests for the fixed effects models indicate that there is no endogeneity of the fiscal variables and no significant difference between the random effects and fixed effects model.

Columns (1)-(8) in Table 3.3 present significant negative estimates of the elasticity of corporate taxable income in the range -0.7 till -0.8 for the statutory tax rate and -0.2 till -0.3 for the marginal tax rate. For open economies the elasticity is somewhat higher, which is more pronounced when no control variables are included. The results suggest that corporate taxable income is more sensitive to the statutory tax rate as compared to the marginal tax rate, indicating that both profit-shifting and discrete location choices are more sensitive to the corporate tax burden than marginal investment choices. An average corporate taxable income to statutory tax rate elasticity of -0.75 suggests that on average countries are on the upward-sloping part of the Laffer curve.

Although insignificant in some regressions, exemption countries are found to feature smaller tax bases. The finding that the Top Marginal Income Tax Rate exerts a significant negative influence on corporate taxable income is surprising, although the sign depends on the inclusion of control variables. With respect to the control variables, both the growth rate and per capita GDP have a significant positive impact on corporate taxable income indicating that, as expected, both in years of economic prosperity and in rich countries taxable income is larger. As the growth rate and per capita GDP are measured in levels the estimated coefficient should be interpreted as a semi-elasticity. Therefore,

an increase in economic growth with 1 percentage point, results in $0.05 - 0.07$ percent higher corporate taxable income. Furthermore if per capita GDP in country i is 1.000 dollars above the average country, it features a 0.002 percent larger per capita corporate tax base. The unemployment rate is never significant suggesting that the growth rate and per capita GDP are sufficient controls for the business cycle, the unemployment rate is therefore dropped from in the remainder of the chapter.[18]

Finally, including control variables in the static specifications increases the elasticity of corporate taxable income with respect to the corporate tax burden, while the difference between open and closed economies is reduced after including controls. Interestingly, this relationship is reversed when the time dummies are excluded from the regressions. This suggests that time fixed effects control sufficiently for the business-cycle such that the role of per capita GDP in Table 3.3 is to control for the positive relation between statutory rates and per capita GDP.

Columns (9)-(12) of Table 3.3 control for country-fixed effects. After including country-fixed effects, the elasticity of corporate taxable income with respect to the statutory rate increases in case controls for the business cycle are added, without controls the elasticity decreases. The inclusion of fixed effects removes the difference in elasticity between open en closed economies. The fixed effects have no major implications for the control variables.

Columns (1)-(4) of Table 3.4 add depreciation allowances and a lagged business cycle indicator. There is no significant evidence for a broadening of the corporate taxable base. Second, if last year was indicated as a year with negative real growth, corporate taxable income will be between 24 and 40 percent lower this year, in addition to the business cycle this year. Furthermore, although almost never significant, the coefficient on the Top Marginal Income rate is estimated positively and corporate taxable income in open economies is not significant more sensitive. The coefficients of the business cycle variables are not significantly altered through the inclusion of the additional fiscal variables.

Columns (5) - (12) of Table 3.4 allow for cross-country linkages by adding the weighted tax rate to the regression. In columns (5)-(8) the per capita weighting matrix is used, while columns (9)-(12) use the distance matrix. The expected positive coefficient, indicating cross-country income shifting, is only found for the per capita weighting matrix.[19]

The elasticity of corporate taxable income with respect to the own corporate tax burden is in the range -0.7 till -0.9 for the statutory rate and is insignificant for the

[18]Robustness checks have been performed with regressions that replace the log of per capita GDP with the level of GDP, results are generally unaffected.

[19]Robustness checks with various alternative weighting matrices confirm this finding. For some matrixes (uniform, GDP weighted) the coefficient is positive, for all others it is negative.

$EMTR$. This finding suggests that the tax-base elasticity for the statutory rate found in Table 3.3 is robust against missing variables. The elasticity of the $EMTR$ becomes insignificant after including country-fixed effects.

However, serial dependency might influence our estimates. Therefore, the regressions reported in Table 3.5 include the time lag of the corporate tax base in the model.[20] This is the preferred specification as it explicitly controls for time dependency, such that the stickiness of taxable income over time is captured. Besides the common time shocks, the business cycle controls ($\boldsymbol{X}_{it}$) are excluded from the model as lagged taxable income captures their variation.

Table 3.5 shows that indeed per capita taxable income is persistent with the coefficient of lagged taxable income around 0.8. Most importantly, the long-run elasticity of corporate taxable income with respect to the own statutory tax rate ($\delta_1/(1-\lambda)$) is in the range $0.86 - 1.56$ if the foreign tax burden is taken into account and somewhat lower if the foreign tax burden is ignored. On the other hand, the elasticity of corporate taxable income with respect to the foreign statutory rate is in the range: $1 - 2.5$. The elasticities for the marginal tax rate are substantially lower, in the range $0.35 - 0.5$ for the own marginal rate and in the range $0.7 - 1.1$ for the foreign marginal rate. Finally, investment in open economies is more sensitive to the $EMTR$ compared to closed economies, a result that does not hold for the statutory rate.[21] With respect to the remaining variables in Table 3.5, loss-offset remains significant, the consistent negative sign of the Top Marginal Income rate is unexpected.

The elasticities of the own tax rates are smaller in absolute value compared to the elasticities of the weighted foreign tax rates. This despite the intuition that the elasticity of the own tax rate includes both domestic leakages of the corporate tax burden and the international leakages, while the elasticity of the foreign rate only includes the international leakages. This observation suggest an overestimation of the elasticity of the weighted foreign tax rates. Two explanations can be given for this result. First, corporate tax policy in outsider countries: Eastern Europe, China, Latin America. Only 19 OECD countries are included in the data-set, if significant flows of capital and profits exists towards these outsider countries and tax rates in these countries have decreased sharply, the

[20] Besides serial dependency, the residuals can feature spatial error dependency. However, spatial error dependency will only influence the bias of the Blundell Bond estimator when the spatial autocorrelation coefficient is above 0.8, see Jacobs, Ligthart and Vrijburg (2009). The spatial autocorrelation coefficient is below 0.4 for the regressions reported. The results are robust against including spatially weighted exogenous variables as instruments for the weighted foreign tax burden.

[21] Results are robust against changes in the instrument matrix: (i) changing the maximum lag length; (ii) changing the first lag; (iii) including the fiscal instruments in the non-dynamic part of the instrument matrix.

weighted tax rate might capture part of the subsequent capital and profit flows.[22] Second, the weighted tax rate might capture part of the base-broadening policies if depreciation allowances are not a perfect measure. This argument is strengthened by the observation that there is no indication for significant base broadening policies by the governments in Table 3.5. Overall, the analysis suggests that cross-country income shifting is significant and substantial compared to the domestic leakages.

Finally, the analysis ignores a wide range of potentially relevant factors, most notably the significant non-tax revenues in some OECD countries (Norway for oil, and to a lesser extend the Netherlands and Canada for Natural Gas) and the existence of double-tax treaties. Adding these variables as controls does not change the above results, the elasticities found are in the range reported, except for the weighted marginal rate where the range is expanded to $0.5 - 1.1$.[23]

3.6 Conclusions

In this chapter I estimate the elasticities of corporate taxable income with respect to both the own and the weighted foreign tax burden for 19 OECD countries between 1983 and 2005 while controlling explicitly for time dependency.

The preferred specification, reported in Table 3.5, estimates a long-run elasticity of corporate taxable income with respect to the own statutory rate in the range $0.86 - 1.56$. This suggests, in accordance with Clausing (2007), that statutory tax rates are, on average, close to the top of the Laffer curve. The long-run elasticity of corporate taxable income with respect to the effective marginal tax rate is lower, in the range $0.35 - 0.5$, which suggests that the sensitivity of marginal investments to corporate taxation is low compared to paper profits and discrete location choices. This replicates the findings by de Mooij and Ederveen (2004,2008). For the weighted foreign instruments the elasticities are in the range $1 - 2.5$ for the statutory tax rate and in the range $0.7 - 1.1$ for the marginal tax rate. Contrary to Devereux (2006), these elasticities are significantly positive, which is expected, but larger than the own elasticities, which is unexpected. The dynamic specification is needed to estimate this expected positive elasticity

To improve the estimated elasticities, data from outsider countries (for example Eastern Europe, China, Latin-America) is needed as well as better controls for the base-broadening policies, for example, the introduction of thin-capitalization rules. Further-

[22] Notice that Bulgaria, the Czech Republic, Latvia, Lithuania, Poland, Slovakia, and Romania have decreased their statutory tax rates steeply during the 90s.

[23] Data on Oil and Natural Gas are obtained from the EIA, data on double tax treaties are from Unctad.

more, it would be most interesting to expand the analysis with various spatial characteristics (Economic Core versus Economic Periphery). Finally, alternative (improved) measures for the foreign tax burden are needed to obtain accurate estimates of cross-country income shifting from macro-economic data.

In relation to this thesis, the above conclusions show that indeed tax spillovers exist and are substantial. On average, governments seem to have chosen corporate tax policies close to the top of their Laffer curve. This stresses the relevance of studying corporate tax competition, tax spillovers limit the potential to raise tax revenues. The following chapters will study corporate tax competition from a theoretical perspective.

Table 3.2: Variable Definitions and Data Sources

Variable	Definition	Source	Internet Location
Dependent Variable ($Base_{it}$)	Per capita fiscal corporate base in thousands of 2000 US dollars: tax revenue of country i at time t in thousands of 2000 US dollars divided by both the statutory tax rate in country i at time t and the population size of country i at time t.	OECD	stats.oecd.org
Corporate tax burden (τ_{it})			
Stat.Rate	Statutory corporate tax rate for each country and time period.	IFS	www.ifs.org.uk
$EMTR$	Forward-looking effective marginal corporate tax rate for each country and time period.	IFS	www.ifs.org.uk
Openness indicator: O_{it}	Dummy variable: equals one if the openness of country i at time t is above average. Openness is defined as the ratio of the sum of inward and outward FDI to GDP for each country and each time period.	UNCTAD	stats.unctad.org
Pcap GDP weighting matrix	For this matrix we use the per capita GDP variable described below.		
Geographical distance matrix	For this matrix we make use of the geographical distance between the capitals of country i and j. This distance is obtained from the website mentioned.	Own computation	www.infoplease.com
Other Fiscal Variables (F_{it})			
Allowances	The present discounted value of depreciation allowances as a percentage of the acquisition price for each country and time period. The depreciation allowance is computed for an hypothetical investment in plant and machinery. Special first year allowances are included if applicable. Where switching between straight-line and reducing balance methods is allowed, such switching is assumed at the optimal point. The assumed real discount rate is 10 percent, the assumed rate of inflation is 3.5 percent.	IFS	www.ifs.org.uk
Exemption	Dummy variable: equals one when country i followed an exemption system as treatment for foreign source dividends received by parent companies from EU subsidiaries in 1999. It is assumed that policies in the remaining years are similar.	European Commission 2001 (COM(2001) 582 final)	ec.europa.eu
TOPINC	The marginal tax rate applying to the top income bracket for each country and time period.	OECD	stats.oecd.org
Cycle(-1)	Dummy variable: equals one when growth in real GDP (measured in 2000 US Dollars) was negative last year.	Own computation	
Control Variables (X_{it})			
Growth	Economic Growth: percentage change in real GDP, measured in 2000 US Dollars, between t and $t+1$ for all countries and time periods.	OECD	stats.oecd.org
Pcap GDP	GDP per capita: real GDP of country i at time t, measured in 2000 US Dollars, divided by the population size of country i at time t. For all countries and time periods.	OECD	stats.OECD.org
Unemployment	Unemployment rate in percentage of the working population for all countries and time periods.	AMECO	ec.europa.eu
EU	Dummy variable: equals one if country i has joined the EU at time t. For all countries and time periods.	Own Computation	
Size	Size of country i, measured by GDP, relative to the US. For all countries and time periods.	OECD	stats.oecd.org

Table 3.3: Baseline Specification, no time dynamics, no cross-country linkages

	Stat.Rate		EMTR		Stat.Rate		EMTR		Stat.Rate		EMTR	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Tax Rate	-0.806***	-0.874***	-0.286***	-0.336***	-0.504**	-0.717***	-0.028	-0.119	-0.672**	-0.937***	0.011	-0.103
	(0.164)	(0.135)	(0.116)	(0.107)	(0.236)	(0.190)	(0.107)	(0.105)	(0.323)	(0.171)	(0.149)	(0.109)
Open×Tax Rate					-0.212**	-0.101	-0.244***	-0.196***	-0.048	-0.063	-0.031	-0.057
					(0.126)	(0.099)	(0.071)	(0.062)	(0.073)	(0.070)	(0.070)	(0.062)
TOPINC	-0.221*	0.109	-0.244*	0.035	-0.184	0.108	-0.156	0.077	0.141	0.253	0.112	0.210
	(0.144)	(0.155)	(0.150)	(0.169)	(0.162)	(0.152)	(0.171)	(0.152)	(0.364)	(0.216)	(0.356)	(0.223)
Exemption	-0.120	-0.217*	-0.209	-0.272*	-0.151	-0.227*	-0.215	-0.272**				
	(0.211)	(0.154)	(0.218)	(0.170)	(0.196)	(0.147)	(0.201)	(0.151)				
Growth		0.045***		0.073***		0.048***		0.072***		0.027***		0.032***
		(0.009)		(0.013)		(0.009)		(0.011)		(0.011)		(0.011)
Unemployment		-0.017		0.014		-0.004		0.033		0.082		0.158
		(0.130)		(0.136)		(0.127)		(0.118)		(0.101)		(0.126)
Pcap GDP		0.002***		0.002***		0.002***		0.002***		0.002***		0.002***
		(0.000)		(0.001)		(0.000)		(0.000)		(0.000)		(0.000)
R^2	0.543	0.717	0.457	0.641	0.557	0.719	0.513	0.677	0.700	0.792	0.677	0.760
Wooldridge	33.932***	26.045***	40.704***	27.357***	36.831***	26.967***	37.756***	24.792***	19.361***	13.772***	21.622***	16.659***
Fixed vs Random									11.283	14.668	7.774	14.435
Endogeneity									1.135	0.012	0.272	0.017

Notes: ***, **, * denote significance at the 1, 5 or 10 percent level, respectively. Panel robust standard errors are presented in parentheses below the parameter estimates. Period fixed effects are included. Columns (1)-(8) are estimated without country-fixed effects (α_0 is not reported) while columns (9)-(12) are estimated with country-fixed effects. Spatially weighted exogenous variables are included to control for potential spatial error dependency. Various test statistics are reported. First of all, the adjusted R-squared (R^2). Second, the residual serial dependency test suggested by Wooldridge, the test statistic being a t-statistic. Finally, two Hausman tests (Chi-squared distributed) are reported for: (i) the presence of fixed effects, and; (ii) endogeneity of the tax instruments. Significance of the test statistics is indicated with the conventional stars.

Table 3.4: Extended Baseline Specification: cross-country linkages

	No Weighted Tax Rate				Pcap Weighting Matrix				Distance Weighting Matrix			
	Stat.Rate		EMTR		Stat.Rate		EMTR		Stat.Rate		EMTR	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Tax Rate	-0.721**	-1.029***	-0.012	-0.114	-0.754***	-1.030***	-0.003	-0.106	-0.670**	-0.986***	-0.005	-0.109
	(0.333)	(0.146)	(0.143)	(0.109)	(0.312)	(0.145)	(0.139)	(0.107)	(0.357)	(0.185)	(0.141)	(0.109)
Open×Tax Rate	-0.041	-0.050	-0.027	-0.063	-0.033	-0.047	-0.027	-0.062	-0.018	-0.031	-0.014	-0.049
	(0.078)	(0.067)	(0.064)	(0.057)	(0.072)	(0.062)	(0.063)	(0.055)	(0.073)	(0.068)	(0.057)	(0.051)
Weighted Tax Rate					0.498***	0.195**	0.283**	0.182	-0.996	-0.823	-1.516**	-1.382*
					(0.155)	(0.107)	(0.170)	(0.156)	(1.615)	(1.408)	(0.834)	(0.862)
Allowances	0.029	0.483			-0.066	0.430			0.057	0.506		
	(0.928)	(0.570)			(0.867)	(0.543)			(0.920)	(0.575)		
TOPINC	0.128	0.270*	0.100	0.206	0.170	0.281*	0.103	0.204	0.127	0.270*	0.149	0.253
	(0.343)	(0.188)	(0.340)	(0.221)	(0.327)	(0.190)	(0.339)	(0.225)	(0.353)	(0.196)	(0.374)	(0.241)
Cycle (-1)	-0.396***	-0.237***	-0.377***	-0.242***	-0.379***	-0.235***	-0.373***	-0.242***	-0.395***	-0.236***	-0.376***	-0.241***
	(0.103)	(0.094)	(0.104)	(0.087)	(0.102)	(0.093)	(0.103)	(0.085)	(0.103)	(0.095)	(0.103)	(0.089)
Growth		0.027***		0.034***		0.028***		0.034***		0.027***		0.031***
		(0.011)		(0.011)		(0.011)		(0.011)		(0.011)		(0.010)
Pcap GDP		0.002***		0.002***		0.002***		0.002***		0.002***		0.002***
		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
R^2	0.726	0.803	0.701	0.765	0.734	0.804	0.704	0.766	0.727	0.804	0.710	0.773
Wooldridge	17.769***	13.105***	21.562***	16.960***	17.496***	13.096***	21.239***	16.791***	18.298***	13.535***	20.968***	17.216***
Fixed vs Random	11.355	14.620	7.857	13.256	7.899	14.461	6.643	13.331	7.113	13.562	9.412	10.267
Endogeneity	0.696	0.005	0.330	0.031	0.533	-0.172	0.533	0.055	0.293	0.002	0.067	0.045

Notes: ***, **, * denote significance at the 1, 5 or 10 percent level, respectively. Panel robust standard errors are presented in parentheses below the parameter estimates. Period fixed and country-fixed effects are included. Spatially weighted exogenous variables are included to control for potential spatial error dependency. Various test statistics are reported. First of all, the adjusted R-squared (R^2). Second, the residual serial dependency test suggested by Wooldridge, the test statistic being a t-statistic. Finally, two Hausman tests (Chi-squared distributed) are reported for: (i) the presence of fixed effects, and; (ii) endogeneity of the tax instruments. Significance of the test statistics is indicated with the conventional stars.

Table 3.5: Dynamic Specification

	No Weighted Tax Rate		Pcap Weighting Matrix		Distance Weighting Matrix	
	Stat.Rate	EMTR	Stat.Rate	EMTR	Stat.Rate	EMTR
	(1)	(2)	(3)	(4)	(5)	(6)
Base(-1)	0.793***	0.781***	0.775***	0.750***	0.837***	0.822***
	(0.043)	(0.050)	(0.040)	(0.051)	(0.031)	(0.034)
Tax Rate	-0.107*	0.017	-0.191****	-0.016	-0.247***	-0.091**
	(0.073)	(0.046)	(0.077)	(0.051)	(0.068)	(0.048)
Open×Tax Rate	-0.075	-0.091***	-0.040	-0.091***	0.024	-0.024
	(0.060)	(0.038)	(0.054)	(0.035)	(0.051)	(0.030)
Weighted Tax Rate			0.226***	0.169**	0.404***	0.202***
			(0.082)	(0.078)	(0.100)	(0.074)
Allowances	0.148		-0.031		-0.200	
	(0.205)		(0.197)		(0.159)	
TOPINC	-0.041	-0.066	-0.021	-0.102**	-0.042	-0.096**
	(0.059)	(0.068)	(0.053)	(0.061)	(0.041)	(0.051)
Cycle (-1)	-0.160***	-0.149**	-0.160***	-0.176***	-0.147***	-0.172***
	(0.062)	(0.067)	(0.057)	(0.067)	(0.057)	(0.060)
R^2	0.933	0.928	0.934	0.925	0.938	0.935
Sargan	33.373	29.813	38.860	26.599	46.675	40.492
FO Autocor.	0.405	0.677	0.410	1.059	0.010	0.272
SO Autocor.	0.559	0.703	0.525	0.970	0.248	0.416

Notes: ***, **, * denote significance at the 1, 5 or 10 percent level, respectively. Newey-West serial dependency robust standard errors are presented in parentheses below the parameter estimates. Period fixed and country-fixed effects are included. Spatially weighted exogenous variables are included to control for potential spatial error dependency. Various test statistics are reported. First of all, the adjusted R-squared (R^2). Second, the Sargan test for over-identifying restrictions, the test statistic being chi-squared distributed. Finally, t-statistics for remaining serial error correlation of the first order (FO) and second order (SO), are reported. Significance of the test statistics is indicated with the conventional stars.

Chapter 4

Optimal Capital Tax after Enhanced Cooperation

4.1 Introduction

4.1.1 Contribution

In Chapter 2 I stressed that the existing literature shows that Enhanced Cooperation Agreements (ECAs) are welfare improving under the condition of strategic complementarity. That is, ECAs are welfare improving if a tax increase in one country is followed by a tax increase in the other countries. This is standard assumption in the literature. For example, it is implicitly imposed when governments are assumed to maximize tax revenues. To see this, note that if a country has a government that wants to maximize tax revenues, this government is only interested in choosing a tax rate on the top of its Laffer curve. Furthermore, the tax base of this country is increasing in the tax rate of any other country due to an inflow of profits and/or capital (see Chapter 3). As a result the Laffer curve of this country expands due to a foreign tax increase and it is optimal to choose a higher tax rate.

The present chapter allows governments to maximize utility and shows that in this case strategic complements are not guaranteed.[1] In particular, I derive conditions under

[1]This chapter is based on de Mooij, R. and H. Vrijburg (2010), *Enhanced Cooperation in an Asymmetric Model of Tax Competition*, CESifo working paper no. 2915, CESifo, Munich. I thank Leon Bettendorf, Albert van der Horst, Bas Jacobs, Jenny Ligthart, Joana Pereira, and Floris Zoutman for comments and suggestions. I also benefited from comments of seminar participants at the Tinbergen Institute, the NAKE Research Day, and the IIPF conference in Cape Town.

which tax rates are strategic substitutes instead of strategic complements.[2] The intuition for this is that a welfare maximizing government is not only interested in the Laffer curve, it is also interested in the marginal valuation of tax revenues. As the marginal valuation of tax revenues is decreasing in tax revenues, it is a normal good, it decreases after a foreign tax increase. This because the foreign tax increase directly raises tax revenues. From this argument the government wants to reduce its tax rate which works against the argument of an expanding Laffer curve.

As mentioned before, the focus on the strategic game played between governments is important as the strategic game determines both the size of the common gain from an ECA and its distribution between insider and outsider countries. To study the implications of the above derived condition for the welfare implications from ECAs, chapter presents a simple three-country asymmetric capital tax-competition model where countries differ in size. That is, I extend the model of Bucovetsky (1991) and Wilson (1991) with a third country. I find that strategic substitutability has important implications for the feasibility and the welfare implications of an ECA. For instance, the chapter shows that an ECA might no longer be welfare improving for participating countries if they fail to take account of the opposite response by outsider countries, i.e. under Nash competition. This result changes, however, under Stackelberg leadership of the ECA countries. More generally, the analysis of an ECA under Stackelberg leadership leads to conclusions that either generalize or oppose existing findings in the literature. For instance, when the ECA members act as a Stackelberg leader and tax rates are strategic complements, the welfare gains for all countries are positive, consistent with earlier studies that only consider Nash equilibria. However, when ECA members act as a Stackelberg leader and tax rates are strategic substitutes, even the ECA members may decide to reduce their tax rate instead of raising it. This contrasts common wisdom. Furthermore, the mere option to form an ECA may impede future global harmonization, reflecting the status-quo bias found in other papers.

Furthermore, size asymmetry between countries is allowed as asymmetry is at the heart of the inability to cooperate between all countries in the first place. It turns out that size affects the strategic game played by the countries. If the countries that form the ECA are sufficiently different in size compared to the outsider country, the conditions

[2]Under strategic substitutes, a tax increase in one country is followed by a reduction in the tax rate of another country. Strategic substitutability seems at odds with empirical findings on strategic tax setting. For example, Devereux, Lockwood and Redoano (2008) find that, on average, countries respond by increasing their tax rate in response to an increase in the average level of taxation in neighboring countries. However, this average response by no means rules out that some countries will prefer an opposite response and thus act as a strategic substitute.

for tax rates to be strategic substitutes become weaker. The reason for this is that size asymmetry causes larger countries to be further away from the top of their Laffer curve compared to small countries. The larger countries can more easily obtain tax revenues because capital is relatively less mobile from the perspective of the large country. For strategic interactions this is important, the further away from the top of the Laffer curve, the more likely it is a country will reduce its tax rate in response to a foreign tax increase. That is, the distance to the top of the Laffer conveys information on arguments that withhold the government from increasing its tax rate.

4.1.2 Relation to the Existing Literature

As discussed extensively in Chapter 2, the feasibility of an ECA in corporate taxation has been analyzed in a small theoretical literature.[3] Burbidge, DePater, Myers and Sengupta (1997) study the endogenous formation of coalitions. The authors assume that prospective members of a coalition must agree on: (i) a common policy, (ii) a sharing rule for dividing the surplus from cooperation, and (iii) the preferred coalition partners. An agreement between all countries is only feasible when countries are sufficiently similar such that their policy preferences are aligned. Otherwise, smaller coalitions will be formed consisting of countries with relatively similar policy preferences. Prospective members trade-off the benefits from cooperation against the cost of aligning with the common policy (see also Alesina, Angeloni, Etro (2005)). Some prospective members prefer to stay outside the coalition if they can extract surplus from the coalition, or are banned from the coalition if they are expected to erode the common gain from cooperation.[4] A coalition among countries with similar policies can serve as a pilot in case the benefits from cooperation are uncertain (see also Bordignon and Brusco (2006)). Alesina et al. (2005) and Bordignon and Brusco (2006) emphasize that ECA members might be reluctant to accept newcomers if the latter intend to change the ECA policies. This leads to a status quo bias as the original ECA hampers further harmonization initiatives. Yet, forming coalitions might be impossible if excluding prospective members is prohibited and the surplus from cooperation vanishes beyond a particular ECA size: a tragedy of clubs (see Manzini and Mariotti (2002)).

[3]Besides these theoretical contributions, enhanced cooperation in corporate taxation is studied in computable general equilibrium models by a number of authors, see Sørensen (2000, 2004a), Brøchner, Jensen, Svensson and Sørensen (2006) and Bettendorf, van der Horst, de Mooij and Vrijburg (2010). Furthermore, ECAs have been studied in the trade literature (see Kemp and Wan (1976) and Kennan and Riezman (1990)).

[4]As an application, Riedel and Runkel (2007) show that an ECA stipulating a common corporate tax base with formula apportionment can extract a positive surplus from outsiders due to reduced profit shifting towards these outsider countries.

A number of papers explore how an ECA affects welfare in participating and non-participating countries. Beaudry, Cahuc and Kempf (2000) develop a model with symmetric countries. The common policy by the ECA members internalizes within-ECA spillovers. If spillovers within the ECA are of the same sign as the spillovers between the ECA and the rest of the world, the ECA will also benefit outsiders. Applied to a symmetric capital tax-competition model, Konrad and Schjelderup (1999) add to this prescription the requirement that the policy of the ECA and the outsider countries should be strategic complements, i.e., outsider countries should respond by adjusting tax rates in the same way as the ECA countries do. Bucovetsky (2009) extends this analysis to asymmetric countries. Similar to Konrad and Schjelderup (1999), he assumes that tax rates are strategic complements and finds that ECAs are always welfare improving.

4.1.3 Structure of the Chapter

The rest of the chapter is organized as follows. Section 4.2 introduces the three-country model. Section 4.3 characterizes the optimal tax rates under four different regimes. Section 4.4 discusses tax reaction functions across countries and analytically derives conditions for tax rates to be strategic complements. Section 4.5 illustrates the global properties of equilibrium tax rates for different size configurations and under different regimes regarding tax setting. Section 4.6 simulates the welfare effects in the associated equilibria. Finally Section 4.7 concludes.

4.2 A Three-Country Model of Tax-Competition

Consider three countries $i = 1, 2$ and 3 each populated with a fixed number of N_i immobile citizens. Households have a common *per capita* capital endowment (e) and a labor endowment ($l = 1$), which they supply inelastically. Labor is immobile while capital is perfectly mobile internationally.

4.2.1 Firms

Each country produces one good using a stock of physical capital (K_i) and effort from labor (N_i). There is perfect competition in the output and factor markets. For each country, the production function $F(K_i, N_i)$ is homogeneous of degree one, so it can be written in intensive form: $N_i f(k_i)$ where $k_i = K_i/N_i$ denotes the capital-labor ratio employed in country i. $F(.)$ is concave in its two inputs and twice continuously differentiable. Hence: $f'(k_i) > 0,\ f''(k_i) < 0$. Profit maximizing firms set the marginal product of capital equal

to its price: the tax-inclusive cost of capital. Thereby, firms face a distortionary source-based unit-specific tax on capital ($t_i > 0$).[5] Hence, the first-order condition for profit maximization yields for all i:

$$f'(.) = t_i + \rho. \tag{4.1}$$

The after-tax rate of return on capital ($\rho > 0$) is equal across countries due to the international mobility of capital.[6] The wage rate per worker equals firm revenue minus capital costs: $f(.) - f'(.)k_i$.

4.2.2 Consumers

A representative consumer features a twice-continuously differentiable, monotonously increasing utility function of the form: $U(g_i, c_i)$, where g_i and c_i denote public and private consumption, respectively. Public consumption reflects a publicly provided private good rather than a pure public good.[7] Household private consumption is subject to a household budget constraint, given by:

$$c_i = [f(.) - f'(.)k_i] + \rho e. \tag{4.2}$$

Hence, private consumption equals the wage, reflected by the term in between square brackets on the right-hand side of Eq. (4.2), plus interest income from the capital endowment (ρe).

4.2.3 Government

The government maximizes welfare, which is determined by the utility of the representative household. It chooses the optimal tax rate t_i, thereby taking into account the government budget constraint that restricts public consumption to equal tax revenues:

$$g_i = t_i k_i. \tag{4.3}$$

[5] Lockwood (2004) analyzes the consequences of replacing the unit-specific tax rate with an *ad valorem* tax rate. Results are comparable, only tax-competition is more intense under *ad valorem* tax rates. I prefer the unit-specific model as this approach is standard in the literature I contribute to.

[6] Note that (part) of the countries are large enough to influence the after-tax rate of return with their tax policy. I will elaborate on this below.

[7] In case of a pure (non-rival) public good the utility function is modified to $U(G_i, c_i)$, where $G_i = g_i N_i$ such that larger countries can finance a given level of public goods with a lower tax compared to smaller countries. I will discuss this shortly in the concluding section.

Optimization with respect to the tax rate is equivalent to optimization with respect to the provision of public goods. The optimum satisfies the following condition:

$$\frac{\partial U(.)/\partial t_i}{U_c(.)} = \frac{\partial c_i}{\partial t_i} + MRS(c_i, g_i)\frac{\partial g_i}{\partial t_i} = 0, \tag{4.4}$$

where $MRS(c_i, g_i) = U_g(.)/U_c(.) > 0$ denotes the marginal rate of substitution between public and private goods. The right-hand side of Eq. (4.4) measures the welfare effect of the tax via, changes in private consumption and public consumption, respectively.

4.2.4 Equilibrium

Countries differ in size. To simplify the analysis, I assume: $s_1 = s_2 = s \neq s_3 \equiv (1 - 2s)$, where $s_i = N_i/N$, denotes the share of the population of country i in the world population (N).[8] With a fixed world capital stock of $\overline{K} = Ne$, the world resource constraint reads as:

$$\begin{aligned} \overline{K} &= K_1 + K_2 + K_3, \\ e &= s_1 k_1 + s_2 k_2 + s_3 k_3. \end{aligned} \tag{4.5}$$

Eq. (4.5) together with each country's demand for capital in Eq. (4.1) determine the capital stock in each country and the world rate of return, k_i and ρ, respectively. Both are implicit functions of the set of tax rates $[t_1, t_2, t_3]$.[9]

4.3 Optimal Tax Rates under Four Regimes

I now derive expressions for the optimal tax rates in the three countries, which are characterized by Eq. (4.4). To that end, I rewrite the derivatives in Eq. (4.4) by differentiating

[8] This assumption implies that I side-step a number of complications that arise in case the union consists of asymmetric countries. In particular, when union members are asymmetric, both their preference for the optimal union policy and the payoff from cooperation might differ. The latter would require an advanced sharing rule for the common surplus from cooperation. Our approach is familiar in the literature on coalitions, see for example Kennan and Riezman (1990).

[9] I assume that $\rho > 0$, ruling out the possibility of an excess supply regime where part of the capital stock is not used (see Bucovetsky (1991)).

Eqs. (4.2) and (4.3) with respect to the tax rate:

$$\frac{\partial c_i}{\partial t_i} = -f_i''(.)\frac{\partial k_i}{\partial t_i}k_i + \frac{\partial \rho}{\partial t_i}e < 0, \tag{4.6}$$

$$\frac{\partial g_i}{\partial t_i} = k_i\left[1 + \frac{t_i}{k_i}\frac{\partial k_i}{\partial t_i}\right] > 0. \tag{4.7}$$

Eq. (4.6) shows that a higher tax rate reduces private consumption for two reasons. First, a higher tax will cause an outflow of capital (see below). The smaller capital stock reduces labor productivity and, therefore, the wage and private consumption. Second, the higher tax reduces the world rate of return on capital and, therefore, interest income. This magnifies the reduction in private consumption.

Eq. (4.7) shows that the effect of a higher tax on public consumption depends on the slope of the Laffer curve. In particular, the first term on the right-hand side of Eq. (4.7) shows that a higher tax raises revenue over the existing tax base. The second term indicates that a higher tax causes an erosion of the tax base to the extent that it reduces the domestic capital stock. This reduces tax revenue, especially when the initial tax rate is high. As long as the outcome is on the upward sloping part of the Laffer curve, the first term dominates and public consumption increases in the tax rate.

By differentiating Eq. (4.1) with respect to τ_i, I find how a change in the tax rate of country i affects its capital stock:

$$\frac{\partial k_i}{\partial t_i} = \frac{1}{f_i''(.)}\left[1 + \frac{\partial \rho}{\partial t_i}\right], \tag{4.8}$$

As $f_i''(.) < 0$, Eq. (4.8) states that a higher tax reduces capital in country i as long as the term between square brackets on the right-hand side is positive. This term denotes the net tax effect on the cost of capital. The first term captures the direct increase in the cost of capital due to a higher tax rate. The second term shows an offsetting effect associated with a lower interest rate. In particular, the interest rate is determined on the world capital market. Lower capital demand in country i may reduce the interest rate if country i exerts market power on the world capital market. The adjustment in the capital stock in Eq. (4.8) implies that the before-tax return to capital in country i changes enough to equalize after-tax rates of return across countries. This restores equilibrium on the international capital market. The larger $f_i''(.)$ the smaller the change in the capital stock needed to reduce the before-tax return.

Define $\epsilon_{K,i} \equiv -\frac{t_i}{k_i}\frac{\partial k_i}{\partial t_i} \geq 0$ as the tax elasticity of capital and $\epsilon_{R,i} \equiv -\frac{\partial \rho}{\partial t_i} \geq 0$ as the tax-rate elasticity of the interest rate. Together with Eq. (4.6), (4.7) and (4.8), rewrite (Eq. 4.4) as:[10]

$$MRS_i(.) = MCF_i \equiv \frac{1 + \epsilon_{R,i}\left[(e/k_i) - 1\right]}{1 - \epsilon_{K,i}}. \tag{4.9}$$

Eq. (4.9) reflects the modified Samuelson rule for publicly provided private goods, it is similar to the policy rules derived by Bucovetsky (1991) and Wilson (1991).[11] It shows that the marginal rate of substitution between public and private goods on the left-hand side is equal to the marginal cost of public funds (henceforth MCF) times the marginal rate of transformation (which equals unity in our model). Eq. (4.9) shows that the MCF_i rises in the tax elasticity of capital $\epsilon_{K,i}$. Intuitively, a higher tax elasticity implies a larger erosion of the tax base. Accordingly, the tax is more distortionary. The MCF_i in Eq. (4.9) increases also in $\epsilon_{R,i}$ if country i is a net capital exporter ($e > k_i$). It decreases if it is a net capital importer ($e < k_i$). Intuitively, a net capital exporter is a net receiver of interest vis-a-vis the rest of the world. Therefore, it suffers from a welfare loss if the interest rate drops. This makes public goods more expensive as higher taxes reduce the interest rate. For a net capital importer, the lower interest rate is a net benefit because the country would pay less to foreign capital owners, which reduces the MCF.

The elasticities $\epsilon_{K,i}$ and $\epsilon_{R,i}$ in Eq. (4.9) vary with the tax regime adopted by countries. Appendix A derives expressions for these elasticities under four different regimes: full harmonization, decentralization, ECA under Nash and ECA under Stackelberg behavior of governments. Table 4.1 summarizes the elasticities under these four regimes. Note, however, that the elasticities in Table 4.1 cannot be directly compared as they are evaluated at different equilibria (i.e. at different levels of k_i and t_i). Yet, I can compare their values when evaluated at one equilibrium, e.g. the decentralized equilibrium.

4.3.1 Harmonization

The superscript 'H 'is used to indicate variables under the harmonized regime. If countries harmonize their tax systems, they adopt uniform tax rates and simultaneously modify them. According to Table 4.1, this implies that $\epsilon^H_{K,i} = 0$ and $\epsilon^H_{R,i} = 1$. Intuitively, Eq.

[10] I assume that both g_i and c_i are normal goods. It follows that: $\partial MRS_i(.)/\partial t_i < 0$, i.e. choosing a higher tax rate leads to a reduction in the marginal valuation of the public good. The assumption of normal goods implies: $\partial MRS_i(.)/\partial c_i > 0$ and $\partial MRS_i(.)/\partial g_i < 0$. This assumption is used by Bayindir-Upmann and Ziad (2005) to proof the existence of a second-order locally consistent equilibrium for classical tax-competition models.

[11] See Atkinson and Stern (1974) for a discussion on the modified Samuelson rule for the optimal provision of public goods.

Table 4.1: Elasticities under four different regimes

Regime	Capital	Interest Rate
Harmonization (H)	$\epsilon^H_{K,i} = 0$	$\epsilon^H_{R,i} = 1$
Decentralization (D)	$\epsilon^D_{K,i} = -\frac{t_i}{f_i''(.)k_i}\left[\frac{s_j(1/f_j''(.))+s_k(1/f_k''(.))}{\Delta}\right] > 0$	$\epsilon^D_{R,i} = \frac{s_i(1/f_i''(.))}{\Delta} > 0$
ECA Nash (N)	$\epsilon^N_{K,u} = -\frac{t_u}{f_u''(.)k_u}\left[\frac{(1-2s)(1/f_3''(.))}{\Delta}\right] > 0$ $\epsilon^N_{K,3} = -\frac{t_3}{f_3''(.)k_3}\left[\frac{2s(1/f_u''(.))}{\Delta}\right] > 0$	$\epsilon^N_{R,u} = \frac{2s(1/f_u''(.))}{\Delta} > 0$ $\epsilon^N_{R,3} = \frac{(1-2s)(1/f_3''(.))}{\Delta} > 0$
ECA Stackelberg (S)	$\epsilon^S_{K,u} = \epsilon^N_{K,u}\,(1 - E[\partial t_3/\partial t_u])$ $\epsilon^S_{K,3} = \epsilon^N_{K,3}$	$\epsilon^S_{R,u} = \epsilon^N_{R,u} + \epsilon^N_{R,3}E[\partial t_3/\partial t_u]$ $\epsilon^S_{R,3} = \epsilon^N_{R,3}$
Common denominator	$\Delta = s_1(1/f_1''(.) + s_2(1/f_2''(.)) + s_3(1/f_3''(.)) < 0$	

(4.5) shows that the world capital stock is fixed and supplied inelastically. Hence, a global tax on capital boils down to a lump-sum tax. As capital does not change, any tax should be absorbed by a change in the interest rate. The uniform global tax rate is equal in all countries, so that $k_i = e$. As a result, Eq. (4.6) and (4.7) simplify to $\frac{\partial c_i(.)}{\partial t_i} = -k_i$ and $\frac{\partial g_i(.)}{\partial t_i} = k_i$, i.e. a higher tax on capital transfers funds from private to public consumption, without inducing distortions. The MCF_i in Eq. (4.9) equals unity and the marginal rate of substitution between public and private goods equals its marginal rate of transformation. This reflects the ordinary Samuelson rule for the optimal provision of public goods. Global harmonization thus brings us in a first-best world.

4.3.2 Decentralization

Under decentralization, countries set their tax rates individually. I assume that governments do not take into account the impact of their own tax rate on other countries' policies, that is, I consider a Cournot-Nash equilibrium. Superscript "D" denotes variables evaluated under the decentralized regime. The elasticity $\epsilon^D_{K,i}$ in Table 4.1 is unambiguously positive, i.e. an increase in t_i reduces capital in country i. The elasticity depends on the capital demand responses in other countries, which determine the impact on the world interest rate. Note that, in the model considered, governments will never set tax rates on the downward sloping part of the Laffer curve, implying: $0 < \epsilon^D_{K,i} < 1$. In Table 4.1, we see that $0 < \epsilon^D_{R,i} < 1$. Hence, a higher tax rate in country i unambiguously reduces the world interest rate.

The MCF_i under decentralization in Eq. (4.9), denoted by MCF_i^D, exceeds unity for capital-exporting countries (where $e/k_i > 1$). For these countries, both the distortion in capital demand and the reduction in the interest rate render the tax distortionary. In capital importing countries (where $e/k_i < 1$), MCF_i^D exceeds unity only if the decline in capital induced by taxes, as measured by $\epsilon_{K,i}^D$, is large relative to the benefit of a lower interest rate, as measured by $\epsilon_{R,i}^D\left[(e/k_i)-1\right]$. Intuitively, capital importers export part of the tax burden abroad to foreign capital owners by reducing the interest rate.

4.3.3 ECA Nash

Under the enhanced cooperation agreement (ECA), countries 1 and 2 form a union (u) in setting their tax rates. Country 3 does not join this union. As countries 1 and 2 are equivalent, it follows that: $k_u = k_1 = k_2$, $f_u''(.) = f_1''(.) = f_2''(.)$ and $t_u = t_1 = t_2$. I assume that the ECA countries maximize the sum of welfare in the two countries: $sU_1(.) + sU_2(.) = 2sU_u(.)$ and U_u denotes per capita welfare in the ECA. With respect to expectations of ECA governments, I start with the Cournot-Nash assumption that was also adopted under decentralization. That is, I assume that both the ECA countries and country 3 take the tax policy of the other country as given when deciding on their own tax policy. I use superscript "N" to indicate the case of Enhanced Cooperation under Cournot-Nash.

Table 4.1 shows that the elasticities for country 3 are the same as under decentralization. Neither its size nor the number of jurisdictions it competes with has changed. Hence, the creation of the ECA does not directly influence MCF_3^N. For countries 1 and 2, Table 4.1 shows that the elasticities differ from those under decentralization (when evaluated at the same equilibrium). In particular, $\epsilon_{K,1}^D = \epsilon_{K,2}^D > \epsilon_{K,u}^N$, i.e. ECA countries feature a smaller tax elasticity of capital than under decentralization. Intuitively, the ECA eliminates capital flows across the two ECA countries, which makes capital less responsive to the tax. Effectively, the ECA countries have grown bigger, which reduces their tax elasticity of capital. Table 4.1 shows further that $\epsilon_{R,u}^N > \epsilon_{R,1}^D = \epsilon_{R,2}^D$. The interest rate response to the tax is twice as large because ECA countries together are twice the size of a single country.

These results imply that, at the decentralized equilibrium, the MCF_u^N is smaller than MCF_i^D for $i = 1, 2$ on account of the smaller elasticity of capital demand. The larger tax-rate elasticity of the interest rate further reduces the MCF_u^N if the ECA countries are net capital importers. However, a larger interest elasticity mitigates the reduction in the MCF_u^N if ECA countries are net capital exporters.

4.3.4 ECA Stackelberg

Under Stackelberg, one country foresees the strategic tax reaction by the other country when deciding about its own tax policy. This is the Stackelberg leader. In the analysis, I consider the case where the ECA countries act as Stackelberg leader. Hence, the ECA countries choose their optimal point on the reaction function of country 3. The superscript "S" is used to indicate the case of Enhanced Cooperation under Stackelberg.

The elasticities under Stackelberg, $\epsilon^S_{R,i}$ and $\epsilon^S_{K,i}$ in Table 4.1, depend on the strategic reaction of country 3 ($\partial t_3/\partial t_u$).[12] I compare these elasticities with those under decentralization and ECA Nash, again evaluated at the decentralized equilibrium. If taxes are strategic complements (i.e. if $\partial t_3/\partial t_u > 0$), we see from Table 4.1 that the tax elasticity of capital in the ECA countries will be smaller than under Nash, i.e. $\epsilon^S_{K,u} < \epsilon^N_{K,u}$. The reason is that the ECA countries realize that country 3 will set a higher tax rate in response to the higher rate in the ECA countries, which mitigates the expected capital outflow. However, if taxes are strategic substitutes (i.e. if $\partial t_3/\partial t_u < 0$), it follows that: $\epsilon^S_{K,u} > \epsilon^N_{K,u}$. The expected erosion of the tax base is now larger under Stackelberg than under Nash, because country 3 reduces its tax in response to the higher rate in the ECA countries. This reinforces the outflow of capital. In this case, I cannot be sure that $\epsilon^S_{K,u}$ is smaller than $\epsilon^D_{K,1} = \epsilon^D_{K,2}$.

Under strategic complementarity, the higher tax rate in ECA countries amplifies the reduction in the interest rate compared to the ECA-Nash regime, i.e. $\epsilon^S_{R,u} > \epsilon^N_{R,u}$. For capital importing countries, both the smaller capital elasticity and a larger interest elasticity reduce the MCF under Stackelberg compared to Nash. For a capital exporter, strategic complementarity implies offsetting effects on the MCF as the higher interest elasticity raises the MCF. Under strategic substitutability, we have $\epsilon^S_{R,i} < \epsilon^N_{R,i}$. In that case, the MCF is unambiguously larger under Stackelberg than under Nash for capital importing countries (for whom both the capital elasticity is larger and the interest elasticity is smaller). For capital exporting countries, the two effects are offsetting and therefore I cannot draw conclusions how the Stackelberg outcome compares to the decentralized equilibrium.

[12] If country 3 would respond aggressively, i.e. $\partial t_3/\partial t_u$ close to or above 1, it is possible that the sign of the elasticities changes. I rule out this possibility, however, and will assume that $\epsilon^S_{R,i} > 0$ and $1 > \epsilon^S_{K,i} > 0$.

4.3.5 The Impact of Country Size

The formation of an ECA has the same properties as an increase in country size of the cooperating countries. Indeed, country size determines the elasticities $\epsilon_{K,i}$ and $\epsilon_{R,i}$ and, therefore, the optimal tax rates. For instance, the partial derivatives of $\epsilon_{K,1}$ and $\epsilon_{R,1}$ with respect to the size of country 1 are given by:

$$\frac{\partial \epsilon^D_{K,1}}{\partial s_1} = -\epsilon^D_{K,1} \frac{1/f_1''}{\Delta} < 0, \tag{4.10}$$

$$\frac{\partial \epsilon^D_{R,1}}{\partial s_1} = \epsilon^D_{R,1} \left[1 - \epsilon^D_{R,1}\right] > 0. \tag{4.11}$$

where Δ is defined in Table 4.1. Eq. (4.10) and (4.11) suggest that country size reduces the tax elasticity of capital and increases the tax-rate elasticity of the interest rate. The larger interest elasticity is because large countries have more market power on the world capital market. In turn, this implies a bigger offsetting impact of the tax on the cost of capital, causing a smaller tax elasticity of capital. On account of the smaller $\epsilon_{K,i}$, large countries feature a lower MCF and will set a higher tax rate than small countries. For that reason, large countries will be capital exporters and small countries will be capital importers.

4.4 Strategic Tax Response by the Outsider Country

Country 3, the outsider country, is not affected by the formation of an ECA ex-ante: nor the number of countries it competes with, nor its own size is affected by the formation of an ECA. Country 3 is only affected after countries 1 and 2 decide to change their tax policy due to the ECA. The strategic tax response by country 3 to the change in policy by the ECA members is vital for determining the changes in welfare and optimal tax policies due to ECAs, especially in case of Stackelberg.

To understand the factors determining strategic tax responses, this section derives them analytically. In general, tax reaction functions take the form: $t_i = V_i(t_j, t_k)$, where $F_i(t_j, t_k)$ gives the best response of country i to the tax rates chosen by countries j and k. Unfortunately, I am unable to find closed-form expressions for the tax rates under each regime. Therefore, I linearize the tax reaction functions around an initial equilibrium. This yields analytical expressions of the tax by a country in response to tax changes in

the other countries. The linearized tax responses reflect marginal tax changes relative to the initial, decentralized, equilibrium.[13]

4.4.1 Linearization

A change in tax policy by neighboring countries will change both the MRS on the left-hand side of Eq. (4.9) and the MCF on the right-hand side. To obtain a reduced form expression for the tax reaction function, I linearize both:

$$\widetilde{MRS}_i = \widetilde{MCF}_i, \tag{4.12}$$

where a tilde ($\tilde{}$) denotes a relative change.

First, I linearize the MCF on the right-hand side of Eq. (4.12). From Eq. (4.9) it follows that the MCF depends on $\epsilon_{K,i}$, $\epsilon_{R,i}$ and k_i. Hence, I can write the linearized MCF as:

$$\widetilde{MCF}_i = \eta_i \widetilde{\epsilon_{K,i}} + \lambda_i \widetilde{\epsilon_{R,i}} - \mu_i \tilde{k}_i, \tag{4.13}$$

where

$$\eta_i \equiv \frac{\epsilon_{K,i}}{1-\epsilon_{K,i}} > 0, \quad \lambda_i \equiv \frac{\epsilon_{R,i}\left[e/k_i - 1\right]}{1+\epsilon_{R,i}\left[e/k_i - 1\right]}, \quad \mu_i \equiv \frac{\epsilon_{R,i} e/k_i}{1+\epsilon_{R,i}\left[e/k_i - 1\right]} > 0.$$

The MCF in Eq. (4.13) reflects the price of the public good. The first term on the right-hand side of Eq. (4.13) shows by how much the MCF rises in the tax elasticity of capital. This effect, captured by η_i, is convex in the capital elasticity. In particular, the closer a country is to the top of the Laffer curve ($\epsilon_{K,i} \approx 1$), the larger is the impact of a marginal change in the elasticity on the MCF.

The second term on the right-hand side of Eq. (4.13) cannot be signed unambiguously as it depends on the status of a country regarding capital export. If a country is a net capital importer ($e/k_i < 1$), we see that $\lambda_i < 0$, i.e. a higher interest elasticity reduces the MCF. This is because a capital importer can shift part of its tax burden to foreign suppliers of capital. For a capital-exporting country, however, $\lambda_i > 0$ so that a higher interest elasticity raises the MCF.

The third term on the right-hand side of Eq. (4.13) suggests that a higher capital stock will ceteris paribus reduce the MCF. The reason is that an increase in the capital stock (for a given endowment of capital owned by domestic residents, e) will make reductions

[13]The second-order conditions are satisfied for the decentralized equilibrium. ∇_i in Eq. (4.20) is equal to minus the second-order condition and it is always positive for the simulations presented in this thesis.

in the interest rate less costly at the margin. Indeed, more interest needs to be paid to foreign capital owners so that the potential for tax exportation increases. Accordingly, taxes become less costly because they reduce the interest rate through $\epsilon_{R,i}$.

Second, I linearize the MRS on the left-hand side of Eq. (4.12) for a Constant Elasticity of Substitution (CES) utility function:

$$\widetilde{MRS}_i = \frac{\widetilde{c}_i - \widetilde{g}_i}{\sigma}, \tag{4.14}$$

where $\sigma \equiv dlog(c_i/g_i)/dlog(MRS_i) > 0$ denotes the elasticity of substitution between public and private goods which describes the slope of the indifference curve in the $(c, g$ space. σ therefore determines the change in the willingness to pay for public goods following a change in the ratio of private to public consumption. If σ is large, public and private goods are close substitutes, so that the willingness to pay for public goods is not strongly affected by changes in the ratio of private to public consumption.

I substitute Eq. (4.1) into the household budget constraint Eq. (4.2) to eliminate f_i' and get for private consumption: $c_i = f_i(.) + \rho(e - k_i) - t_i k_i$. Linearizing this expression and combining it with the government budget constraint in Eq. (4.3), I arrive at an expression for the ratio of private and public consumption:

$$\tilde{c}_i - \tilde{g}_i = -\tilde{k}_i + \phi_i \tilde{\rho} - \frac{1}{\alpha_i}\tilde{t}_i, \tag{4.15}$$

where $\alpha_i \equiv c_i/(c_i + g_i)$ and $\phi_i \equiv (e - k_i)(\rho/c_i)$. The first term on the right-hand side of Eq. (4.15) states that a higher capital stock directly reduces the ratio of private-to-public-consumption. The reason is that, at the margin, an inflow of capital leaves private consumption unchanged as the return to the imported unit of capital is paid to the foreign capital owner. However, public revenue increases due to a broader capital tax base. Hence, an inflow of capital directly reduces the ratio of private to public consumption.

The second term on the right-hand side of Eq. (4.15) measures the impact of a higher interest rate. On the one hand, a higher interest rate directly increases income from the capital endowment received by the residents of country i, which raises private consumption. On the other hand, a higher interest rate increases the capital costs for firms. This reduces wages because labor and capital are cooperative factors and, therefore, private consumption. On balance, the net impact of a higher interest rate depends on the coefficient ϕ_i, which depends on net capital exports. For a net capital exporter, it follows that $\phi_i > 0$ so that the positive effect on interest income dominates the negative wage effect. Hence, a higher interest rate increases private consumption. For a net capital importer, it follows that $\phi_i < 0$ so that a higher interest rate reduces private consumption.

The third term on the right-hand side of Eq. (4.15) captures the direct negative impact of a higher tax on the ratio of private to public consumption. This effect depends on the initial share of private consumption, α_i.

If I substitute Eq. (4.13), Eq. (4.14) and Eq. (4.15) into Eq. (4.12), I arrive at an expression for the change in the tax rate of country i, as a function of the changes in the capital stock, the interest rate and the elasticities:

$$\frac{1}{\alpha_i}\tilde{t}_i = \left[\mu_i - \frac{1}{\sigma}\right]\tilde{k}_i + \frac{\phi_i}{\sigma}\tilde{\rho} - \eta_i\widetilde{\epsilon_{K,i}} - \lambda_i\widetilde{\epsilon_{R,i}}. \tag{4.16}$$

4.4.2 Starting from the Decentralized Equilibrium

I will now rewrite the variables on the right-hand side of Eq. (4.16) in terms of changes in tax rates. Our focus will be entirely on the strategic tax responses, evaluated at the initial decentralized equilibrium.

To arrive at the relative change in the elasticities on the right-hand side of Eq. (4.16), I need to specify a production function. I follow the literature (see amongst others Bucovetsky (1991, 2009), Devereux *et al.* (2008), Parry (2003) and Wilson (1991)) by adopting a quadratic production function of the form: $f(k) = [a - (1/2)bk]k$ with $a > 0$ and $b > 0$. This allows me to obtain more simple analytical reduced-form equations for the elasticities. In particular, the quadratic form implies the following elasticities: $\epsilon_{K,i} = \frac{t_i(1-s_i)}{bk_i}$ and $\epsilon_{R,i} = s_i$. The next step in the analysis is the linearization of the tax elasticities. Note that tax competition by definition only exists due to endogenous tax elasticities, the foreign tax rates do not directly enter Eq. (4.9). The tax base elasticities are a function of the tax base, which is dependent on foreign taxes. By linearization, I obtain:

$$\widetilde{\epsilon_{K,i}} = \tilde{t}_i - \widetilde{k}_i \quad \text{and} \quad \widetilde{\epsilon_{R,i}} = 0, \tag{4.17}$$

Hence, the tax elasticity of the capital stock rises proportionally with the tax rate and in reductions in the capital stock, which is due to the broadening of the tax base. The interest elasticity is not marginally affected by the tax rate.[14]

[14]The linearized elasticities for a general production function are complex and take the form: $\widetilde{\epsilon_{R,i}} = \nu_{1,i}\widetilde{k}_i$ and $\widetilde{\epsilon_{K,i}} = \widetilde{t}_i - (1 + \pi_{1,i}\nu_{1,i} - \pi_{2,i})\widetilde{k}_i$, where the parameters $\pi_{1,i}, \pi_{2,i}$ and $\nu_{1,i}$ are positive. A capital inflow leads to: (i) a broader tax base which lowers the capital stock elasticity, (ii) more market power ($\nu_{1,i} > 0$) and hence a larger interest elasticity and smaller capital stock elasticity ($\pi_{1,i}\nu_{1,i} > 0$), (iii) a larger semi-elasticity of capital demand ($\pi_{2,i} > 0$) which increases the capital stock elasticity. The latter effect dominates for sufficiently small countries. This ambiguity disappears in case of an *ad valorem* rate combined with an elasticity of substitution between capital and labor less than or equal to unity. Derivations and simulation results can be obtained upon request. The existence of strategic substitutes remains as this depends on the decreasing marginal utility of tax revenues.

To rewrite the relative changes in the interest rate and the capital stock on the right-hand side of Eq. (4.16), I linearize the capital market equilibrium in Eq. (4.5) and the first-order condition for firms in Eq. (4.1). This yields:

$$\tilde{\rho} = -\frac{t_i}{\rho}\epsilon_{R,i}\tilde{t}_i - \frac{t_j}{\rho}\epsilon_{R,j}\tilde{t}_j, \tag{4.18}$$

$$\tilde{k}_i = -\epsilon_{K,i}\tilde{t}_i + \epsilon_{K,ji}\tilde{t}_j, \tag{4.19}$$

for $i \neq j = \{u, 3\}$, where $\epsilon_{K,ji} \equiv -\frac{t_j}{f_i'' k_i}\frac{s_j(1/f_j'')}{\Delta} > 0$ denotes the cross-tax elasticity of capital demand in country i with respect to the tax rate in country j. Eq. (4.18) shows that an increase in taxes in both ECA and non-ECA countries reduces interest rates, with an impact size determined by the interest elasticity. The first term in Eq. (4.19) shows that capital declines in the own tax rate of a country, an effect measured by the tax elasticity of capital. The second term in Eq. (4.19) shows by how much capital demand in country i increases if country j increases its tax, an effect that is always positive.

Substituting Eqs. (4.17), (4.18) and (4.19) into Eq. (4.16), I find the linearized tax reaction function:

$$\nabla_i \tilde{t}_i = \left[(\mu_i + \eta_i)\epsilon_{K,ji} - \frac{\epsilon_{K,ji}}{\sigma} - \frac{\phi_i}{\sigma}\frac{t_j}{\rho}\epsilon_{R,j}\right]\tilde{t}_j \quad \text{for} \quad i \neq j = u, 3, \tag{4.20}$$

where

$$\nabla_i \equiv \frac{1}{\sigma\alpha_i} + \eta_i + ((\mu_i + \eta_i) - \frac{1}{\sigma})\epsilon_{K,i} + \frac{\phi_i}{\sigma}\frac{t_i}{\rho}\epsilon_{R,i} > 0$$

equals (minus) the second-order condition for a welfare maximum.

The right-hand side of Eq. (4.20) determines the sign of the strategic tax response by country i to an increase in the tax rate of country j. The tax rate of country 3 is a strategic complement to the tax rate in the ECA countries if the following condition holds:

$$\overbrace{(\mu_3 + \eta_3)\epsilon_{K,3u}}^{\widetilde{MCF}} - \overbrace{\frac{\epsilon_{K,3u}}{\sigma} - \frac{\phi_3}{\sigma}\frac{t_u}{\rho}\epsilon_{R,u}}^{\widetilde{MRS}} > 0. \tag{4.21}$$

Condition (4.21) consists of three terms. The first term, captured by $(\mu_3 + \eta_3)$, measures how the flow of capital from the ECA countries to country 3 makes it attractive for the latter country to increase its tax due to a lower MCF. On the one hand, the MCF falls because the inflow of capital reduces the capital elasticity (see Eq. (4.17)). This effect is captured by $\eta_3 > 0$. The convexity of η_3 implies that this effect is especially strong for countries with a high capital elasticity. On the other hand, capital inflows make

it beneficial for country 3 to export the tax burden via reductions in the interest rate. This effect is captured by $\mu_3 > 0$ and is, ceteris paribus, larger for a capital exporter. This first term is always positive: based on this argument, tax rates are always strategic complements.

Hence, the potential for strategic substitutes originates from the remaining two terms which follow from the linearization of the MRS. The second term in condition (4.21) has a negative sign and reduces the likelihood of strategic complementarity. This term makes clear that an inflow of capital increases public revenue through a broader capital tax base. This reduces the marginal willingness to pay for public goods giving an incentive to lower the tax rate. The reduction in the marginal willingness to pay for public goods depends on σ. When public and private goods are closer substitutes (larger value of σ), the reduction in the marginal willingness to pay for public goods will be smaller.

The last term in condition (4.21) measures the negative impact of the higher tax in the ECA countries on the world interest rate. The lower interest rate either increases or decreases private consumption in country 3, depending on whether it is a net capital importer ($\phi_3 < 0$) or a net capital exporter ($\phi_3 > 0$), respectively. If private consumption is increased, the marginal willingness to pay for the public good increases, this gives an incentive to raise the tax rate. The opposite holds in case private consumption is decreased. Again, changes in the marginal willingness to pay for public goods depend on the size of σ.

To summarize, from Eq. (4.21) the following proposition can be derived:

Proposition 1 *The probability that country i will decrease its tax rate in response to an increase in the tax rate of country j (strategic substitutes) is large when: (i) the substitution elasticity between public and private goods (σ) is small; (ii) $\eta_i + \mu_i$ is small; (iii) the foreign tax increase does not increase private consumption ($\phi_i > 0$ or $\phi_i \approx 0$).*

Condition (i) ensures that the foreign tax increases causes a relative large decrease in the marginal willingness to pay for additional public goods. Condition (ii) ensures that the foreign tax increases causes a relative small reduction in the MCF. The size of $\eta_i + \mu_i$ is dominated by the convexity of η_i. This implies that especially countries close to the top of their Laffer curve ($\epsilon_{k,i} \approx 1$) experience a large reduction in the MCF: $\eta_i + \mu_i$ is large. From Eq. (4.10) we learn that this is the case for small countries. On the other hand, $\eta_i + \mu_i$ is relatively small when country i is relatively far from the top of its Laffer curve initially. This occurs when country i is large. Condition (iii) excludes the possibility that the foreign tax increase raises private consumption substantially. This would erode the

reduction in the marginal valuation of public goods and hence the incentive to reduce the own tax rate.

It is important to stress that the existence of strategic substitutes claimed in proposition 1 depends on a decreasing marginal valuation of public goods and therefore on the assumed objective function of the government.[15] Alternative assumptions on the production process (functional form, production factors) influence the argument only quantitatively by affecting the marginal excess burden from taxation and the top of the Laffer curve for a particular country, but do not rule out the existence of strategic substitutes.

4.4.3 Simulations

Linearization offers insight in the parameters that determine the slope of the tax reaction function locally, starting from an initial equilibrium. It offers little insight, however, in the global properties of the tax reaction functions. To illustrate these properties, this subsection simulates tax reaction curves for country 3, i.e. the outside country. In performing the simulations, I use a CES utility function of the form: $U = \left[\omega c^{(\sigma-1)/\sigma} + (1-\omega)g^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)}$ and a quadratic production function: $f(k) = (a - 1/2bk)k$. The parameters adopted are: $\omega = 1/4$, $a = 2$, and $b = 1/2$.[16] Given the importance of the substitution elasticity between public and private goods, I consider two values: $\sigma = 0.1$ and $\sigma_{gc} = 1$.[17] I draw the fiscal reaction curves of country 3 under three different assumptions regarding its size: $s_3 = 0.8, s_3 = 0.6$ and $s_3 = 0.2$.

Figures (4.1) and (4.2) show the tax reaction curves for, $\sigma = 0.1$ and $\sigma_{gc} = 1$, respectively. The figures suggest that the tax reaction function of country 3 shifts upward in the size of country 3. Hence, larger countries set higher tax rates.

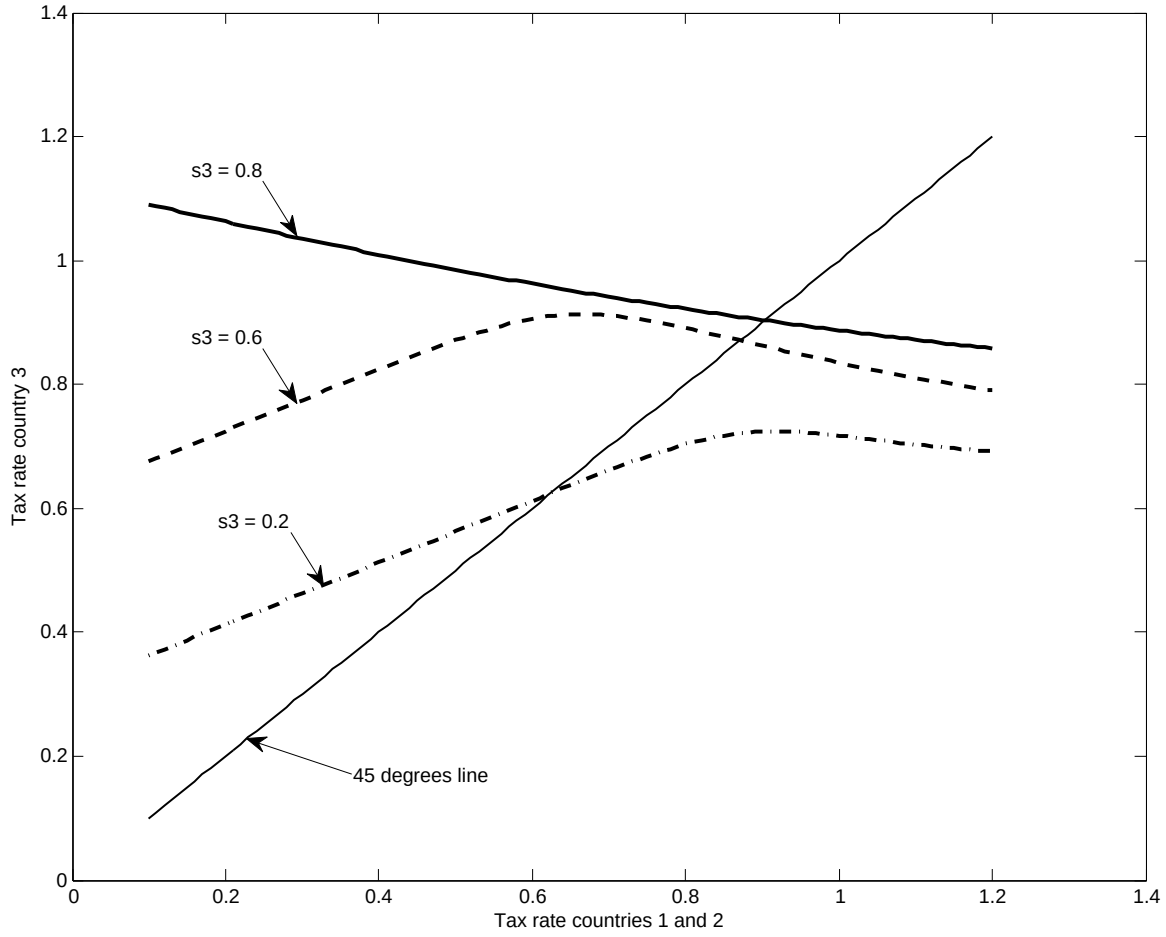
The slope of the fiscal reaction function is always positive in Figure (4.2), i.e. when $\sigma = 1$. Hence, country 3 will raise its tax in response to a higher rate in the ECA countries. This is consistent with condition (4.21) for strategic complementarity. Indeed, for a high

[15] Popular modeling approaches in the tax-competition literature impose strategic complementarity by assuming either that the government maximizes tax revenues (see e.g. Kanbur and Keen (1993)) or that the government has a linear objective function in both private and public consumption (see e.g. Devereux et al. (2008) and Bucovetsky (2009)).

[16] The fact that the model is highly stylized and characterized by asymmetric countries complicates a realistic calibration. Therefore, the choice of parameters is somewhat arbitrary. In particular, the imposed positive net return: $f'(.) = a - bk_i > t_i$ constraints our choice of the production function parameters a and b. The parameter values chosen imply that the elasticity of the demand for capital with respect to the tax-inclusive cost of capital ($\epsilon_{\rho+t_i}$) equals $a/b - 1 = 3$, whereas a value close to or below 1 is more in line with the empirical literature. A robustness analysis which in not reported confirms my main findings.

[17] Wildasin (1989) and Parry (2003) study a range of [0.2, 1] and [0.3, 1] for σ, respectively, and stress that scarce empirical evidence points to an inelastic demand for public goods (see also Rubinfeld (1987)).

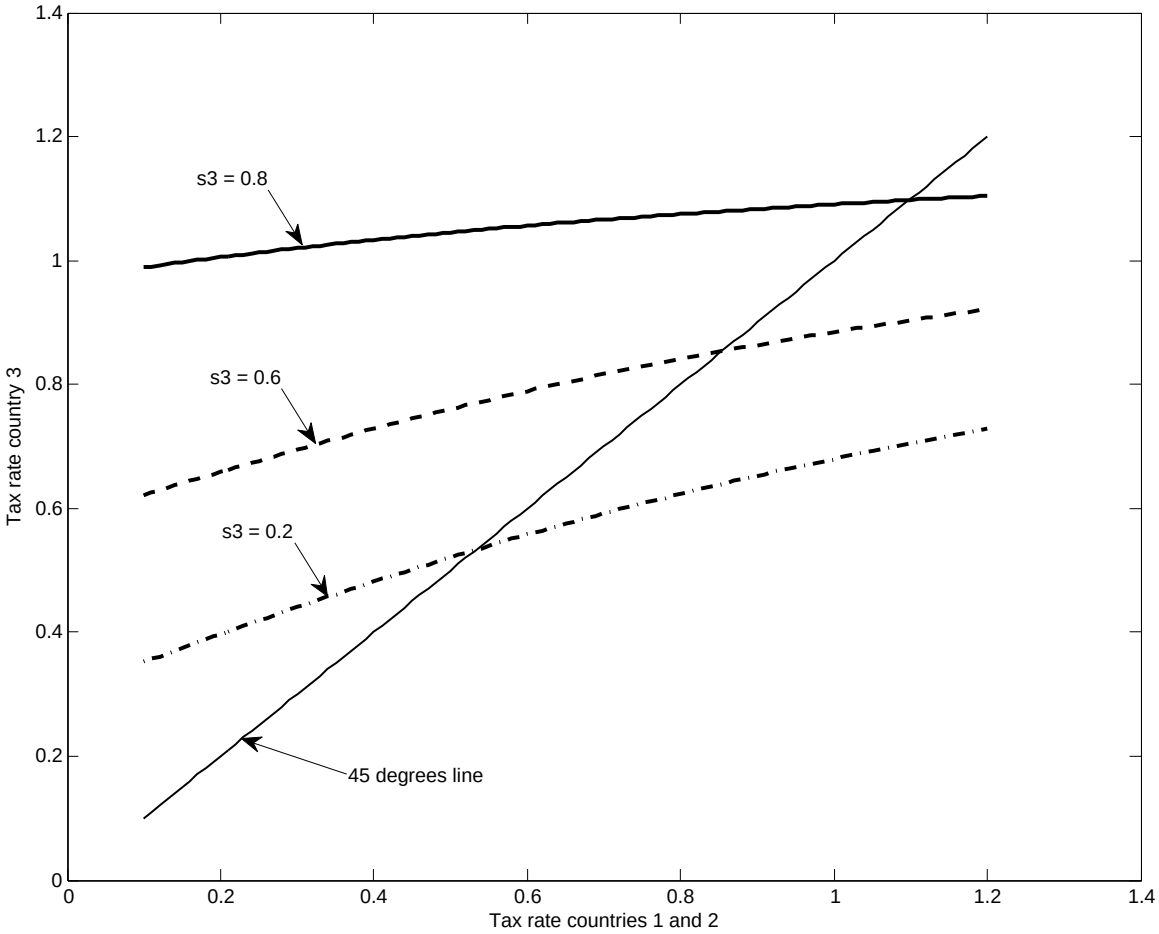
Figure 4.1: Tax Reaction Function country 3, $\sigma = 0.1$



value of σ, the first term in condition (4.21) is relatively important, which makes strategic complementarity more likely. In Figure (4.1), i.e. when $\sigma = 0.1$, the tax reaction function of country 3 can be either upward or downward sloping. With a small σ, the first term in condition (4.21) is relatively unimportant. Hence, the decrease in the willingness to pay for public goods is more likely to dominate the tax response.

If country 3 is smaller, its reaction function is steeper in Figures (4.1) and (4.2). In Figure (4.1) the slope is even negative in case the size of country 3 equals 0.8. This can be explained by the size of η_i and ϕ_i. First, small countries feature a high tax elasticity of capital (η_i large), which constrains their attempt to raise tax revenue. As a result, small countries have a high valuation of additional public goods and have a strong incentive to increase their rate when a foreign tax increase relieves their public financing constraint. Large countries, on the other hand, feature a relative low tax elasticity of capital and are less constrained in raising tax revenue. This yields a relative low value of η_i.

Figure 4.2: Tax Reaction Function country 3, $\sigma = 1$



Second, the value of ϕ_i is important. As we will see below, large countries choose high tax rates and, hence, are capital exporters ($\phi_i > 0$). The foreign tax increase implies a reduction in net interest income. For small and low-tax countries the opposite result holds. The tax increase by a large country reduces net interest payments and, hence, increases private consumption ($\phi_i < 0$). The incentive to reduce the tax rate in response to the foreign tax increase is therefore reduced.

4.5 Simulating Equilibrium Tax Rates

This section numerically simulates the equilibrium tax rates. I do this for four different regimes (harmonization, decentralization, ECA Nash, and ECA Stackelberg) and a continuum of country size configurations. Figures (4.3) and (4.4) show the equilibrium tax rates for, respectively, $\sigma = 0.1$ and $\sigma_{gc} = 1$. On the horizontal axis is the size (s) of

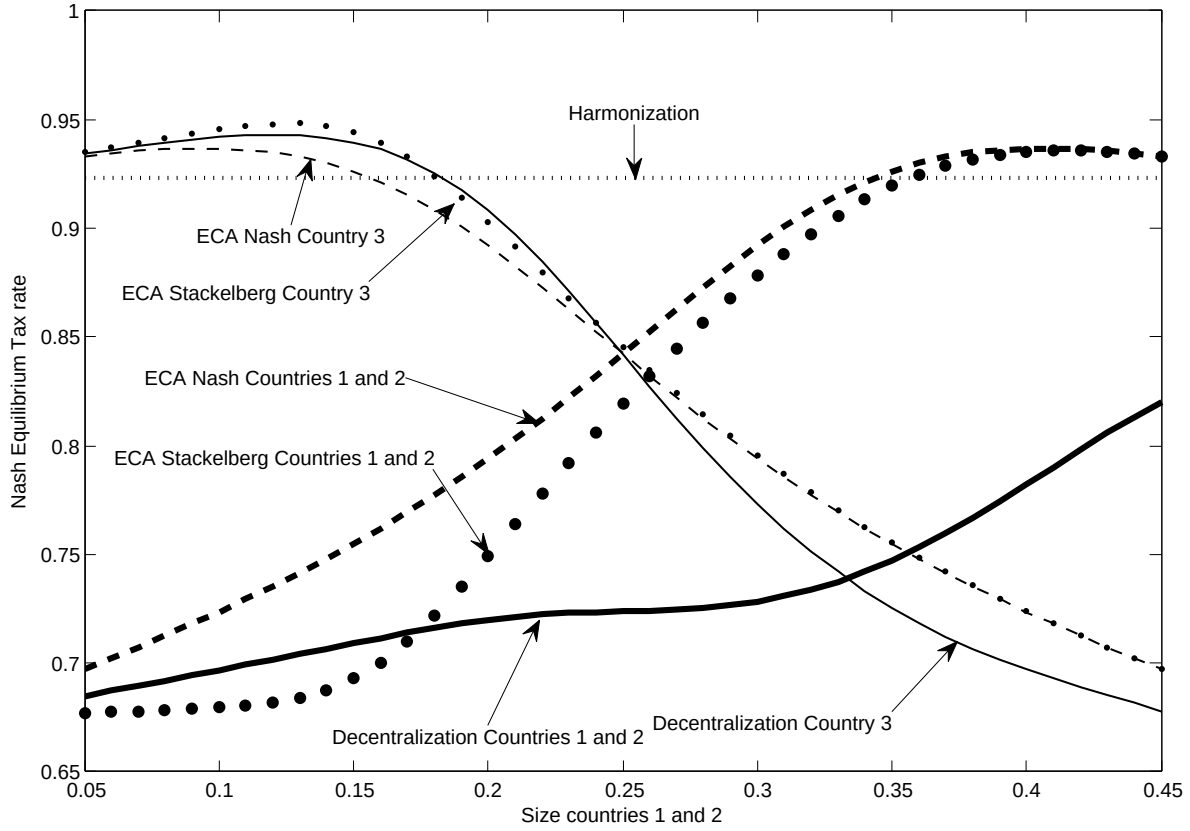
countries 1 and 2. It increases from $s = 0.05$ on the left to $s = 0.45$ on the right. As $s_3 = (1 - 2s)$, the size of country 3 moves between 0.9 and 0.1. The vertical axis captures the equilibrium tax rates. The fat lines describe the equilibrium taxes for countries 1 and 2 while the slimmer lines describe the equilibrium taxes for country 3. In performing the simulations, I use the same specifications and parameter values as in the previous section. The first-best harmonized rate, t_i^H, is flat in both figures and set at, respectively, $t_i^H = 0.92$ and $t_i^H = 1.31$ (note that these are unit-specific tax rates). They serve as a benchmark for the tax rates in the other regimes.

4.5.1 Decentralization

In Figures (4.3) and (4.4), the solid lines represent the equilibrium tax rates under decentralization: t_i^D. Under decentralization we see that governments generally set their tax rates lower than under harmonization, i.e. $t_i^D < t_i^H$. For instance, if countries are symmetric ($s = 0.33$), the optimal decentralized tax in all countries is $t_i^D = 0.74$ when $\sigma = 0.1$ and $t_i^D = 0.61$ when $\sigma_{gc} = 1$. This reflects the fiscal externality associated with tax-competition: the tax induces an outflow of capital to other countries, which hurts domestic welfare. Accordingly, countries set lower tax rates as they do not take into account the benefits from the outflow of capital for other countries. This fiscal externality is responsible for an underprovision of public goods (Zodrow and Mieszkowski (1986)).

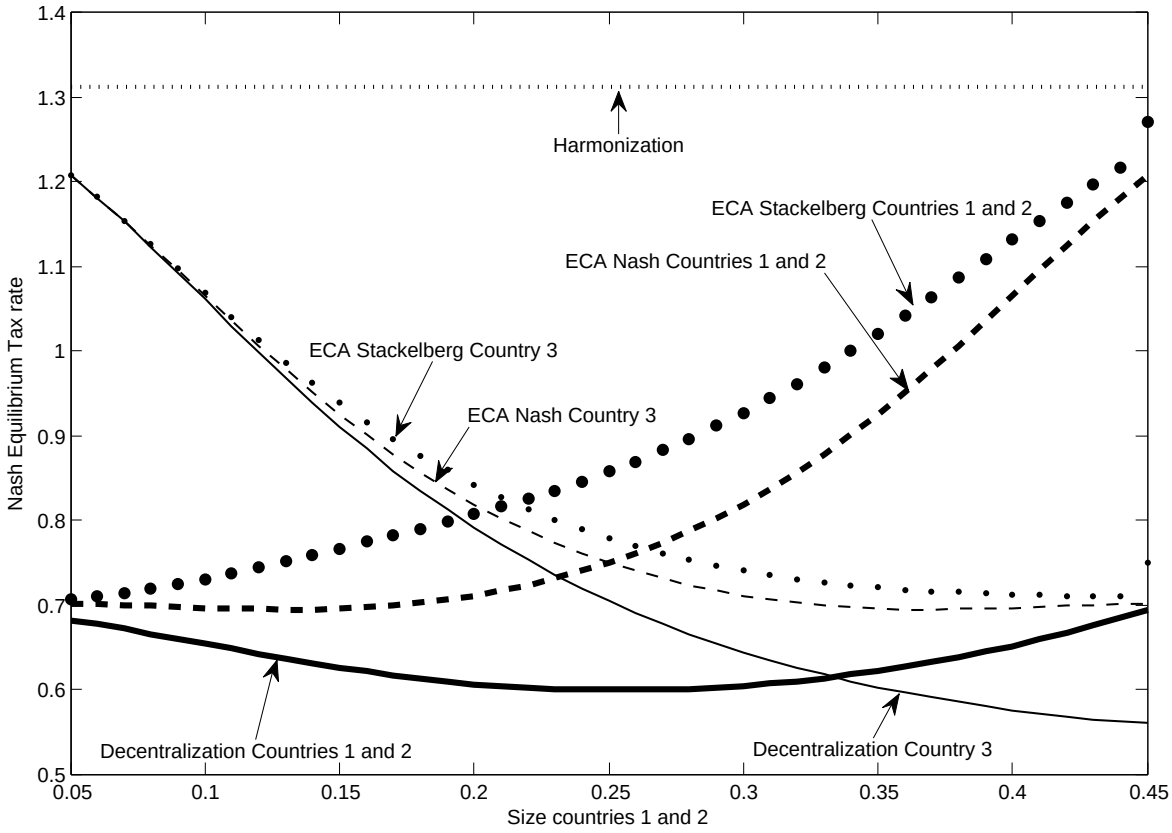
However, tax rates are not always lower under decentralization compared to harmonization. Figure (4.3) illustrates this for the case $\sigma = 0.1$. If s_3 is sufficiently large, and $s_1 = s_2$ is therefore small, we see that country 3 will set its tax rate under decentralization above the harmonized rate ($t_3^D > t_3^H$). The reason is that the small countries 1 and 2 set a much lower tax rate under decentralization than under harmonization. This causes an outflow of capital from country 3 to countries 1 and 2. Compared to the harmonized regime, country 3 thus has a smaller tax base and supplies fewer public goods for the same level of tax as under harmonization. If substitution between public and private consumption is difficult, the lower level of public goods is relatively costly in terms of welfare. Accordingly, the government of country 3 finds it optimal to increase the tax to raise the level of public goods. This raises the tax rate above the level under harmonization. Note that the level of public consumption might still be lower under decentralization, due to the outflow of capital from country 3 to countries 1 and 2. Figure (4.4) shows that the upward effect on the tax rate in country 3 is not sufficiently strong to compensate for the fiscal externality if $\sigma = 1$. In that case, decentralized tax rates are always lower than the harmonized rate.

Figure 4.3: Equilibrium tax rates under four regimes, $\sigma = 0.1$



In Figure (4.3), tax rates always increase in size. This is consistent with the partial derivatives of the elasticities with respect to size in Eqs. (4.10) and (4.11). Intuitively, a larger country features a lower tax elasticity of capital, $\epsilon_{K,i}$ and a higher tax rate elasticity of the interest rate, $\epsilon_{R,i}$. This is generally associated with a lower MCF and a higher tax rate. Also in Figure (4.4), the tax rate in country 3 increases in size. However, this is not the case for countries 1 and 2. Indeed, the relationship between the size of the ECA countries and the tax rate is U-shaped. Hence, for very small size, countries 1 and 2 set a higher tax rate than when they are slightly larger. For instance, Figure (4.4) shows that the tax rate in countries 1 and 2 is larger when $s = 0.05$ than when $s = 0.2$. This is due to general equilibrium effects induced by strategic tax responses. In particular, if the size of countries 1 and 2 is marginally increased, the size of country 3 is marginally decreased. From a partial equilibrium argument, countries 1 and 2 have a tendency to increase their tax rate, but country 3 has an incentive to reduce its rate. This worsens the tax rate differential from the perspective of countries 1 and 2 and results in a capital outflow. For

Figure 4.4: Equilibrium tax rates under four regimes, $\sigma = 1$



$\sigma = 1$, this capital outflow exerts a negative effect on the tax rate of countries 1 and 2. Accordingly, tax rates decrease in size over a certain range.

4.5.2 ECA Nash

ECA Nash tax rates in Figures (4.3) and (4.4) (t_u^N and t_3^N) are shown by the dashed lines. We see that these lines are symmetric in size around $s = 0.25$. Indeed, if $s = 0.25$ the ECA and country 3 are identical. When the relative size on either side changes, tax rates move symmetrically. Hence, tax-competition under the ECA Nash regime merely boils down to competition between two countries, where the size of the ECA is determined by the joint size of countries 1 and 2.

Figures (4.3) and (4.4) show that the ECA countries always set their tax rate higher under the ECA than under decentralization ($t_i^N > t_i^D$ for $i = \{1, 2\}$). This is for two reasons. First, the ECA reduces the tax elasticity of capital since spillovers between countries 1 and 2 are eliminated ($\epsilon_{K,i}^N < \epsilon_{K,i}^D$ for $i = 1, 2$). Second, the ECA increases

the tax rate elasticity of the interest rate ($\epsilon^N_{R,i} > \epsilon^D_{R,i}$ for $i = 1, 2$). If the ECA countries are small, they are net capital importers. In that case, both changes in the elasticities reduce the MCF so that ECA countries set a higher tax rate. If ECA countries are large, they are net capital exporters. In that case, the larger interest elasticity raises the MCF and thus offsets the effect of the lower capital elasticity. Nevertheless, the effect of a lower tax elasticity of capital dominates so that I always find a higher tax rate by the ECA countries. In fact, the difference between t^N and t^D increases in the size of the ECA countries. This is because size magnifies the fiscal externality among the two ECA countries relative to the fiscal externality vis-a-vis country 3. The gains from internalizing the intra-ECA fiscal externality is therefore relatively important.

Figure (4.4) shows that, if $\sigma = 1$, country 3 will always set its tax rate above the decentralized rate, i.e. $t^N_3 > t^D_3$. This is because the tax reaction function of country 3 is upward-sloping, i.e. the tax of country 3 is a strategic complement (see Figure (4.2)). As the ECA countries increase their tax rate by more if they are larger (i.e. if we move more to the right in Figure (4.4)), we see that this also induces a larger tax increase by country 3.

In Figure (4.3), where $\sigma = 0.1$, we see that the ECA-Nash tax in country 3 exceeds the decentralized rate only if $s > 0.25$. If $s < 0.25$, it follows that $t^N_3 < t^D_3$. For one part, the shift of the equilibrium taxes reflect strategic substitutability of country 3′s tax rate at the margin, i.e. $\frac{\partial t_3}{\partial t_u} < 0$ evaluated at the decentralization equilibrium. Indeed, following Eq. (4.21), for low σ the tax rate in country 3 is more likely to be a strategic substitute, especially if country 3 is large (i.e. s is small). For another part, as the reaction function is non-linear, the slope of the tax reaction of country 3 may adjust as the equilibrium changes. Therefore, the tax rates may be strategic complements at the margin in the ECA-Nash equilibrium, i.e. $\frac{\partial t_3}{\partial t_u} > 0$. This is illustrated by the inverse U-shape of the reaction curves in Figure (4.4). Figure (4.3) thus suggest that the tax in country 3 is a strategic complement on average when moving from t^D_3 to t^N_3 as long as $s > 0.25$.

4.5.3 ECA Stackelberg

Dotted lines in Figures (4.3) and (4.4) show the equilibrium tax rates under ECA-Stackelberg. Figure (4.4) (with $\sigma = 1$) reveals that the ECA countries always set a higher tax under Stackelberg leadership than under Nash or decentralization (i.e. $t^S_u > t^N_u > t^D_i$ for $i = 1, 2$). Intuitively, the tax rate in country 3 is always a strategic complement if σ is large enough, so that $\partial t_3 / \partial t_u > 0$. Accordingly, the ECA countries realize that the

equilibrium capital response to an increase in the tax is smaller, as country 3 will also increase its tax rate. This induces them to set a higher tax rate.

In Figure (4.3) (with $\sigma = 0.1$), the results are less clear-cut as the low value of σ allows for strategic substitutability. In particular, Figure (4.3) shows that the tax rate in the ECA countries 1 and 2 under Stackelberg is always below the Nash tax rate, i.e. $t_u^S < t_u^N$. This is due to strategic substitutability at the margin of the ECA-Nash equilibrium, i.e. $\partial t_3/\partial t_u < 0$. This seems at odds with the higher ECA-Nash tax rates in Figure (4.3) for $s > 0.25$ for country 3. However, this is due to the non-linear shape of the tax reaction curve. In particular, while the tax rate of country 3 is a strategic substitute evaluated at the ECA-Nash equilibrium, it may be a strategic complement evaluated at the decentralized equilibrium. The observed change in the equilibrium tax rate by country 3 between the decentralized equilibrium and the ECA-Nash equilibrium, due to the increased tax rate by countries 1 and 2, reflects the average slope of the reaction curve, not the marginal effect.

Accordingly, country 3 may set a higher tax under ECA-Nash than under decentralization if $s > 0.25$, i.e. $t_3^N < t_3^D$, but still set lower tax under ECA Stackelberg compared to ECA Nash $t_u^S < t_u^N$. For $s < 0.15$, Figure (4.3) shows that the ECA-Stackelberg rate is even lower than the rate under decentralization ($t_u^S < t_i^D$ for $i = 1, 2$). In that case, the strength of strategic substitutability is so strong because this effect increases in the size of country 3. Strategic substitutability implies also that the equilibrium tax rate in country 3 is higher than under ECA-Nash, as ECA countries set a lower tax.

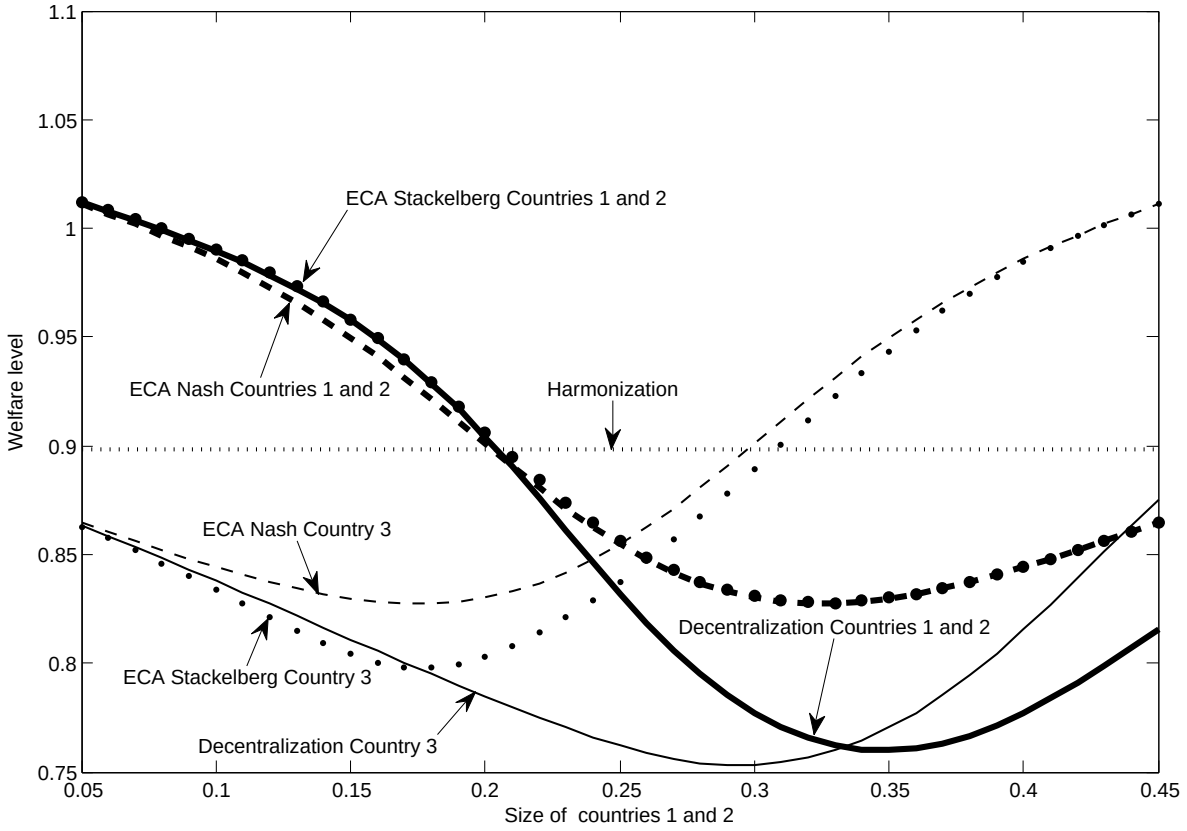
4.6 Comparing Welfare between Tax Regimes

This section compares the welfare levels across the four different coordination regimes. To that end, I compute the utility level of households for the specifications chosen in the simulation exercises before. As in the previous section, I look at a continuum of size configurations. The relations between country size, welfare and the tax regime are presented in Figures (4.5) and (4.6) for, respectively $\sigma = 0.1$ and $\sigma = 1$. The horizontal lines in Figures (4.5) and (4.6) reflect the welfare levels under the first-best harmonized regime in which there are no distortions (U_i^H). This regime maximizes global welfare.

4.6.1 Decentralization

Solid lines in Figures (4.5) and (4.6) reflect the utility levels under decentralization (U_i^D). We see that, if $s = 0.33$, utility is equal in the three countries. The level of welfare is

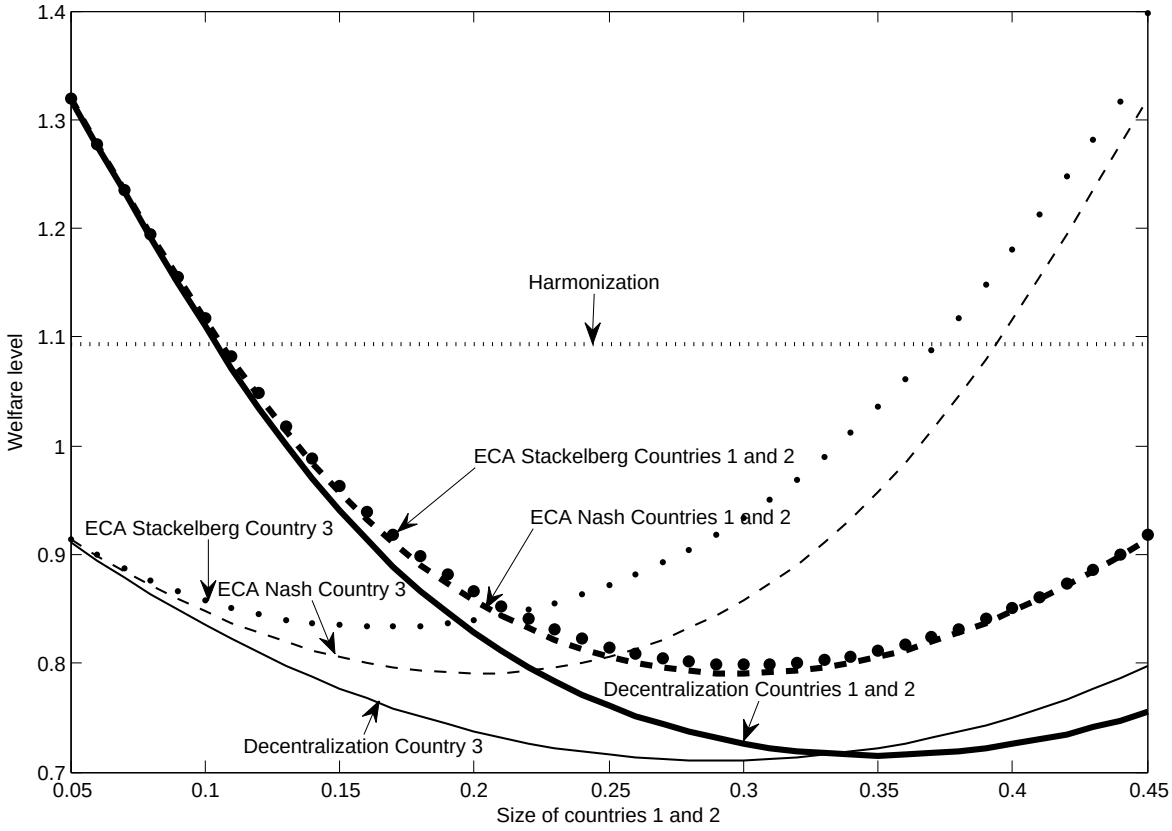
Figure 4.5: Welfare under four regimes, $\sigma = 0.1$



lower than under harmonization ($U_i^D < U_i^H$), however, due to the underprovision of public goods. If countries differ in size, global welfare under decentralization is reduced further as different rates of tax distort the international allocation of capital. This reduces the world interest rate and further harms global welfare.

The welfare cost of tax-competition are not equally divided among countries. Comparing the two solid lines, we see that the welfare level in the smaller country exceeds the welfare level in the larger country. In fact, welfare under tax-competition in the small country may even exceed the welfare under harmonization if a country becomes sufficiently small ($U_i^D > U_i^H$ for s_i sufficiently small). Two offsetting effects are responsible for this. On the one hand, small countries set a lower tax rate under decentralization compared to harmonization as their taxes are highly distortive. This low tax rate yields an underprovision of public goods, resulting in lower welfare. On the other hand, the low tax rate benefits welfare in the small country due to an inflow of capital from the large country. For a sufficiently small size, these benefits exceed the cost of underprovision of

Figure 4.6: Welfare under four regimes $\sigma = 1$



public goods.[18] In the large country, welfare is always lower as it suffers a welfare loss from both an undersupply of public goods and an outflow of capital. The asymmetry in welfare effects may explain why some countries are not inclined to cooperate in tax harmonization initiatives. These results are in accordance with Bucovetsky (1991) and Wilson (1991).

4.6.2 ECA Nash

Dashed lines in Figures (4.5) and (4.6) show the welfare levels under the ECA Nash regime (U_i^N). If $\sigma = 1$, Figure (4.6) shows that welfare levels are always higher due to the ECA, both for the ECA countries and for the outside country, i.e. $U_i^N > U_i^D$ for $\{i = u, 3\}$. The reason is that the ECA countries internalize the fiscal spillovers among each other. Hence, the MCF declines, so that countries set higher tax rates. By collecting

[18]This result does not hold for the case where country 3 is small in the present setup. The reason being that, in this case, country 3 competes with two average-sized countries such that the tax differential is not large enough to generate a massive capital inflow.

more public revenue, they are able to mitigate the underprovision of public goods, which raises welfare. This welfare gain is more substantial when the ECA countries are large. In that case, intra-ECA spillovers are important and offer a high potential for welfare improvements.

The tax increase by the ECA countries also raises welfare in country 3 due to an inflow of capital in that country. This broadens the capital tax base in country 3, thereby increasing public goods supply and reducing the MCF. As a result, country 3 is richer and allocates its resources more efficiently, hence welfare is unambiguously increased. Moreover, the tax in country 3 is a strategic complement, which implies that the capital flow out of countries 1 and 2 is mitigated. This boosts welfare in countries 1 and 2. The welfare gain in both the ECA and country 3 is thus related to strategic complementarity. As in Konrad and Schjelderup (1999), it ensures that country 3 does not destroy the welfare gain in the ECA countries by more aggressively competing for capital. Under strategic complementarity, the formation of an ECA may thus find approval by both the ECA members and the non-ECA members.

In Figure (4.5) (where $\sigma = 0.1$), countries 1 and 2 benefit from the formation of an ECA only if $s > 0.2$. For smaller s, welfare in the ECA countries is lower than under decentralization ($U_u^N < U_u^D$). This is the outcome of two offsetting effects. On the one hand, a higher tax rate raises welfare by internalizing intra-ECA spillovers which mitigates the underprovision of public goods in the ECA countries. On the other hand, the higher tax causes an outflow of capital towards country 3. When the ECA countries are large, the internalized spillovers are large and the per capita capital outflow is relatively small from the point of view of the large ECA countries. Furthermore, the ultimate welfare effect for the ECA countries depends on the response by country 3. With small σ and $s < 0.25$, country 3 responds to the higher tax in the ECA countries by reducing its own rate (see previous section). This magnifies the outflow of capital from the ECA countries and reduces its welfare. Under ECA Nash, the ECA countries do not take this endogenous response by country 3 into account when deciding about their tax. Hence, it unexpectedly erodes their tax base and creates a welfare loss. For small s, this loss dominates the gains from removing intra-ECA spillovers. When $s > 0.25$, country 3 responds to the higher tax in the ECA countries by increasing its tax rate. Moreover, with a larger size the welfare gains from internalizing intra-ECA spillovers is larger. Accordingly welfare under the ECA exceeds that under decentralization ($U_u^N > U_u^D$).

Figure (4.5) shows that country 3 always benefits from the formation of the ECA ($U_3^N > U_3^D$). This is due to the inflow of capital which makes country 3 richer and lowers its MCF such that it will choose a more efficient allocation of public and private goods.

Figures (4.5) and (4.6) show that small countries are better off under the ECA than under full harmonization ($U_u^N > U_u^H$ for s sufficiently small). Similarly, country 3 is better off under the ECA than under harmonization if it is sufficiently small, i.e. $U_3^N > U_3^H$ for s sufficiently large. In general, small countries are neither interested in forming an ECA nor in full harmonization as they benefit from competition with the large country. Small countries gain, however, if two large countries form an ECA. For instance, in Figure (4.5) we see that welfare of country 3 is highest under an ECA by the countries 1 and 2, then under full harmonization, and lowest under decentralization: $U_3^N > U_3^H > U_3^D$. Hence, opening up the possibility to form an ECA may prevent country 3 from joining in a global harmonization agreement. The possibility of forming an ECA frustrates negotiations for full harmonization: a status-quo bias.

4.6.3 ECA Stackelberg

Dotted lines in Figures (4.5) and (4.6) reveal the welfare levels under the ECA Stackelberg regime (U_i^S). We see that welfare under Stackelberg in the ECA countries is always higher than in both the decentralized outcome and the ECA-Nash outcome, i.e. $U_u^S > U_u^N$ and $U_u^S > U_u^D$. Hence, potential welfare losses under strategic substitutability with the ECA Nash regime disappear. The reason is that the ECA countries choose the welfare maximizing tax policy, thereby internalizing the strategic tax response by the outside country. Indeed, if the tax in country 3 is a strategic substitute, the ECA countries will increase their tax rates by less. This mitigates the outflow of capital, which benefits their welfare.

In Figure (4.6), we see that welfare in country 3 is always higher under ECA-Stackelberg than under ECA-Nash, i.e. $U_3^S > U_3^N$. Under strategic complementarity, both the ECA countries and country 3 choose higher tax rates and thus achieve a more efficient level of public goods provision. In Figure (4.5), however, tax rates are strategic substitutes. Under ECA-Stackelberg, this mitigates the tax increase by the ECA countries. Accordingly, country 3 sets a higher tax than under ECA-Nash. As a result, it suffers from a lower capital stock and its citizens are worse off than under ECA-Nash, i.e. $U_3^S < U_3^N$. For small s, welfare in country 3 is even lower than welfare under the decentralized equilibrium, i.e. $U_3^S < U_3^D$.

4.7 Conclusions

This chapter studies enhanced cooperation in an asymmetric three-country tax competition model. Using both analytical results and a simulation analysis, the chapter explores how equilibrium tax rates and welfare change due to the formation of an ECA. The results highlight the occurrence of strategic substitutability, which is generally ignored in the literature. The conditions for tax rates to be strategic substitutes become weaker if countries become more distinct in terms of size and if public and private goods are sufficiently different in utility (weak substitutability). Under both Nash and Stackelberg behavior of governments, I derive outcomes with respect to tax setting and welfare under an ECA. A number of results oppose common wisdom.

The analysis has important policy implications. For example, countries might even loose from forming an ECA in case the outsider country reduces its tax rate in response to the increased tax rate by the insider countries. This result highlights the importance of strategic substitutability for determining the welfare gains from forming an ECA. Furthermore, a small country with large neighbors might prefer full harmonization over decentralization in the absence of enhanced cooperation, but might prefer to be an outsider to an ECA between two large countries. Hence, the mere option to create an ECA can hamper the occurrence of full harmonization that would have been feasible without the ECA. Moreover, I find that if two small countries form an ECA, the tax rates of the outsider and ECA countries tend to converge. This improves the global efficiency of capital taxation. However, if two large countries form an ECA, the tax rates of insider and outsider countries diverge. This reduces global efficiency.

In deriving the results, a number of simplifying assumptions are imposed. Crucial is the assumed objective function for the government. Strategic substitutes can be ruled out theoretically when the government does not feature a decreasing marginal valuation of public goods, e.g. if it would aim at revenue maximization. Critical to the result of strategic substitutability is a decreasing marginal valuation of tax revenues. This will generally be the case for a government that maximizes welfare, which is a very reasonable assumption on the (long-run) government objective. The qualitative findings do not, however, depend the assumptions made. For example, allowing for a pure public good instead of a publicly provided private good does not matter. It only implies that large countries are less constrained in financing the public good compared to small countries, which leads to a lower perceived excess burden in the decentralized equilibrium and less stringent conditions for strategic substitutability. The assumed quadratic production function is not crucial either. It implies that the tax base elasticity decreases in the foreign rate, which

may not be true for a more general production function. A general production function typically weakens the likelihood of strategic complements. Also, labor as a second, elastic, production factor will influence effect sizes, but will not destroy the potential for strategic substitutes. A final important simplifying assumption is the identical size of the countries that form the ECA, which follows Bordignon and Brusco (2006) and Burbidge et al. (1997). Relaxing this assumption creates a number of challenges. The ECA members will have different optimal policies: how will the ECA decide on its common policy? Winners and losers from cooperation might arise within the ECA: how will the ECA divide the gains from cooperation? I leave this topic, as well as endogenous coalition formation along the lines of Kempf and Rota Graziosi (2010), for future research.

With respect to corporate taxation, the most important simplification is the unit-specific capital tax used to obtain the above results. The following chapters will extend the model developed in the present chapter with a more realistic corporate tax structure. In doing so, the analysis becomes more complex, but the result obtained in the present chapter remains valid.

4.A Deriving Elasticities under Four Regimes

This appendix derives the elasticities reported in Table 4.1. The elasticities under harmonization directly follow from the assumptions in the model. Under decentralization, I consider how a change in the tax rate in country i affects the capital stock in countries i and j.

$$\frac{\partial k_i}{\partial t_i} = \frac{1}{f_i''(.)}\left[1 + \frac{\partial \rho}{\partial t_i}\right], \tag{4.A.1}$$

$$\frac{\partial k_j}{\partial t_i} = \frac{1}{f_j''(.)}\left[\frac{\partial \rho}{\partial t_i}\right], \tag{4.A.2}$$

From Eq. (4.5) it follows that the total size of the capital stock is fixed, therefore:

$$s_i \frac{\partial k_i}{\partial t_i} = -s_j \frac{\partial k_j}{\partial t_i} - s_k \frac{\partial k_k}{\partial t_i}. \tag{4.A.3}$$

Combining Eqs. (4.A.1), (4.A.2), and (4.A.3) I obtain:

$$\frac{\partial k_i}{\partial t_i}\frac{t_i}{k_i} = \frac{t_i}{f_i''(.)k_i}\left[\frac{s_j(1/f_j''(.)) + s_k(1/f_k''(.))}{s_i(1/f_i''(.) + s_j(1/f_j''(.)) + s_k(1/f_k''(.))}\right] = -\epsilon^D_{K,i} < 0. \tag{4.A.4}$$

The change in the interest rate follows from substituting Eq. (4.A.4) in (4.A.1):

$$\frac{\partial \rho}{\partial t_i} = \frac{-s_i(1/f_i''(.))}{s_i(1/f_i''(.)) + s_k(1/f_k''(.)) + s_j(1/f_j''(.))} = -\epsilon_{R,i}^D < 0.$$

Under an ECA, countries 1 and 2 form a union (u), with: $k_u = k_1 = k_2$, $f_u''(.) = f_1''(.) = f_2''(.)$ and $t_u = t_1 = t_2$. The following two equations describe the capital market:

$$f_i''(.)\frac{\partial k_i}{\partial t_i} - 1 = f_j''(.)\frac{\partial k_j}{\partial t_i}, \tag{4.A.5}$$

$$s_i\frac{\partial k_i}{\partial t_i} = -(1 - s_i)\frac{\partial k_j}{\partial t_i}, \tag{4.A.6}$$

where i and $j \in \{u, 3\}$, and $s_u = 2s$ and $s_3 = (1 - 2s)$. This yields:

$$\frac{\partial k_i}{\partial t_i}\frac{t_i}{k_i} = \frac{t_i}{f_i''(.)k_i}\left[\frac{s_j(1/f_j''(.))}{s_i(1/f_i''(.) + s_j(1/f_j''(.))}\right] = -\epsilon_{K,i}^N < 0.$$

Substituting back into Eq. (4.A.5), I obtain:

$$\frac{\partial \rho}{\partial t_i} = \frac{-s_i(1/f_i''(.))}{s_i(1/f_i''(.)) + s_j(1/f_j''(.))} = -\epsilon_{R,i}^N < 0.$$

Under Stackelberg, I obtain the same elasticities as under Nash, but for the ECA countries we need to add to this the expected response by the third country.

Chapter 5

Tax Competition with Two Corporate Tax Instruments

5.1 Introduction

5.1.1 Contribution

The corporate taxation reforms implemented in OECD countries during the 1980s and 1990s relied on tax-rate-cutting, base-broadening policies (see the stylized facts in Devereux, Griffith and Klemm, 2002). The combination of falling statutory tax rates with broader tax bases resulted in rather stable effective marginal tax rates. This observation cannot be captured by the standard one-dimensional theories on tax competition, such as the model studied in Chapter 4. Therefore, this chapter will focus on corporate tax competition with two corporate tax instruments: the statutory tax rate and a defintion of taxable income wich is modelled as the fraction of the cost-of-capital that is tax deductible.[1] Furthermore, this chapter will do so in a model with asymmetric countries, this has never been done before.

The distinction between the statutory tax rate and the definition of taxable income is important because the recent proposal by the EC, as discussed in Chapter 1, consists of only a harmonized definition of taxable income. Statutory tax rates are left uncoordinated. Analysing such a reform properly requires a model that allows governments to choose both

[1]This chapter is based on Bettendorf, L. and H. Vrijburg (2010), *Strategic Interaction in an Asymmetric Tax Competition Model with Two tax Instruments*, IIPF conference paper, Uppsala. I thank Aart Gerritsen, Albert van der Horst, Bas Jacobs, Jenny Ligthart, Ruud de Mooij, Thorsten Bayindir-Upmann, and Floris Zoutman for comments and suggestions. I also benefited from comments of seminar participants at the CPB Netherlands Bureau for Economic Policy Analysis, and the IIPF conference in Uppsala.

tax instruments endogenously. In this chapter, I study such a model which extends the model developed by Haufler and Schjelderup (2000) and Devereux *et al.* (2008). In these models the government taxes a multinational enterprise (MNE) that can shift both capital and profits out of the country. As already mentioned before, the government has two tax instruments, the statutory tax rate and a definition of taxable income. Pure profits (the rents from production) are affected by the former. Capital invested is on the margin affected by both: an (effective) marginal tax rate.

My first contribution is that I study optimal corporate taxation policies in general equilibrium, to my knowledge this has not often been done before (with Devereux *et al.* and Eichner and Runkel (2011) as notable exceptions, although Eichner and Runkel do not optimize the tax system in both tax instruments). General equilibrium is needed for tax competition to exist. That is, by definition tax competition does not exist in partial equilibrium. A change in a foreign country does not affect the home country when this foreign country is small relative to the world.

Second, as opposed to Devereux *et al.* (2008), Eichner and Runkel (2011) and Haufler and Schjelderup (2000) the model incorporates asymmetric countries. In particular, similar to Chapter 4, I assume that the two countries differ in size. This modification is important as asymmetry affects the strategic game between the two countries (see also Chapter 4). Relative sizes matters for optimal corporate taxation policies since a large country has more market power to manipulate the world price of capital than a small country. In addition, the citizens from each country own a MNE to which they supply their labor inelastically. Therefore, the MNE in the large country is larger. The multinational owns a subsidiary in the other country which it uses for profits-shifting purposes. Because I assume that monitoring profit-shifting is a function of profits shifted per employee (number of citizens in the home country, measures the size of the multinational), the subsidiary will be proportional to the size of the home country. As a result, small countries are more "open" compared to large countries: the subsidiary of the foreign MNE is relatively large, therefore the government of the small country is sensitive to a change in the allocation of profit in the large MNE.

I discuss both the asymmetric equilibrium and the optimal policy responses to an hypothetical exogenous shock evaluated at an asymmetric equilibrium. Since closed-form solutions for the optimal tax mix cannot be found in this case, I linearize the tax reaction function around the initial (pre-shock) equilibrium. In accordance with Devereux *et al.* (2008), the statutory and marginal tax rates are substitutes in financing the public good. Furthermore, cross-country, the various tax rates are strategic complements when I assume of a linear utility function. However, the larger the preference for public goods, the larger

fiercer the tax responses to exogenous shocks. With respect to cross-country asymmetry, small countries respond fiercer to changes in foreign taxes compared to large countries. Furthermore, following Chapter 4 I generalize the utility function by assuming that the marginal valuation of tax revenues is decreasing in tax revenues. This strengthens the channels that render statutory tax rates and marginal tax rates within and between countries to be strategic substitutes. The results from this chapter, are useful in the following chapter in which I study again enhanced cooperation between a subset of countries.

As a third contribution, more general production functions are studied than typically employed in the literature. Instead of the quadratic production function, which is used in the majority of the tax competition literature in combination with a unit-specific tax, the main results on strategic interaction in this chapter are robust to a Cobb-Douglas specification which is combined with an *ad valorem* tax rate. Both assumption are more realistic. As opposed to a quadratic production function, the Cobb-Douglas production function is standard in the economic literature in general. Furthermore, the corporate tax systems observed around the world resemble an *ad valorem* tax on the return to capital instead of a unit-specific tax. Simulation results with a CES production function also support these findings for reasonable parameter values.

5.1.2 Relation to the Existing Literature

Only a few papers study corporate tax competition with two corporate tax instruments. The first paper that employs a model with two instruments is Haufler and Schjelderup (2000). They distinguish the statutory tax rate, imposed on the rent from production, from the marginal tax rate, imposed on capital income. Each government chooses in a Nash tax game both the rate and the base of the corporation tax, subject to a fixed revenue constraint. In the optimum of a closed economy, the first-best in this model, full deductibility of investment expenditures leaves the investment decision undistorted and the statutory tax rate is determined by the budget restriction. This statutory tax rate does not distort the production decisions as it only taxes the immobile rent from production. After incorporating multinational firms and transfer pricing, which causes the rent from production to be mobile across countries, the optimal statutory tax rate is lower to deter profit shifting to the foreign country. The lower statutory tax rate leads the government to broaden the tax base, by limiting the deduction of investment expenditures, in order to satisfy the government budget constraint. In choosing the optimal corporate tax policy, the government equalizes the marginal excess burdens of the statutory and marginal tax rate. An important limitation of this model is that it only studies optimal corporate tax

policies in partial equilibrium, by assuming that each country is small relative to the world capital market. However, a general equilibrium perspective is required for the analysis of tax harmonization when one believes that such a change would be large relative to the world capital market.

Devereux *et al.* (2008) build on this model. In a symmetric setting, they first show analytically that the statutory tax rate and the marginal tax rate of an individual country are strategic substitutes; this replicates the conclusion by Haufler and Schjelderup. Second, the domestic and foreign statutory tax rate are strategic complements and a similar conclusion holds for the marginal tax rates (i.e. an increase in the foreign tax rate will increase the optimal domestic tax rate). These conclusions are supported by estimates of the tax reaction functions for a sample of 21 OECD countries. Devereux *et al.* study corporate tax policies in general equilibrium, but focus on two symmetric countries only.

Egger and Raff (2009) provide a complementary explanation for the trends observed in the data. They develop a simple deterministic model where a monopolistic MNE, that is owned by citizens from a third country, makes a discrete location choice to produce in either country 1 or 2. The monopolist produces the private good and supplies this to countries 1 and 2. As the profits flow to the third country, the government wants to tax the profits with the statutory tax rate: Tax exportation. Furthermore, because a monopolist produces too little output from a social point of view, the government wants to subsidize investment via the marginal tax rate. However, the government is constrained in taxing the MNE by the neighboring country. It chooses the marginal tax rate such that consumer surplus is maximized and the statutory rate such to ensure that the MNE is indifferent between both countries. Increased taxation in the neighboring country (through either the statutory or marginal rate) relaxes the constraint on taxing the MNE: the home government therefore increases its tax rate as well, cross-country strategic complements. Egger and Raff find evidence in support of their model in an empirical test.

I focus my discussion exclusively on corporate taxation. This implies that I exclude from this discussion some interesting papers that study tax competition with both a tax on capital and a tax on labor (see for example Bucovetsky and Wilson (1991) and Wehke (2006)) or papers that focus on preferential tax regimes (see Keen (2001) and Bucovetsky and Haufler (2007)). Furthermore, I exclude papers that use similar models but without two tax instruments, see for example Nielsen, Raimondos-Møller and Schjelderup (2010), who compare separate accounting to formula apportionment. Eichner and Runkel (2011) study a model very similar to ours, but do not use the fraction of the cost-of-capital that is tax-deductible as an endogenous policy instrument.

5.1.3 Structure of the Chapter

The chapter is structured as follows. Section 5.2 explains the model and derives the first-order conditions for the optimal corporate tax policies. Section 5.3 presents the Nash equilibrium under asymmetry. Thereafter, Section 5.4 analyzes strategic interaction by presenting linearized tax reaction functions for asymmetric countries under the assumption of a constant willingness to pay for public goods. Section 5.5 extends the model with an endogenous marginal valuation of public spending. Section 5.6 presents a robustness analysis. Section 5.7 discusses the reduced form of the tax reaction functions and compares our findings with the empirical results of Devereux *et al.* (2008). Section 5.8 concludes.

5.2 The Model

Consider a model with two countries (i, j) that are populated by N_i identical citizens who own a *per capita* capital endowment of e which they supply inelastically to the international capital market. Countries differ in the number of citizens, define $s_i = N_i/N$ as the share of the world population (N) residing in country i. I assume that capital is perfectly mobile internationally but the world-capital stock is fixed:

$$e = s_i k_i + (1 - s_i) k_j, \tag{5.1}$$

where k_i denotes the per capita capital stock invested in country i. The international mobility of capital ensures that the net of tax rate of return to capital (ρ) is equalized across countries.[2]

Industry

Each country hosts a multinational enterprise (MNE_i), which owns a subsidiary in the other country.[3] The locations of the MNEs and subsidiaries are fixed, their size (capital investments and the location of profits) is endogenous. The parent company produces output: $y = F(K_i, L_i)$, by combining capital (K_i) and labor (L_i) with intermediate inputs (suppressed in the notation) produced by its subsidiary. L_i is the fixed factor in

[2]Following Bucovetsky (1991), I assume that $\rho > 0$, ruling out the possibility of an excess supply regime where part of the capital stock is not used.

[3]I assume multinationals are owned by the residents of the home country, so no foreign ownership. However, as each country hosts both the parent of the own MNE_i and the subsidiary of the foreign MNE_j there is foreign ownership of the industry profits at the country level when tax rates differ across countries.

production. Furthermore, each unit of labor needs one unit of intermediate input to work with. The production function is concave in K_i and L_i, twice continuously differentiable, and homogeneous of degree one: $f'(k_i) > 0,\ f''(k_i) < 0$, where $f(.)$ is the intensive form of the production function with $k_i = K_i/L_i$ denoting the per-capita capital stock. The price of output is normalized to unity. Note that the return to the fixed factor (labor) equals: $f(k_i) - f'(k,i)k_i$.

The intermediate inputs are produced by the subsidiary in country j at true unit cost $p = 0$ (normalized to zero) and subsequently sold to the parent company in country i at transfer price q_j^i. This subsidiary is proportional to the size of the parent company as each unit of labor employed at the parent needs one unit of intermediate input, larger parents therefore demand more inputs. MNE_i shifts profits to the low-tax country by choosing: $q_j^i \neq 0$. I think of profit-shifting by MNE_i as an activity at the boundary between tax avoidance (legal) and tax evasion (illegal), this implies that it might be subject to penalties by the revenue *losing* government.[4] The probability that the actions of MNE_i are detected and labeled tax evasion by the revenue *losing* government is, for simplicity, assumed to be equal to $1 > |q_j^i| > 0$. That is, I assume that the probability of detection is increasing in the distance between q_j^i and the true price of the intermediate product (normalized to zero). Note that this implies that per unit tax evasion matters here, not the absolute volume of tax evasion: the government treats large and small multinationals alike which can be defended from a principle of horizontal equity.[5] In case of detection, the MNE_i must pay a fine equal to $\alpha|q_j^i|$, where α can be interpreted as the penalty attached to illegal profit-shifting in the high-tax country. This yields an expected fine of:[6]

[4]In Chapters 5 and 6 I model profit-shifting by multinational firms and assume that the governments penalize this profit-shifting. However, profit-shifting is often thought as being, legal, tax avoidance. Legal actions cannot be penalized. To resolve this seeming controversy, I like to think of profit-shifting as an continuous attempt by companies to search for the boundaries of the tax law. That is, companies hope that their actions are regarded as tax avoidance by the government of the country, and therefore allowed. But in their search for legal tax avoidance, they run the risk of crossing the bounds of the law now and then, after which their action is regarded as illegal tax evasion by the government and therefore subject to a penalty. The complexity of fiscal law allows for such controversies and leaves room for new fiscal constructions that are close to or just crossing the boundary of what is allowed.

[5]One might argue that the government might be more interested in monitoring the larger companies as these shift larger volumes of profit. However, lobby activities might prevent them from doing so as might incentives to reduce effective tax rates. In this thesis I abstract from these considerations and assume that all strategic tax setting is through strategic choice of the tax instruments instead of varying monitoring activities. See Becker and Fuest (2007) for a discussion on tax enforcement and tax competition.

[6]Implicitly I assume $\Omega_i = \alpha q_j^i p(q_j^i)$. The function $p(.)$ is assumed to be equal to $|q_j^i|$ leading to the simple representation in Eq. 5.2. More strict monitoring would affect this function and make it steeper, see the section on the government below for further discussion. For further reading, see Gresik and Nelson (1994) for a study into optimal transfer pricing rules.

$$\Omega_i = \alpha(q_j^i)^2, \tag{5.2}$$

see Haufler and Schjelderup (2000) for a discussion on generalizing the cost of transfer-pricing function. In general, a convex cost of transfer-pricing function is sufficient to obtain the results presented in this chapter. The intuition being that the more companies try to challenge the fiscal rules of a country in order to reduce their tax liability, the higher the expected penalty from these actions.[7]

Consolidated after-tax profit (Π_i) for MNE_i is given by the sum of the net-of-tax profits of the parent company (Π_p^i) and the subsidiary (Π_j^i) minus the expected fine from transfer-pricing:

$$\Pi_i = \Pi_p^i + \Pi_j^i - \Omega_i. \tag{5.3}$$

Net-of-tax profit of the parent company equals output minus costs and source-based corporate taxes:

$$\Pi_p^i = f(k_i) - \rho k_i - q_j^i - \tau_i^s b_i, \tag{5.4}$$

where τ_i^s represents the statutory tax rate in country i, and b_i represents corporate taxable income in country i:

$$b_i \equiv f(k_i) - a_i \rho k_i - q_j^i, \tag{5.5}$$

where $1 > a_i > 0$ represents the fraction of the cost of capital that is tax deductable. For example when $a_i = 1/2$, half of the cost of capital is deductible. Assuming half of the capital stock is financed by equity and the other half by debt, this comes close to the classical corporate tax system as applied by governments in OECD countries. Alternatively, $a_i = 0$ leads to a tax system close to the Comprehensive Business Income Tax (CBIT) where the cost of capital is not tax deductible. When $a_i = 1$, the total cost of capital is tax deductible, resembling the Allowance for Corporate Equity (ACE) system.

Finally, net-of-foreign-taxes profit of the subsidiary is given by:

[7] An alternative explanation of Eq. (5.2) might refer to increased tax compliance costs that MNE_i needs to pay to tax laywers in order to induce them to be more creative in shifting profits.

$$\Pi_j^i = (1 - \tau_j^s) q_j^i. \tag{5.6}$$

MNE_i maximizes consolidated after-tax profit (Eq. 5.3) by choosing investment k_i and the transfer price q_j^i for $j \neq i$. MNE_i chooses k_i by equating the marginal product of capital to the marginal after-tax cost of capital:

$$(1 + \tau_i^e)\rho = f'(k_i), \tag{5.7}$$

where τ_i^e is the effective marginal tax rate:

$$\tau_i^e = \tau_i^s (1 - a_i)/(1 - \tau_i^s), \tag{5.8}$$

which will be referred to as the marginal tax rate in the remainder of this chapter.[8] Eqs. (5.1) and (5.7) define together the allocation of capital (k_i and ρ) as a function of the set of marginal tax rates.

MNE_i chooses q_j^i for $j \neq i$ by equating the marginal reduction in tax payments through profit-shifting with the marginal increase in the expected fine:

$$\tau_i^s - \tau_j^s = 2\alpha q_j^i, \tag{5.9}$$

which is a function of statutory tax rates only. A sufficient condition for $0 < |q_j^i| < 1$ is $\alpha > 1/2$, because the maximum difference between the losing government statutory tax rate ($\tau_i^s = 1$) and the statutory tax rate of the other government ($\tau_j^s = 0$) is equal to one. The absolute signs are needed to give q_j^i the interpretation of a probability because $q_j^i < 0$ for the low-tax country. Note that Eq. (5.9) implies (apart from the minus sign) identical transfer-prices for MNE_i and MNE_j. This follows naturally from the insight that the tax differential is the same for MNE_i and MNE_j and the assumption that large and small MNEs are treated identical by tax authorities, as explained above.

[8] Recalling the examples spelled out above, this implies an ACE ($a_i = 1$) leads to: $\tau_i^e = 0$, whereas a CBIT ($a_i = 0$) implies a pure *ad valorem* tax on the marginal product of capital: $\tau_i^e = \tau_i^s/(1 - \tau_i^s)$.

The government

Following Devereux *et al.* (2008), the government of country i chooses the tax policy mix $\{\tau_i^e, \tau_i^s\}$ that maximizes the welfare of a representative agent.[9] The representative agent features a twice-continuously differentiable, monotonously increasing utility function $U_i(g_i, c_i)$ in public consumption (g_i) and private consumption (c_i). Private consumption equals the sum of after-tax profit of MNE_i, given by Eq. (5.3), and the net-of-tax return to capital invested on the international capital market. Using Eq. (5.9) this yields:

$$\begin{aligned} c_i &= \Pi_i + \rho e, \\ &= (1-\tau_i^s)R_i(\tau_i^e, \tau_j^e) + H_i(\tau_i^s, \tau_j^s) + \rho e > 0, \end{aligned} \tag{5.10}$$

$$R_i(.) = f(k_i) - (1+\tau_i^e)\rho k_i, \tag{5.11}$$

$$H_i(.) = \frac{(\tau_i^s - \tau_j^s)^2}{2\alpha} - \Omega_i > 0. \tag{5.12}$$

After-tax profit of MNE_i equals the after-tax domestic rent from production: $(1-\tau_i^s)R_i(.)$, plus the net reward from profit-shifting due to transfer-pricing: $H_i(.)$. Note that $R_i(.)$ can be interpreted as labor income as labor is the fixed factor in production.

Public consumption equals the sum of tax revenue from the domestic parent and the foreign subsidiary. Using $q_j^i = -q_i^j$, Eq. (5.4) and (5.6) yield:

$$\begin{aligned} g_i &= \tau_i^s b_i + \tau_i^s \frac{1-s_i}{s_i} q_i^j, \\ &= \tau_i^s R_i(.) + \tau_i^s P_i(s_i, \tau_i^s, \tau_j^s) + \tau_i^e \rho k_i, \end{aligned} \tag{5.13}$$

$$P_i(.) = \frac{1}{s_i}\frac{\tau_j^s - \tau_i^s}{2\alpha}. \tag{5.14}$$

Public revenue comes from three sources: rents from production ($R_i(.)$), net profit shifting by both domestic and foreign subsidiaries ($P_i(.)$) and taxes paid over the cost of capital ($\tau_i^e \rho k_i$). The absolute size of net-profit shifting depends, besides the tax-rate differential, on the size of country i relative to the size of country j. This follows from the assumptions that MNE_j demands N_j units of intermediate input from its subsidiary in country i and tax evasion is evaluated on a per-unit basis. The relative size of the subsidiary of MNE_j therefore grows with the relative size of country j, and as a result its profit-shifting activities become more important from the perspective of country i.

[9] Notice that the choice of τ_i^e and τ_i^s implies a value of the deductible fraction a_i.

Finally, note that the revenues from the penalties on profit-shifting (Ω_i) do not show up in Eq. (5.13). This follows from the simplifying assumption that these revenues are equal to the costs of monitoring transfer-pricing: transfer-pricing results in pure economic waste. To defend this, one might imagine that setting up the monitoring authority requires fixed costs to the government and that the net revenue from monitoring depends on both the revenues (additional tax revenue and expected penalties) and some cost from monitoring effort. At the present level of monitoring the government has maximized its revenue and just breaks even.[10] Monitoring more or less would lead to a net loss. Furthermore, abandoning the monitoring authority all together is not an option as well, because this would lead to the complete erosion of the statutory tax base. In addition, I assume that penalties cannot be raised to infinity due to social (punishment must be reasonable) or political (lobying activities by MNEs) constraints. In general, the thesis abstracts from monitoring as an active choice for the government and focuses on the statutory tax rate and the definition of taxable income as the strategic tax variables, see Becker and Fuest (2007) for a discussion on strategic monitoring in case of tax harmonization. Relaxing the assumption that the monitoring costs exactly equal the revenues from penalties would result in a net revenue (or loss) from monitoring transfer-pricing. A change in statutory tax rates would have revenue implications from this channel which adds another layer of complexity. This is deemed undesirable at this point as the focus of the present chapter is on the interaction between the statutory and marginal tax rates via cross-dependency in the tax base as shown in Eq. (5.13).[11]

[10] Recall from above, implicitly I assume $\Omega_i = \alpha q_j^i p(q_j^i)$. The function $p(.)$ is assumed to be equal to $|q_j^i|$ leading to the simple representation in Eq. 5.2. This is a normalization of the more general function: $p(.) = \widehat{\alpha}|q_j^i|$, where $\widehat{\alpha}$ represents monitoring effort. This representation would just add the term $\widehat{\alpha}$ to the right-hand-side of Eq. (5.2) and Eq. (5.9). Net revenue from choosing monitoring (given α and the tax rates) is now: $g_i^* = (\tau_i^s/s_i)q_j^i + \alpha\widehat{\alpha}(q_j^i)^2 - C_i(\widehat{\alpha})$, with $C_i(\widehat{\alpha})$ some total cost of monitoring that is a function of monitoring effort, and q_j^i given by Eq. (5.9) multiplied by $\widehat{\alpha}$. This net revenue is maximized at:

$$\widehat{\alpha} = \sqrt{\frac{(2\tau_i^s - \tau_j^s)(\tau_i^s - \tau_j^s)}{4s_i\alpha C'(.)}}.$$

The thesis abstracts however from this choice by the government and focusses solely on strategic interaction via the tax instruments. In the simulation study, the value of α is determined such that the corporate tax system features realistic statutory tax rates. This calibrated value therefore reflects both expected penalties and monitoring efforts.

[11] When I generalize the assumption that monitoring breaks even, the first-order conditions to be spelled out below would include a term reflecting the change in net revenues from monitoring. Assuming that these revenues are much lower than tax revenues from the statutory and marginal tax rate this will not change the main conclusions in this chapter.

Equilibrium

The strategic game unfolds as follows. First, governments choose their tax policy mix (τ_i^e, τ_i^s), while assuming that the governments of neighboring countries do not change their policies (I study Nash Equilibria), and taking into account that firms shift investments and profits in response to tax changes. Thereafter, firms relocate their investments and profits given the tax differentials they observe. Finally, production and consumption takes place. Below I focus on this first step, taking into account the final two steps.

The government of country i can increase public spending by increasing the tax burden:

$$\frac{\partial g_i}{\partial \tau_i^s} = R_i[1 + E_i - \epsilon_{ii}^{\Pi}] > 0, \tag{5.15}$$

$$\frac{\partial g_i}{\partial \tau_i^e} = \rho k_i \left\{1 - \tau_i^s \epsilon_i^R - \epsilon_i^\rho - \epsilon_{ii}^k\right\} > 0, \tag{5.16}$$

at the expense of private consumption:

$$\frac{\partial c_i}{\partial \tau_i^s} = -R_i(1 - \epsilon_i^H) < 0, \tag{5.17}$$

$$\frac{\partial c_i}{\partial \tau_i^e} = -\rho k_i \left\{1 - \tau_i^s \epsilon_i^R - \epsilon_i^\rho + (e/k_i - 1)(\epsilon_i^\rho/\tau_i^e)\right\} < 0, \tag{5.18}$$

where the elasticities reflect that firms shift investment and profit. Table 5.1 presents the definition of the (semi) elasticities $\epsilon_{ii}^{\Pi}, \epsilon_i^R, \epsilon_i^\rho, \epsilon_{ii}^k, \epsilon_{H,i}$ and the coefficient E_i. I will discuss the elasticities below, they represent the main channels that influence optimal tax policy within a country. The signs of the partial derivatives in Eqs. 5.15-5.18 follow from the intuition that a rational government faced with a distortionary tax will only use this tax when it raises positive revenues.[12]

An increase in the statutory rate with one percentage point leads to additional tax revenue equal to R_i which comes at the account of lower private consumption because MNE_i is owned by the citizens of country i (first term in both Eq. (5.15) and (5.17)). This is the direct effect of the change in the statutory rate, private goods are transformed into public goods.

However, this direct effect must be corrected for three channels. First of all, paper profits will flow to the other country, reducing taxable rents ($\epsilon_{ii}^{\Pi} > 0$). This reduces the net public revenue from the tax increase. Second, the public revenue from a tax

[12] I will prove later that the tax instruments are substitutes in the optimal policy mix such that the theoretical possibility that increased use of one tax instrument improves the revenue raising capability of the other instrument does not occur in this setting. Hence, it is always optimal to remain on the upward-sloping part of the Laffer curve with both instruments.

Table 5.1: Elasticities in Eq. (5.15)-(5.18)

	Elasticity	**Definition**	**Function**
		Statutory Rate	
Taxable profits	$0 < \epsilon_{ii}^{\Pi}$	$-\frac{\partial P_i}{\partial \tau_i^s}\frac{\tau_i^s}{R_i}$	$\frac{1}{s_i}\frac{\tau_i^s}{2\alpha R_i}$
Change net dividend	ϵ_i^H	$\frac{\partial H_i(.)}{\partial \tau_i^s}\frac{1}{R_i}$	$\frac{\tau_i^s-\tau_j^s}{2\alpha R_i}$
Profit Export	$E_i(.)$	$P_i(.)/R_i(.)$	$\frac{1}{s_i}\frac{\tau_j^s-\tau_i^s}{2\alpha R_i}$
		Marginal Rate	
Rents	$0 < \epsilon_i^R < 1$	$-\frac{\partial R_i}{\partial \tau_i^e}\frac{1}{\rho k_i}$	$0 < 1 - \Sigma_i < 1$
Interest rate	$0 < \epsilon_i^\rho < 1$	$-\frac{\partial \rho}{\partial \tau_i^e}\frac{\tau_i^e}{\rho}$	$0 < \frac{\tau_i^e}{1+\tau_i^e}\Sigma_i < 1$
Capital stock	$0 < \epsilon_{ii}^k$	$-\frac{\partial k_i}{\partial \tau_i^e}\frac{\tau_i^e}{k_i}$	$0 < \frac{1}{\phi_i}\frac{\tau_i^e}{1+\tau_i^e}(1-\Sigma_i)$
		General	
Market Power country i		$0 < \Sigma_i = \frac{s_i k_i/\phi_i}{s_i k_i/\phi_i + (1-s_i)k_j/\phi_j} < 1$	
Elasticity of the marginal product		$0 < \phi_i = \frac{-k_i f_i''(.)}{f_i'(.)}$	

increase can either be larger or smaller than R_i as not only the home MNE_i pays for the increase in public consumption, also the subsidiary of MNE_j pays its share, and therefore the citizens of country j. This tax exportation is captured by the coefficient E_i which measures whether the tax base is larger or smaller than R_i. E_i is positive when country i is a profit importer, the domestic tax base is larger than R_i, and negative if country i is a profit exporter and, hence, the tax base is smaller than R_i. Third, the private cost of the tax increase can either be larger or smaller than R_i, depending on the opportunities for profit-shifting due to the change in tax differentials. In case a low-tax country increases its tax rate, the tax differential between the two countries is reduced and tax shifting becomes harder which is an additional private cost ($\epsilon_i^H < 0$). The opposite argument holds in case a high-tax country increases its statutory tax rate ($\epsilon_i^H > 0$). This argument reveals, somewhat paradoxically, that a welfare maximizing government values increased opportunities for profit-shifting positively from the perspective of private consumption.

An increase in the marginal tax rate with one percentage point leads to additional tax revenue equal to ρk_i (first term in Eqs. (5.16) and (5.18)). This represents the direct transformation of private goods into public goods. This direct effect must be corrected for two types of channels: domestic leakages and international leakages.

It is instructive to start with the erosion of the tax base of the marginal tax rate (ρk_i). The increase in the marginal tax rate will reduce the tax base by reducing both the worlds interest rate and the capital stock in country i. Both effects are intrinsically linked by country size because the worldwide net return on capital is affected by absolute flows of capital. Therefore, a relative large *per capita* capital outflow from a small country is needed to obtain the same change in the worlds interest rate that is obtained from a relative small *per capita* capital outflow from a large country. This implies that a small country features a relatively small interest elasticity (ϵ_i^ρ) and a large capital stock elasticity (ϵ_{ii}^k).[13] After a change in the marginal tax rate, a relative large per capita capital outflow is needed before the net returns to capital are equalized but because the absolute volume of this capital flow is relatively small it hardly influence the worlds interest rate. For large countries the reverse holds. The change in the interest rate is labeled the second domestic channel and the change in the capital stock the first international channel because the former exists in a closed economy as opposed to the latter. The latter outflow of capital is the true excess burden of the marginal tax rate for country i. Furthermore, the reduction in the interest rate both erodes the tax base for the government and the interest costs of MNE_i: ϵ_i^ρ appears both in Eq. (5.16) and Eq. (5.18).

In general, ϵ_i^ρ and ϵ_{ii}^k depend on the weighted inverse elasticity of the worldwide marginal product (Σ_i, see Table 5.1). Σ_i depends, besides size, on two additional parameters and captures market power on the international capital market. The first is the capital stock (k_i); countries with a large capital stock per capita have more market power as more units of capital are affected by the tax policy change. The second is the elasticity of the marginal product (ϕ_i); if the elasticity of the marginal product increases, market power decreases. Ceteris paribus when ϕ_i is low relative to ϕ_j, a very large capital outflow is needed following an increase in τ_i^e in order to equalize after-tax returns. This large capital outflow will reduce the before-tax returns in country j substantially and, hence, the after-tax return on the worlds capital market.

Market power also affects the remaining two channels. The second international channel states that the change in the interest rate will affect private income in capital-importing

[13]Note that the excess burden of the marginal tax rate is identical to the excess burden in the classical tax competition model by Zodrow and Mieszkowski (1986), Wilson (1986) for symmetric countries and Bucovetsky (1991) and Wilson (1991) for asymmetric countries.

and capital-exporting countries differently. A capital exporter ($e/k > 1$) is a net receiver of interest income and will therefore be harmed by a reduction in the interest rate, as opposed to a capital importer. This is again a tax exportation argument, as the capital importer can export part of its tax burden to foreign capital owners.[14]

This leaves me with the first domestic leakages which is very important. An increase in the marginal tax rate reduces taxable rents (ϵ_i^R) because the cost-of-capital of MNE_i: $(1+\tau_i^e)\rho k_i$, is increased. This channel depends on market power (Σ_i). For larger countries, most of the increase in the marginal tax rate is compensated by a substantial reduction in the interest rate which implies that this effect is relatively weak. The opposite holds for smaller countries as the offsetting reduction in the interest rate is smaller (see the discussion on the interest elasticity). As a consequence the tax increase yields less public revenue ($\tau_i^s \epsilon_i^R$) and costs less private income. This argument implies an interaction between the marginal tax rate and the tax base of the statutory tax rate.

The above channels can be summarized in the optimal policy rules for the government. The government of each country equates the marginal increase in welfare from extra public goods relative to private goods ($MRS = U_g(.)/U_c(.)$) to the marginal cost of obtaining extra public goods in terms of private goods (MCF) for both instruments:

$$MRS_i(.) \equiv \frac{-\partial c_i/\partial \tau_i^s}{\partial g_i/\partial \tau_i^s} = \frac{1-\epsilon_i^H}{1+E_i-\epsilon_{ii}^{\Pi}} \equiv MCF_i^s > 1, \tag{5.19}$$

$$MRS_i(.) \equiv \frac{-\partial c_i/\partial \tau_i^e}{\partial g_i/\partial \tau_i^e} = \frac{1-\tau_i^s\epsilon_i^R-\epsilon_i^\rho+(e/k-1)(\epsilon_i^\rho/\tau_i^e)}{1-\tau_i^s\epsilon_i^R-\epsilon_i^\rho-\epsilon_{ii}^k} \equiv MCF_i^e > 1. \tag{5.20}$$

where the assumptions underlying the implicit function theorem are used to establish that an equilibrium exists, see Mas-Colell, Whinston, and Green (1995) p. 940 - 942.

These equations represent the modified Samuelson Rules for the optimal provision of public goods in case of two tax instruments. The inequality signs follow from three conditions. First I need that country i either chooses both tax rates above the tax rates of country j or vice-versa, this holds as I will show below. Second, the statutory tax rate of country i is never below one-half times the statutory tax rate of country j: $\tau_i^s > (1/2)\tau_j^s$.[15] The third condition is an arbitrage condition stating that the home government will choose: $MCF_i^s = MCF_i^e$.

[14] Both international channels are equivalent to the tax distortions of the unit-specific tax in the standard asymmetric tax competition model by Bucovetsky (1991) and Wilson (1991) as discussed in Chapter 4.

[15] A sufficient condition would be that the slope of the tax reaction function for statutory tax rate is larger than 1/2, but this is not the case. The slope is smaller than one half. $\partial\tau_i^s/\partial\tau_j^s = (\gamma_1 - s_i)/(2\gamma_1 - s_i) < 1/2.$, see linearization below.

Using these conditions, I can proof that the inequality signs are unambiguously positive. For the case country i is a high-tax country ($\tau_i^s > \tau_j^s$ and $\tau_i^e > \tau_j^e$, using the first condition) as they are capital importers ($e < k_i$) such that: $MCF_{e,i} > 1$. For this case, $MCF_{s,i} > 1$ follows from the arbitrage condition. Furthermore, for the case country i is a low-tax country ($\tau_i^s < \tau_j^s$ and $\tau_i^e < \tau_j^e$), the first inequality ($MCF_i^s > 1$) always holds as: $\epsilon_i^H < 0$ and $E_i - \epsilon_{ii}^{\Pi} < 0$ using the second condition. The arbitrage condition now states that: $MCH_i^e > 1$, which completes the proof.

The modified Samuelson Rules of country i depend on tax policy by country j, as already mentioned at the start of this section, I define an equilibrium in this tax-setting game as the Nash equilibrium where the choice of tax policy by each government is optimal given the tax policy of its neighbor. In general, the modified Samuelson Rules in Eq. (5.19)-(5.20) cannot be solved analytically for the optimal tax policy mix. Therefore, in the next section I discuss the intuition behind Eq. (5.19) and (5.20) for the case countries 1,2 and 3 set their tax rates unilaterally using a simulation analysis.

5.3 Nash Equilibrium under Asymmetry

Before discussing the simulated asymmetric Nash equilibrium, I will first discuss the assumptions underlying the calibration. The model is simulated using a Cobb-Douglas production function ($f(.) = k_i^{\omega}$, $\omega = 0.36$) and two utility functions: (i) a linear utility function ($U(c_i, g_i) = c_i + \gamma_1 g_i$ as in Proposition 2 of Devereux *et al.* (2008), with $\gamma_1 = 1.32 = MRS$, and; (ii) a quasi-linear utility function ($U(c_i, g_i) = c_i + \gamma_1/\gamma_2 g_i^{\gamma_2}$, $\gamma_1 = 0.72$, and $\gamma_2 = 0.53$). The linear utility function excludes the possibility that tax rates are strategic substitutes across countries as discussed in Chapter 4 but simplifies the analysis considerably.[16] Assuming $\gamma_1 > 1$ implies that the government of country i implicitly maximizes tax revenue. However, contrary to a government solely interested in tax revenue maximization, the government does take the private costs of higher taxes into account. Note that the linear utility function leads to the very unrealistic first best solution that only public goods will be consumed. Although I prefer the non-linear utility function in general, the linear utility function will be used extensively in this chapter as it allows me to explain the most important channels of strategic interaction. Furthermore, as tax harmonization (the first-best) is not the focus of this chapter the simplification is acceptable. Finally, the parameter for the profit-shifting technology is chosen to be: $\alpha = 1.91$.

[16] Under a general utility function, the MRS between private and public goods is a non-linear function of the tax policies of both countries, this adds considerable complexity to the analysis that follows.

The parameter values are calibrated such that the symmetric decentralized equilibrium ($s_1 = s_2 = 1/2$) gives a realistic corporate tax structure: $\tau^e = 0.3$, $\tau^s = 0.3$, $g/c = 0.38$, while the size of the economy is constraint at: $c + g = f(e) = 1$. The calibrated statutory tax rate is close to the median statutory rate for OECD countries in 2005 (0.32 percent) and the calibrated marginal tax rate is close to the upper bound of the median marginal tax rate for OECD countries in 2005 (in the range $0.19 - 0.29$ percent, depending on the type of investment).[17] I am restricted in my choice for the statutory and the marginal tax rate as together they define the share of capital costs that are deductible (a, see Eq. 5.8), and they determine the range in which the ratio of public goods to private goods should be defined:

$$\tau^e < g/c < \tau^s/(1 - \tau^s), \tag{5.21}$$

for $0 < a_i < 1$. The choice of $g/c = 0.38$ is therefore deliberate.[18] Section 5.6 presents a robustness analysis with respect to the choice of production and utility function.

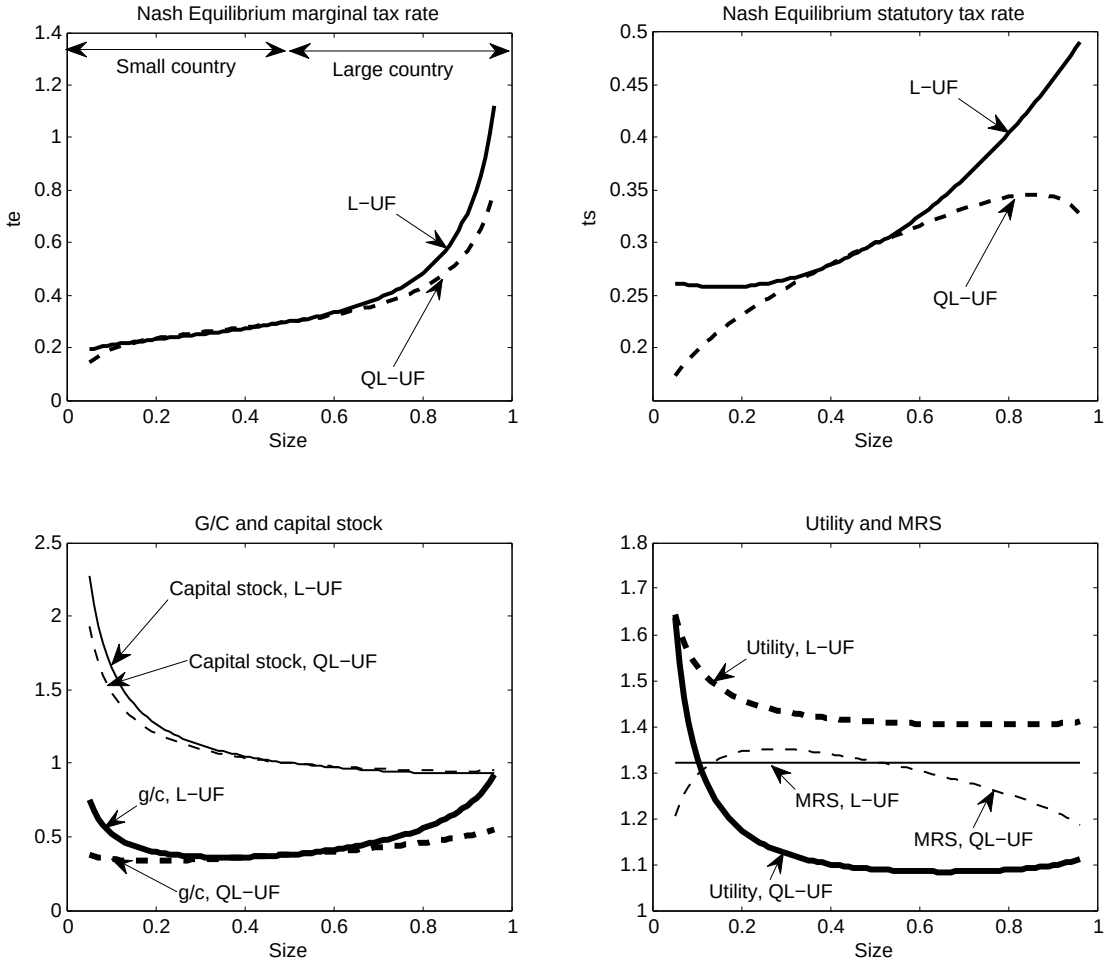
Figure 5.1 presents the simulation results for the Nash equilibrium in tax setting, the two upper plots in Figure 5.2 present the underlying elasticities. For all figures in this chapter the x-axis measures population size. Consequently, outcomes at size equal to 0.5 correspond to the symmetric equilibrium. To the left of this point, a country is called small, and to the right a country is called large. The Nash equilibrium under asymmetry consists of the tax rate chosen by the small country and the corresponding tax rate chosen by the large country that is located at the same distance from the symmetric point, each point on the curves in the figures take into account that the country is competing with another country, it is the general equilibrium solution. The plots in Figure 5.1 contain two lines. The solid lines reflect the outcomes under the assumption of a constant marginal rate of substitution, the dashed lines reflect the outcome under the assumption of a quasi-linear utility function (will be discussed in Section 5.5).

I start with the equilibrium taxes. The upper left and right plots of Figure 5.1 present the marginal and the statutory tax rate in the Nash equilibrium, respectively. Analogous to the one-instrument asymmetric tax competition models by Wilson (1991) and Bucovetsky (1991), the Nash equilibrium marginal tax rate is increasing in size, signalling that market power reduces the excess burden of the marginal tax rate. The peak in the marginal tax rate for very large countries is explained by the two international channels

[17] Data is provided by the Institute for Fiscal Studies (IFS) using the methodology discussed in Devereux and Griffith (2003).

[18] See Appendix A for the prove of this inequality and a more extensive discussion regarding the calibration.

Figure 5.1: Equilibrium under asymmetry



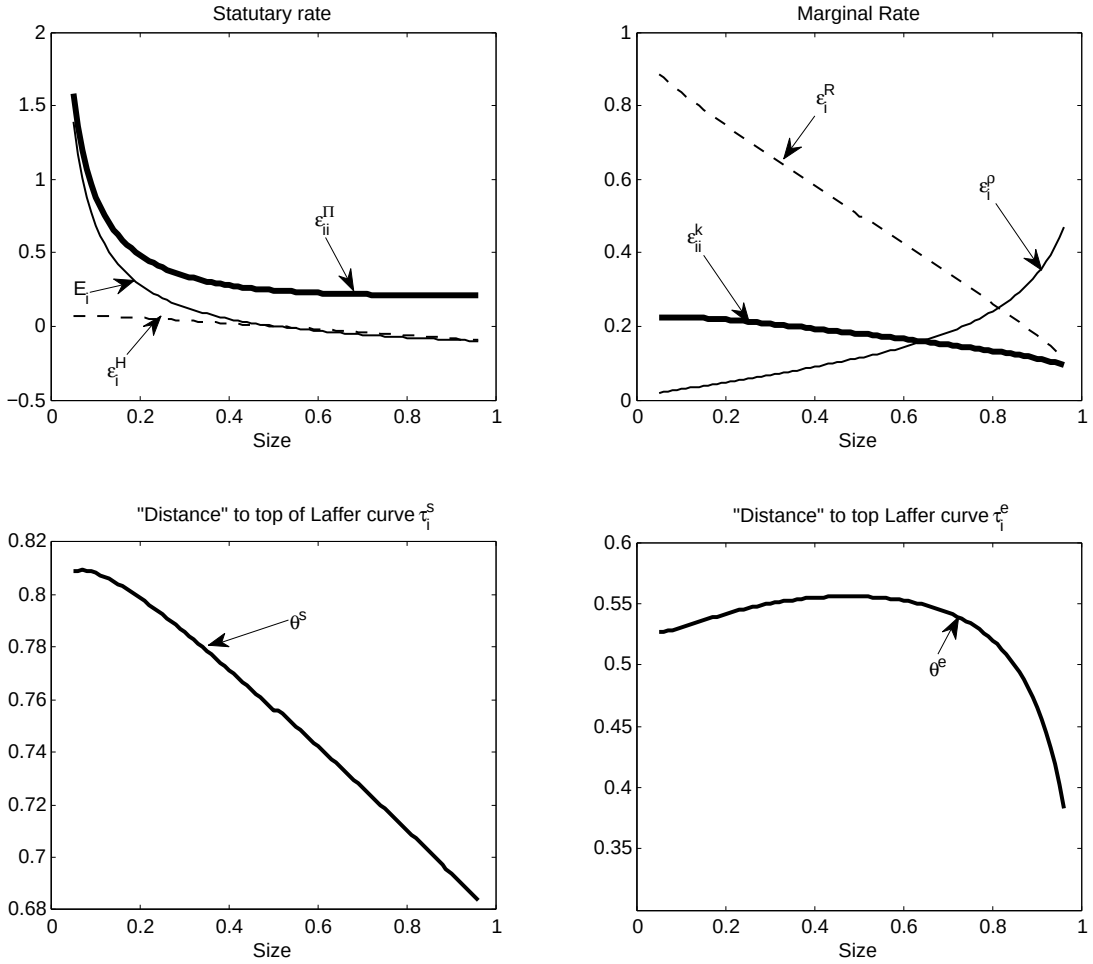
identified in Section 5.2. First, the capital stock elasticity (ϵ^k_{ii}) becomes small (see the upper-right plot in Figure 5.2); this elasticity measures the excess burden of the marginal rate. Second, as the large country is a capital exporter, the second international channel suggests that this creates a ceiling on the marginal tax rate because a capital exporter does not want to reduce the net-of-tax interest rate (ρ) to much. However, this argument is weak as in per capita terms only a very small fraction of the capital stock is exported. Hence, the capital stock is approximately equal to the capital endowment ($k_i \approx e = 1$, see the dotted line in the lower-left panel of Figure 5.1). As a consequence, the international marginal excess burden is small. In addition, as the large interest elasticity makes it hard to raise revenue (large domestic leakage leading to base erosion), a high marginal tax rate is needed to obtain the preferred level of public revenues.[19] Next to that, as the marginal

[19]When capital is (approximately) immobile ($\epsilon^k_{ii} \approx 0$), the Laffer curve for the marginal tax rate is described by: $\partial(\tau^e \rho k)/\partial\tau^e = \rho k(1-\epsilon^\rho) > 0$, with $\epsilon^\rho = \tau^e/(1+\tau^e)$. The top of the Laffer curve is reached with an infinitely high marginal tax rate: $\epsilon^\rho \approx 1$ if $\tau^e \approx \infty$.

willingness to pay for public goods is constant and larger than one, the government is willing to substitute private for public goods continuously until the marginal cost of funds becomes too high.

The relatively constant marginal tax rate for the small country follows from reversed arguments. The capital stock elasticity becomes large (see the thin solid line in the upper-right plot of Figure 5.2) and this gives a strong incentive to reduce the marginal tax rate. However, the small country becomes a massive capital importer (see the slim solid line in the lower-left plot of Figure 5.1) which gives a strong incentive to increase the marginal tax rate to export part of the tax burden. The shape of the curve can therefore completely be explained from the international leakages of the marginal tax rate.

Figure 5.2: Elasticities under asymmetry



Also for the statutory tax rates I find that the large country sets the highest rate. The intuition behind this result is that increases in size reduce the absolute size of the subsidiary of the foreign MNE such that larger countries are less concerned with the profit-shifting activities of this foreign subsidiary: ϵ_{ii}^{Π} decreases (see the upper-right plot

of Figure 5.2).[20] The opposite reasoning applies versa for the small country. The statutory tax rates reflect this pattern. The former argument is mitigated by the tax exportation argument (E_i). From the upper-right plot of Figure 5.2 I infer that for small countries this argument can be strong: E_i is positive and decreases fast in size. For very small countries the tax exportation argument is equally strong compared to the profit-shifting argument: this leads to the lower bound on the statutory tax rates observed in Figure 5.1. For large countries E_i is negative, but this argument loses its strength when the absolute value of the foreign subsidiary relative to the home MNE decreases with size. Furthermore, for small countries ϵ_i^H is negative (higher taxes cannot be avoided or evaded) but close to zero as the direct effect (R_i) is very large due to the large per capita size of the home MNE (recall that the country imports capital). For the same argument ϵ_i^H is positive and large in value for large countries. The private costs of an increase in the statutory tax rate are lower in large countries as profits can be shifted away to the low-tax country.

Comparing the equilibrium taxes under the assumption of a constant MRS (solid lines in the upper plots of Figure 5.1) to the case where the MRS decreases with public consumption (dashed lines in the upper plots of Figure 5.1) reveals that governments are less likely to impose high taxes in the latter case. The government of a large country chooses a lower tax rate when the valuation for public goods decreases. For the same reason, the government of a smaller country choose lower tax rates: the massive inflow of capital and profits imply that they can easily obtain their required level of public goods supply which reduces their valuation of public goods on the margin.

The lower-left plot of Figure 5.1 presents the values for the public-to-private-goods ratio (thick lines) together with the capital stock (slim lines). The lower-right plot presents the utility levels (thick lines) and the MRS (slim line). Again, the results from the model using a linear utility function are represented by the solid lines, whereas the quasi-linear case is represented by the dashed lines.

The peaks in the figure are driven by the massive inflow of capital and profits (the latter is not presented in the figures). The variation in utility follows the variation in the public consumption (recall the linear utility function). Smaller countries feature higher utility levels as the low tax rates result in a massive inflows of capital and profits. This increases both private and public consumption, where the increase in the latter is dominant. This because private consumption is on the margin almost not affected by the

[20] As discussed in the methodological notes to this thesis, assuming that the absolute size of the MNE is proportional to population size is crucial. Absent this assumption, statutory tax rates would be low in large countries and high in small countries as both tax instruments are substitutes in the optimal policy mix of the government (discussed in the next section). OECD data confirms that larger countries feature higher statutory tax rates, see Chapter 3, which validates the assumption made.

inflow of profits and capital. For a small country, the inflow of profits is mainly due to the subsidiary of the large foreign multinational, which does not benefit private consumption. Furthermore, wages constitute the above normal return which is zero on the margin. To conclude, the two instruments asymmetric model replicates the results by Bucovetsky (1991) and Wilson (1991): the small country has the lowest taxes and experiences the highest welfare.

The lower two plots of Figure 5.2 present the simulated values for the slope of the Laffer curve (solid lines) and the private costs of a tax increase (dashed lines) for the statutory tax rate (left plot) and the marginal tax rate (right plot). It is important to stress that it are the larger countries that are closer to the top of their Laffer curve. This contrasts the results in Chapter 4 where the small countries locate closer to the top of their Laffer curve. The difference lies in the mechanism leading to the equilibrium. In Chapter 4 the decreasing marginal valuation of public goods leads large countries to choose a point at a larger distance from the top of their Laffer curve (tax competition constraints these large countries less). The private costs of a tax increase where dominated by the decreasing marginal valuation of public goods. The latter argument is absent for the simulations presented here, which gives room for the private costs to determine the preferred point on the Laffer curve. As mentioned above, the private costs are lower for larger countries such that they choose a point closer to the top of the Laffer curve. The relative valuation of public goods (γ_1) determines the strength of this argument. The solid lines are shifted down for larger values of γ_1, while taxes move up.

5.4 Reaction Functions

In the above discussion, I explained the equilibrium taxes and the allocation of production factors and profits across the size-space. However, to explain optimal tax responses, I need to analyze the strategic game played by the governments under asymmetry. Therefore, as a second step, I linearize Eqs.(5.19)-(5.20) around the asymmetric Nash equilibrium to study changes in the optimal tax policy mix of country i after an, assumed exogenous, change in tax policy in the neighboring country.[21] For this, I denote the percentage change in some variable $x_i > 0$ by $\widetilde{x}_i = \partial x_i / x_i$.

[21]Section 5.6 shows that the linearized tax reaction functions predict an almost identical response by the government of country i to a 1 percent tax policy change in country j compared to the simulated optimal non-linear response. The linearization therefore gives a good approximation of the slope of the tax reaction function.

Linearizing Eq. (5.19)-(5.20) gives:

$$\widetilde{MRS}_i = \widetilde{MCF}_i^s, \tag{5.22}$$

$$\widetilde{MRS}_i = \widetilde{MCF}_i^e. \tag{5.23}$$

The linearization of the modified Samuelson rule follows a number of steps. I first assume, following Devereux *et al.* (2008), a constant MRS_i and linearize MCF_i^s and MCF_i^e. Second, I allow for an endogenous marginal willingness to pay for public goods and linearize MRS_i. When linearizing of the marginal cost of funds expressions in Eq. (5.19)-(5.20) it will become clear that tax reaction functions, or strategic tax interactions in general, follow from the endogenous tax elasticities ($\epsilon_{ii}^{\Pi}, \epsilon_i^H, E_i, \epsilon_i^{\rho}, \epsilon_{ii}^k$ and ϵ_i^R). Tax rate changes abroad potentially have an influence on the tax base at home and, in doing so, affect the Laffer curve of the home government. Note that when these tax elasticities are constant, there is no explicit strategic tax interaction in the tax competition models as tax rate changes abroad do not enter the optimal policy rules in Eq. (5.19)-(5.20) directly.

5.4.1 Linearizing MCF_i^s

The marginal cost of financing the public good with the statutory tax rate (MCF_i^s) is given by the right-hand side of Eq. (5.19). Linearizing MCF_i^s gives:

$$\widetilde{MCF}_i^s = \frac{\epsilon_{ii}^{\Pi}}{1 + E_i - \epsilon_{ii}^{\Pi}} \widetilde{\epsilon}_{ii}^{\Pi} - \frac{E_i}{1 + E_i - \epsilon_{ii}^{\Pi}} \widetilde{E}_i - \frac{\epsilon_i^H}{1 - \epsilon_i^H} \widetilde{\epsilon}_i^H. \tag{5.24}$$

where the denominators are unambiguously positive evaluated at the initial Nash equilibrium, with $E_i = 0$ and $\epsilon_i^H = 0$ at the symmetric Nash equilibrium. The first two terms in Eq. 5.24 describe the incentive to change the statutory tax rate from the perspective of a tax revenue maximizer who only cares about the Laffer curve. The final term deals with changes in the private cost of a tax increase. The denominator indicates how far the initial tax policy of country i is from the top of the initial Laffer curve. The larger this distance, the weaker is the response to an exogenous shock because, apparently, there are substantial private costs to a tax which prevented the government from choosing a point closer to the top of the initial Laffer curve. As mentioned before, Figure 5.2 illustrates that larger countries are located closer to the top of their Laffer curve and thus respond fiercer.

The Laffer curve of the statutory tax rate is affected by endogenous changes in ϵ_{ii}^{Π} and E_i. MCF_i^s is unambiguously increasing in the paper-profits elasticity (ϵ_{ii}^{Π}), when profits

respond relatively fiercer to a tax increase the slope of the Laffer curve becomes flatter, the Laffer curve shrinks. MCF_i^s is unambiguously decreasing in the tax-exportation coefficient (E_i). A broader tax base implies that the slope of the Laffer curve becomes steeper, the Laffer curve expands.

As a next step, I allow ϵ_{ii}^{Π} and E_i to be endogenous and dependent on the various tax instruments. Linearizing ϵ_{ii}^{Π} and E_i (see Table 5.1 for the definitions) yields:

$$\widetilde{\epsilon}_{ii}^{\Pi} = \widetilde{\tau}_i^s - \widetilde{R}_i, \tag{5.25}$$

$$\widetilde{E}_i = -\frac{\epsilon_{ii}^{\Pi}}{E_i}\widetilde{\tau}_i^s + \frac{\epsilon_{ij}^{\Pi}}{E_i}\widetilde{\tau}_j^s - \widetilde{R}_i, \tag{5.26}$$

$$\widetilde{R}_i = -\beta\epsilon_{ii}^k\widetilde{\tau}_i^e + \beta\epsilon_j^{\rho}\widetilde{\tau}_j^e, \tag{5.27}$$

under the assumption of a Cobb-Douglas production function ($f(k_i) = k_i^{\beta}$, $0 < \beta < 1$) such that $R_i = (1-\beta)k_i^{\beta}$, and

$$\epsilon_{ij}^k = \frac{\partial k_i}{\partial \tau_j^e}\frac{\tau_j^e}{k_i} = \frac{1}{1-\beta}\epsilon_j^{\rho} > 0,$$

denotes the elasticity of the capital stock of country i with respect to the marginal tax rate in country j.

From Eq. (5.25)-(5.26) we learn that both coefficients are decreasing in the taxable rents (R_i) as a broader domestic tax base reduces the importance of the indirect leakages. R_i is increasing in the foreign marginal tax rate and decreasing in the home marginal tax rate due to capital mobility. The paper-profits elasticity is increasing in the own statutory tax rate as a larger tax rate implies a larger excess burden. The tax-exportation coefficient (E_i) is decreasing in the own statutory tax rate as the aggregate tax base is reduced due to an outflow of profits. From the reversed argument, E_i is increasing in the foreign statutory tax rate.

A utility maximizing government, not only cares about a change in the Laffer curve, it also changes its tax policy in response to changes in the private costs of a tax increase (the numerator in Eq. 5.19). For the statutory rate this is captured by a change in the dividends elasticity (ϵ_i^H). For a low-tax country ($\tau_i^s < \tau_j^s$), the elasticity is negative ($\epsilon_i^H < 0$), which implies that the marginal cost is increasing in the dividends elasticity, this signals the reduced potential for tax-shifting through narrower tax differentials. The reduction in tax-shifting opportunities is seemingly paradoxically valued negatively by a utility maximizing government because, next to expanding the Laffer curve, it hurts the private consumption of its citizens. For a high-tax country, ($\tau_i^s > \tau_j^s$), the reversed

reasoning applies. ϵ_i^H is endogenous and is linearized as follows:

$$\widetilde{\epsilon}_i^H = -s_i \frac{\epsilon_{ij}^{\Pi}}{\epsilon_i^H} \widetilde{\tau}_j^s + s_i \frac{\epsilon_{ii}^{\Pi}}{\epsilon_i^H} \widetilde{\tau}_i^s - \widetilde{R}_i, \tag{5.28}$$

where,

$$\epsilon_{ij}^{\Pi} = \frac{\partial P_i}{\partial \tau_j^s} \frac{\tau_j^s}{R_i} = \frac{\tau_j^s}{s_i 2\alpha R_i} > 0.$$

denotes the elasticity of taxable rents with respect to the foreign statutory tax rate. The effect of the own statutory tax rate on the dividend elasticity (ϵ_i^H) is either positive or negative. For a high-tax country, the increase in the own statutory tax rate widens the tax differential and therefore increases tax-shifting opportunities: ϵ_i^H increases. For a low-tax country an increase in the tax rate reduces the tax differential and hence ϵ_i^H. For the foreign tax rate the reverse arguments hold. The elasticity is decreasing in taxable rents, when the direct effect expands, indirect effects become less important.

Substituting Eq (5.25)-(5.28) in Eq (5.24) and using the equality of the marginal rate of substitution to the marginal cost of funds yields the following linearized optimal policy rule for the statutory rate:

$$M_{ii}^{ss} \widetilde{\tau_i^s} = M_{ij}^{ss} \widetilde{\tau}_j^s - M_{ii}^{se} \widetilde{\tau}_i^e + M_{ij}^{se} \widetilde{\tau}_j^e + \widetilde{MRS}_i, \tag{5.29}$$

where

$$M_{ii}^{ss} \equiv \frac{\epsilon_{ii}^{\Pi}}{\theta^s} \left(2 - \frac{s_i}{\overline{MCF}}\right) > 0, \quad M_{ij}^{ss} \equiv \frac{\epsilon_{ij}^{\Pi}}{\theta^s} \left(1 - \frac{s_i}{\overline{MCF}}\right) > 0,$$
$$M_{ii}^{se} \equiv \frac{\beta \epsilon_{ii}^k}{\theta^s} \left(1 - \frac{1}{\overline{MCF}}\right), \quad M_{ij}^{se} \equiv \frac{\beta \epsilon_{ij}^k}{\theta^s} \left(1 - \frac{1}{\overline{MCF}}\right),$$

with $\overline{MCF} > 1$ denoting the marginal cost of funds evaluated at the old equilibrium, and: [22]

$$\theta^s = 1 + E_i - \epsilon_{ii}^{\Pi} > 0.$$

The coefficients indicate the sensitivity of the marginal cost of funds of country i with respect to the tax instrument $M_{il}^{um} = |\partial MCF_u^w / \partial \tau_l^m|$ with $w, m \in [s, e]$ and $u, l \in$

[22] In this subsection, $\overline{MCF} = \gamma_1$, but for the analysis below a more general notation is needed.

$[i, j]$. M_{ii}^{ss} equals minus the second-order condition for the maximization problem of the government in country i with respect to the statutory tax rate.

The coefficients consist out of three intuitive terms. First of all, all are divided by the distance between the initial statutory tax rate and the top of the initial Laffer curve for the statutory tax rate (θ^s). As mentioned before, this reflects the eagerness of country i to raise its statutory rate. If the initial tax policy further from the top of the Laffer curve, there is an argument (private costs in this case) that makes tax increases relatively unattractive.

Second, the size of the outward shock to the Laffer curve as indicated by the term in the numerator of each coefficient. The larger this shock, the larger the change in the tax rate.

Finally, the term in between brackets captures the relative weight attached by the government to the private costs of a tax increase. For $\gamma_1 = \overline{MCF} \approx \infty$, we see that the term in between square brackets simplifies to 2 for M_{ii}^{ss}, and 1 for the remaining coefficients: only the Laffer curve arguments matter. Furthermore, we see that lower values of $\gamma_1 = \overline{MCF}$ lead to lower coefficients: smaller responses. Finally, the private costs are independent of country size whereas profit-shifting and capital mobility becomes less important when size increases (see Table 5.1). Therefore, size (s_i) regulates the relative strength of private costs argument. For larger countries the argument is more important such that they respond less fierce.

5.4.2 Linearizing MCF_i^e

The marginal cost of financing the public good with the marginal rate (MCF_i^e) is given by the right-hand side of Eq. (5.20). Linearizing gives:

$$\begin{aligned}\widetilde{MCF_i^e} = &\frac{\tau_i^s \epsilon_i^R}{\theta^e}\left(1 - \frac{1}{\overline{MCF}^e}\right)(\widetilde{\tau}_i^s + \widetilde{\epsilon}_i^R) + \frac{\epsilon_i^\rho}{\theta^e}\left(1 - \frac{1}{\overline{MCF}^e}\right)\widetilde{\epsilon}_i^\rho + \frac{\epsilon_{ii}^k}{\theta^e}\widetilde{\epsilon}_{ii}^k, \\ &- \frac{1}{\theta^e}\frac{e}{k_i}\frac{\epsilon_i^\rho}{\tau_i^e}\frac{1}{\overline{MCF}^e}\widetilde{k}_i + \frac{1}{\theta^e}\frac{\epsilon_i^\rho}{\tau_i^e}\left(\frac{e}{k_i} - 1\right)\frac{1}{\overline{MCF}^e}(\widetilde{\epsilon}_i^\rho - \widetilde{\tau}_i^e),\end{aligned} \tag{5.30}$$

with

$$\theta^e \equiv 1 - \tau_i^s \epsilon_i^R - \epsilon_i^\rho - \epsilon_{ii}^k > 0, \tag{5.31}$$

and $\overline{MCF}^e = \gamma_1 > 1$ denotes the marginal cost of funds evaluated at the decentralized equilibrium. Compared to Eq. 5.24, Eq. 5.30 seems more complex. However, several similarities can be identified. First of all, each term is divided by the distance to the

top of the Laffer of the marginal tax rate (θ^e). Second, each of the terms is related to a specific effect in the modified Samuelson rule. The first two terms capture the two domestic channels identified in Section 5.2, the remaining terms pertain to the international channels. As a result, the first two terms both affect the public costs (the Laffer curve) and the private costs, the third term only affects the Laffer curve, while the last two terms only affect the private costs. To recognize this, recall that an increase in $\gamma_1 = \overline{MCF}^e$ reduces the private cost arguments.

Because the elasticities ϵ_i^R, ϵ_i^ρ and ϵ_{ii}^k do not depend on statutory tax rates, an important observation in Eq. (5.30) is the positive effect from an increase in the statutory tax rate (τ_i^s) on MCF_i^e and the absence of an effect from the foreign statutory tax rate (τ_j^s). A one percentage point reduction in taxable rents (R_i), for example due to an increase in the marginal tax rate, translates into a τ_i^s reduction tax revenues. The higher the statutory rate, the larger this reduction and the more costly is an increase in the marginal rate. Note that the statutory rate appears in the optimal policy rule for the marginal tax rate because the marginal tax rate reduces the tax base of the statutory rate. The foreign statutory rate does not affect MCF_i^e at all because it does not affect the tax base of the marginal rate (ρk_i) or the return to capital received by investors (ρe), and the home government does not value the reduction in tax revenue for the foreign government.

Again, tax interaction runs through endogenous tax elasticities. Changes in the marginal rates affect ϵ_i^R, ϵ_i^ρ, ϵ_{ii}^k and k_i and therefore each of the domestic and international channels. In Eq. (5.30) we see that besides the final term, MCF_i^e is increasing in ϵ_i^R, ϵ_i^ρ and ϵ_{ii}^k. Linearizing $\epsilon_i^R, \epsilon_i^\rho$ and ϵ_{ii}^k under the assumption of a Cobb-Douglas production function gives:[23]

$$\widetilde{\epsilon}_i^R = \frac{s_i k_i}{1 - s_i k_i} \epsilon_{ii}^k \widetilde{\tau}_i^e - \frac{s_i k_i}{1 - s_i k_i} \epsilon_{ij}^k \widetilde{\tau}_j^e, \tag{5.32}$$

$$\widetilde{\epsilon}_i^\rho = \left(\frac{1}{1 + \tau_i^e} - \epsilon_{ii}^k \right) \widetilde{\tau}_i^e + \epsilon_{ij}^k \widetilde{\tau}_j^e, \tag{5.33}$$

$$\widetilde{\epsilon}_{ii}^k = \left(\frac{1}{1 + \tau_i^e} + \frac{s_i k_i}{1 - s_i k_i} \epsilon_{ii}^k \right) \widetilde{\tau}_i^e - \frac{s_i k_i}{1 - s_i k_i} \epsilon_{ij}^k \widetilde{\tau}_j^e, \tag{5.34}$$

An increase in the home marginal rate increases the marginal tax distortion which increases ϵ_i^ρ and ϵ_{ii}^k directly. Furthermore, capital flows out of country i which reduces market power and therefore ϵ_i^ρ while ϵ_{ii}^k and ϵ_i^R are increased.

An increase in the capital stock elasticity (ϵ_{ii}^k) and the semi-elasticity of taxable rents (ϵ_i^R) unambiguously raises MCF_i^e. When capital becomes more mobile (larger ϵ_{ii}^k), the

[23] See Appendix B for a detailed discussion on how market power depends on size, the capital stock depending and the production function.

marginal cost of financing the public good is increased (first international channel). Market power on the international capital market (Σ_i) implies that an increase in the marginal tax rate translates into a smaller increase in the cost of capital ($(1+\tau_i^e)\rho$) of the domestic firm because the reduction in the interest rate counter-acts the increased marginal tax rate. Hence, when market power is reduced, an increase in the marginal tax rate leads to a larger increase in the cost of capital ($(1+\tau_i^e)\rho$) for MNE_i and hence results in more public revenue loss and a larger MCF_i^e (first domestic channel). The ambiguous change in ϵ_i^ρ potentially counter-acts these incentives (second domestic channel) but is dominated.[24] Furthermore, the capital outflow implies that country i becomes more of a capital exporter which also increases MCF_i^e (fifth term in Eq. (5.30)) because an increase in the marginal tax rate now reduces net interest receipts. From these arguments, MCF^e is therefore unambiguously increasing in τ_i^e.

Only the second international channel, represented by the final term in Eq. (5.30), implies an ambiguity. The (semi) elasticity of the interest rate (ϵ_i^ρ/τ_i^e) is unambiguously reduced after an increase in the marginal tax rate. For a capital importer an increase in the semi-elasticity is welcome, since it can more easily export the tax burden, the marginal cost of funds is reduced. A capital exporter on the other hand, will realize that the net interest earnings will be reduced stronger after a tax increase and hence the marginal cost of funds is increased.

The foreign marginal rate affects MCF_i^e through capital re-allocations and the subsequent changes in market power. An increase in the foreign marginal rate, leads to a capital inflow which directly reduces MCF_i^e as country i becomes more of a capital importer (fifth term in Eq. (5.30)) and increases market power which reduces ϵ_{ii}^k and ϵ_i^R but raises ϵ_i^ρ. Again the reduction in ϵ_{ii}^k and ϵ_i^R dominate. Furthermore, there is an unambiguous net reduction in the strength of the second international channel such that MCF_i^e is unambiguously reduced after an increase in the foreign marginal rate.[25]

Combining Eq. (5.30) - (5.34) gives the linearized policy rule for the marginal rate:

$$M_{ii}^{ee}\widetilde{\tau}_i^e = -M_{ii}^{es}\widetilde{\tau}_i^s + M_{ij}^{ee}\widetilde{\tau}_j^e + \widetilde{MRS}_i, \tag{5.35}$$

[24] The reduction in ϵ_i^ρ is dominated by the increase in ϵ_i^R: $(\tau_i^s\epsilon_i^R\widetilde{\epsilon}_i^R + \epsilon_i^\rho\widetilde{\epsilon}_i^\rho = \epsilon_i^\rho[(\tau_i^s a_i/\tau_i^e)\epsilon_{ii}^k + 1/(1+\tau_i^e)]\widetilde{\tau}_i^e > 0$ for $\widetilde{\tau}_i^e > 0$ and $\widetilde{\tau}_j^e = 0$.

[25] From the fifth and sixth term in Eq. (5.30): $(\epsilon_i^\rho/\tau_i^e)[-(e/k_i)(1/\theta^e)\epsilon_{ij}^k + \left(\frac{e}{k_i}-1\right)(1/\theta^e)\epsilon_{ij}^k]\widetilde{\tau}_j^e = -(\epsilon_i^\rho/\tau_i^e)(1/\theta^e)\epsilon_{ij}^k$.

where I use

$$M_{ii}^{ee} \equiv \frac{1}{\theta^e}\left\{\frac{\tau_i^e}{1+\tau_i^e}\left[\epsilon_{ii}^k+\epsilon_i^\rho\right]+\epsilon_i^\rho\epsilon_{ii}^k\Theta_i^{g,k}\right\} + \frac{1}{\theta^e}\frac{\epsilon_i^\rho}{\overline{MCF}^e}\left\{\epsilon_{ii}^k\Theta_i^{c,k}-\left(\frac{e}{k_i}\right)\frac{1}{1+\tau_i^e}\right\}, \tag{5.36}$$

$$M_{ij}^{ee} \equiv \frac{\epsilon_i^\rho\epsilon_{ij}^k}{\theta^e}\Theta_i^{g,k}+\frac{\epsilon_i^\rho\epsilon_{ij}^k}{\theta^e}\frac{1}{\overline{MCF}^e}\Theta_i^{c,k}>0, \tag{5.37}$$

$$M_{ii}^{es} \equiv \frac{\tau_i^s\epsilon_i^R}{\theta^e}\left(1-\frac{1}{\overline{MCF}^e}\right)>0, \tag{5.38}$$

where

$$\Theta_i^{g,k} \equiv \frac{\tau_i^s a_i}{\tau_i^e}+\frac{1}{\phi}>0, \quad \Theta_i^{c,k} \equiv \frac{1-\tau_i^s a_i}{\tau_i^e}>0, \tag{5.39}$$

describe how the public-revenue (the Laffer curve) and the private-cost from an increase in the marginal tax rate is affected by an inflow of capital. Furthermore, M_{ss}^{ee} can be signed as it equals (minus) the second-order condition for the maximization problem of the government of country i with respect to the marginal tax rate.

Again, the coefficients consist out of a number of intuitive parts. First of all, as mentioned before, each coefficient is divided by θ^e, which measures the distance to the top of the Laffer curve of the marginal rate. The larger this distance, the less eager the government of country i will be to raise its marginal tax rate upon a shock to the marginal cost of funds.

Second, each coefficient consists out of a part that pertains to the revenue maximizing incentive of the government (the first part) and a part that pertains to the utility maximizing incentive (the second part, multiplied by $\frac{1}{\overline{MCF}^e}$). The latter takes into account that the private cost from a marginal tax rate will change. The higher $\gamma_1 = \overline{MCF}^e$, the less the change in the private cost is taken into account.

Third, M_{ii}^{ee} contains the terms $\Theta_i^{g,k}$ and $\Theta_i^{c,k}$ that describe how the marginal cost of funds is affected by the capital outflow following an increased marginal tax rate. $\Theta_i^{g,k}$ is positive as a capital outflow reduces market power ($\Sigma_i = s_i k_i$), which increases both the domestic leakages ($\tau_i\epsilon_i^R+\epsilon_i^\rho$) and the international leakage (ϵ_{ii}^k) and hence raises the marginal cost of funds. $\Theta_i^{c,k}$ captures the increase in the private costs due to the capital outflow. The capital outflow reduces market power, which implies that the cost of capital increases stronger after an increase in the marginal tax rate. That is, the off-setting reduction in the interest rate is reduced.

The remaining terms in M_{ii}^{ee} describe how the marginal excess burden is increasing in the own tax rate holding constant the stock of capital and therefore market power, that is, partial equilibrium arguments. The marginal excess burden is increasing in the own tax rate from the perspective of a revenue maximizer. However, for a government that maximizes utility this argument is corrected (the increase in the marginal cost of funds is smaller) because private costs are reduced through a higher interest rate elasticity. Recall that the higher the interest rate elasticity, the smaller is the change in the cost-of-capital for MNE_i following a change in the marginal tax rate, and the smaller is the private cost from an increase in the marginal tax rate. However, for capital importers this argument becomes weaker as most of the capital stock invested in MNE_i is owned by foreigners such that the reduction in the interest rate mainly affects foreigners: tax exportation is also favoured by a utility maximizing government.

Fourth, M_{ij}^{ee} only consists out of the terms that describe how capital flows affect the marginal cost of funds. This is because a change in the foreign marginal tax rate only affects the optimal policy rules in Eqs. (5.19)-(5.20) via movements in capital.

5.4.3 Summarized and Simulated Optimal Policy Rules

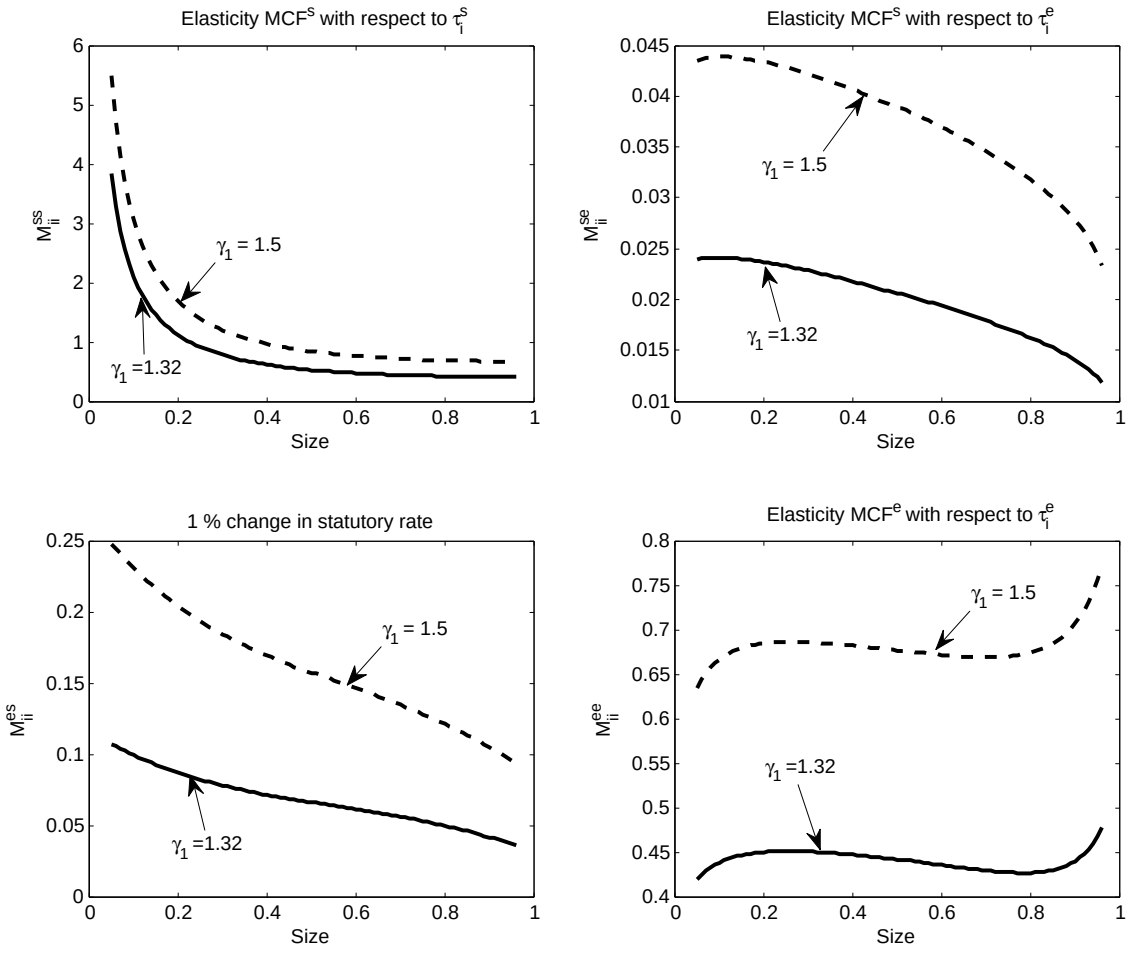
I obtain linearized reduced-form tax reaction functions by combining Eqs. (5.29) and (5.35). The assumption of a linear utility function: $U_i = c_i + \gamma g_i$, $\gamma_1 > 1$ implies that the marginal rate of substitution is constant: $\widetilde{MRS_i} = 0$. For this case, the linearized optimal policy rules are given by the following system:

$$\overbrace{\begin{bmatrix} M_{ii}^{ss} & M_{ii}^{se} \\ M_{ii}^{es} & M_{ii}^{ee} \end{bmatrix}}^{\Xi_{Home}} \begin{bmatrix} \widetilde{\tau}_i^s \\ \widetilde{\tau}_i^e \end{bmatrix} = \overbrace{\begin{bmatrix} M_{ij}^{ss} & M_{ij}^{se} \\ 0 & M_{ij}^{ee} \end{bmatrix}}^{\Xi_{Foreign}} \begin{bmatrix} \widetilde{\tau}_j^s \\ \widetilde{\tau}_j^e \end{bmatrix}, \tag{5.40}$$

where I focus on the strategic interaction in tax rates. The matrix on the left-hand-side of the equation captures the internal substitution between both domestic tax rates. The matrix on the right-hand side captures the strategic reaction of the domestic tax rates to a change in foreign policy. Figures 5.3 and 5.4 provide the simulated values of the various coefficients.

Figure 5.3 presents the coefficients in the matrix of internal substitution on the left-hand-side of Eq. (5.40) for a wide range of values for s. The organization of the figure follows the configuration of the matrix. Furthermore, the solid lines represent coefficients under the assumption of a linear utility function with $\gamma_1 = 1.32$, whereas the dashed lines present the coefficients for a government that is more interested in tax revenues,

Figure 5.3: Internal substitution



$\gamma_1 = 1.5$. All coefficients are positive as expected. Furthermore, the determinant of this matrix is positive for reasonable parameter values and all simulations performed implying that the second-order conditions for welfare maximization are satisfied.[26] The upper-left plot shows that especially MCF_i^s for very small countries is sensitive to changes in the own statutory rate. This follows the shape of the paper-profit shifting elasticity (ϵ_{ii}^{Π}) in Figure 5.2. It implies that for a small country only a small change in the statutory tax rate is needed to restore equilibrium upon a given shock. Second, the marginal and statutory tax rates are substitutes of each other, with the cross-effect approaching zero for very large countries. This follows from the elasticity of taxable rents with respect to the marginal tax rate (ϵ_i^R), this elasticity approaches zero for large countries. Third, the inverted S-shape in the lower-right plot can be explained by the distance to the top

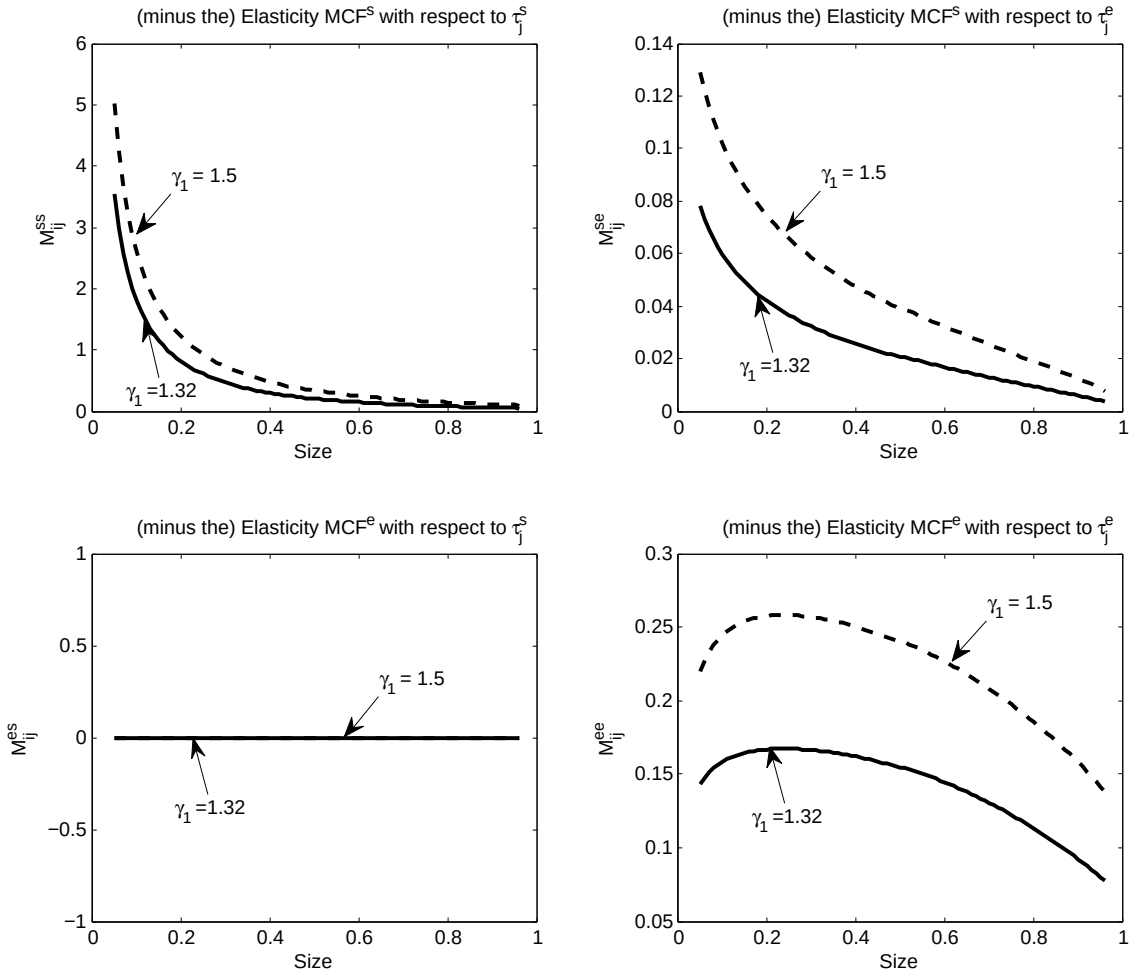
[26] A necessary condition for a welfare maximum is that the determinant of the Hessian matrix is positive, the sign of this determinant is equal to the sign of the determinant of the matrix of internal substitution. See Appendix C.

of the Laffer curve (θ^e). Larger countries are closer to the top of their Laffer curve and therefore respond fiercer to shocks in MCF_i^e. This dominates the reduction in the capital stock elasticity (ϵ_{ii}^k) which would reduce the size of the coefficient in a similar fashion as the reduction in the the paper profit-shifting elasticity ϵ_{ii}^{Π} affects the size of M_{ii}^{ss}. The argument is supplemented by the general equilibrium argument ($\Theta_i^{g,k}$ and $\Theta_i^{c,k}$) which is U-shaped.[27] Combining both leads to the S-shaped curve observed. This implies that for a larger country a smaller change in the marginal tax rate suffices to solve the optimal policy rule after a given shock, this contrasts the findings for the statutory rate in M_{ii}^{ss}. Ceteris paribus, large countries respond fiercer with the statutory tax rate, small countries respond fiercer with the marginal tax rate. Finally, the own effects (M_{ii}^{ss} and M_{ii}^{ee}) are larger compared to the cross-effects (M_{ii}^{se} and M_{ii}^{es}), this will turn out to be important below. As already suggested by the mathematical expressions, a larger γ_1 leads to fiercer responses.

Figure 5.4 presents the coefficients for the strategic reaction of country i to a tax rate change in country j for a wide range of values for s. The organization follows exactly the matrix on the right-hand side of Eq. (5.40). Furthermore, the solid lines represent coefficients under the assumption of a linear utility function with $\gamma_1 = 1.32$, whereas the dashed lines present the coefficients for a government that is more interested in tax revenues, $\gamma_1 = 1.5$. All coefficients are non-negative, which implies that cross-country tax instruments are always complements. First of all, ceteris paribus, the foreign statutory rate does not influence the home marginal rate (lower-left plot). The intuition for this is that whereas the home statutory tax rate determines the amount of tax revenues lost from a reduction in taxable rents, the foreign statutory tax rate plays no such role. It does not enter the optimal policy rule for the marginal tax rate. Second, the sensitivity of MCF_i^s with respect to the foreign statutory rate is especially high for very small countries (upper-left plot). The small countries are confronted with massive profit-shifting following a change in the foreign statutory rate (ϵ_{ij}^{Π} is large), this leads to a large shift in the optimal policy rule for the statutory tax rate. Third, the sensitivity of MCF_i^s with respect to the foreign marginal rate is decreasing in size (see the upper-right plot), this follows from the elasticity of the capital stock with respect to the foreign marginal rate which is strongly decreasing in size. A change in the marginal tax rate in a very small neighboring country does not affect the cost-of-capital of MNE_i and hence does not affect taxable rents (R_i) at home. The opposite holds for a large neighbor. The final coefficient, the lower-right plot, captures the sensitivity of MCF_i^e with respect to the foreign marginal rate and can be explained completely from the distance between the top of the Laffer curve and the initial

[27] To be precise, $\epsilon_i^{\rho}\epsilon_{ii}^k = (1/\phi)(\tau_i^e/(1+\tau_i^e))^2\Sigma_i(1-\Sigma_i)$, which is U-shaped.

Figure 5.4: Reaction to changes in foreign rate



marginal tax rate on the one hand (θ^e), and from general equilibrium changes in market power on the other hand. The closer to the top of the Laffer curve, the smaller θ^e and the larger the coefficient. The larger the foreign country, the larger $\epsilon_{ij}^k = 1/(1-\beta)\epsilon_{\rho,j}$ and the smaller ϵ_i^ρ. So this again is an inverted U-shaped effect, which explains the curvature observed. Also here, as already suggested by the mathematical expressions, a larger γ_1 leads to fiercer responses.

Comparing the plots in Figure 5.3 and 5.4 yields some conclusions. First of all, the effect of a tax instrument on its own marginal cost of funds is always larger than the internal cross-effect. This is a sufficient condition for a welfare maximum. Second, the cross-country effect from the foreign statutory and foreign marginal tax rate can be relatively large for small countries (compared to the internal relations). For large countries, however, the tax instruments tend to be rather independent. The statutory tax rate of a large country will not respond fierce to changes in its own marginal tax rate, or either

one of the foreign tax rates. The only exception is the cross-country reaction on changes in the marginal tax rate, which are rather stable.

5.5 Endogenous Willingness to Pay for Public Goods

The potential to raise revenue is the only argument in choosing tax policy for a government that intends to maximize tax revenues. A welfare-maximizing government is in addition interested in the marginal valuation of public spending. Following Chapter 4, changes in the marginal willingness to pay for public goods should be taken into account before reaching conclusions regarding strategic tax setting by a welfare maximizing government.

Using a quasi-linear utility function: $U(c_i, g_i) = c_i + \gamma_1(1/\gamma_2)g_i^{\gamma_2}$, with $\gamma_2 < 1$ (see Sørensen (2004a) who uses $\gamma_2 = 0.05$) I obtain the following linearization of the marginal rate of substitution:[28]

$$\widetilde{MRS_i} = -(1-\gamma_2)\widetilde{g}_i, \tag{5.41}$$

where the marginal valuation of public goods decreases in public spending.

The linearization of Eq. (5.13) yields

$$\widetilde{g}_i = \beta_i\theta^s\widetilde{\tau}_i^s + \beta_i\epsilon_{ij}^{\Pi}\widetilde{\tau}_j^s + (1-\beta_i)\theta^e\widetilde{\tau}_i^e + (1-\beta_i)\Theta_i^{g,k}\epsilon_j^{\rho}\widetilde{\tau}_j^e, \tag{5.42}$$

where $\beta_i = \tau_i^s(R_i + P_i)/g_i$ equals the fraction of revenues from the statutory tax rate in public consumption. Public consumption increases in all arguments for $a_i \in [0,1]$. For the own rates this is because a rational government always chooses tax policy on the upward-sloping part of the Laffer curve.[29] A higher foreign statutory tax rate induces profit-shifting towards country i, which broadens the tax base for the domestic statutory tax rate. A higher foreign marginal tax rate broadens the base of both the marginal and statutory tax rate due to an increase in domestic investment and a reduction in the cost of capital.

[28] In general, the only assumption on the utility function needed is that the MRS is decreasing in public spending.

[29] Notice that the argument takes the interactions between the tax instruments into account. Notably, the tax instruments are substitutes in financing the public good; an equilibrium with one instrument on the downward sloping part of the Laffer curve is therefore never optimal.

When I add a non-constant MRS to the system in Eq. (5.40), it follows that:

$$\Xi_{Home} \begin{bmatrix} \widetilde{\tau}_i^s \\ \widetilde{\tau}_i^e \end{bmatrix} = \Xi_{Foreign} \begin{bmatrix} \widetilde{\tau}_j^s \\ \widetilde{\tau}_j^e \end{bmatrix} + \widetilde{MRS_i} I, \tag{5.43}$$

$$\overbrace{\begin{bmatrix} M_{ii}^{ss} + (1-\gamma_2)\beta_i/\theta^s & M_{ii}^{se} + (1-\gamma_2)(1-\beta_i)/\theta^e \\ M_{ii}^{es} + (1-\gamma_2)\beta_i/\theta^s & M_{ii}^{ee} + (1-\gamma_2)(1-\beta_i)/\theta^e \end{bmatrix}}^{\Xi_{Home}} \begin{bmatrix} \widetilde{\tau}_i^s \\ \widetilde{\tau}_i^e \end{bmatrix} =$$

$$\overbrace{\begin{bmatrix} M_{ij}^{ss} - (1-\gamma_2)\beta_i\epsilon_{ij}^{\Pi} & M_{ij}^{se} - (1-\gamma_2)(1-\beta_i)\Theta_i^{g,k}\epsilon_j^{\rho} \\ -(1-\gamma_2)\beta_i\epsilon_{ij}^{\Pi} & M_{ij}^{ee} - (1-\gamma_2)(1-\beta_i)\Theta_i^{g,k}\epsilon_j^{\rho} \end{bmatrix}}^{\Xi_{Foreign}} \begin{bmatrix} \widetilde{\tau}_j^s \\ \widetilde{\tau}_j^e \end{bmatrix}, \tag{5.44}$$

where I is a 2×1 vector of ones. A number of lessons can be drawn. First, Eq. (5.43) shows that a welfare maximizing government has an incentive to increase both tax instruments when the marginal willingness to pay for public goods increases. Second, Eq. (5.44) claims that strategic substitutability between the own tax instruments is strengthened in case of a non-constant MRS. An increase in the marginal rate not only increases the cost of financing public goods with the statutory rate, it also lowers the marginal willingness to pay for public goods, and vice-versa. Third, an endogenous willingness to pay for public goods allows for strategic substitutes across countries, that is, the government of country i might reduce one or both tax rates in response to an increase in foreign tax rates because the marginal valuation of public goods decreases due to an inflow of capital and/or profits. This occurs especially when the excess burden of either the statutory or the marginal tax rate is (relatively) insensitive to changes in foreign tax rates, in which case the decreasing marginal valuation of public goods argument dominates. This argument is most strikingly illustrated by the negative response by the home marginal tax rate upon an increase in the foreign statutory rate, because there was no reaction at all for the case of a linear utility function (see the zero in the right-hand side matrix in Eq. 5.40).

Interestingly, the strength of the new argument depends on size. For small countries, the inflow of profits and capital following a foreign tax increase is relatively large. This implies a steep reduction in the marginal willingness to pay: tax instruments of small countries are more likely to act as a strategic substitute from this insight. The net effect depends on the size of the partial coefficients in $\Sigma_{Foreign}$.

Table 5.2: Robustness Analysis

	C	Base Cases		L-UF	QL-UF	CES-UF			Q-PF	CES-PF	
		L UF	QL UF	Sym.	Sym.	$\sigma = 1$	Sym.	$\sigma = 10$	Sym.	$\omega = 0.6$	$\mu = 0.5$
column		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
τ^e	1	0.26	0.26	0.26	0.26	0.38	0.27	0.16	0.28	0.26	0.27
	2	0.37	0.35	0.37	0.35	0.49	0.35	0.22	0.36	0.37	0.36
τ^s	1	0.27	0.26	0.27	0.26	0.40	0.27	0.16	0.27	0.28	0.27
	2	0.35	0.33	0.35	0.33	0.47	0.33	0.20	0.32	0.34	0.32
						Responses Statutory Rate					
$\widetilde{\tau}_i^s/\widetilde{\tau}_i^e$	1	-0.03	-0.10	-0.03	-0.10	-0.12	-0.10	-0.08	-0.13	-0.18	-0.12
	2	-0.04	-0.15	-0.04	-0.15	-0.17	-0.15	-0.13	-0.19	-0.26	-0.17
$\widetilde{\tau}_i^s/\widetilde{\tau}_j^s$	1	0.56	0.28	0.56	0.28	0.16	0.33	0.42	0.30	0.34	0.29
	2	0.25	0.08	0.25	0.08	0.00	0.11	0.15	0.09	0.15	0.09
$\widetilde{\tau}_i^s/\widetilde{\tau}_j^e$	1	0.04	0.00	0.04	-0.01	-0.02	0.01	0.01	0.02	-0.02	0.01
	2	0.03	-0.02	0.03	-0.01	-0.02	0.00	0.01	0.01	-0.02	0.00
						Responses Marginal Rate					
$\widetilde{\tau}_i^e/\widetilde{\tau}_i^s$	1	-0.17	-0.59	-0.17	-0.59	-1.06	-0.55	-0.32	-0.75	-0.34	-0.69
	2	-0.13	-0.63	-0.13	-0.63	-1.24	-0.60	-0.35	-0.86	-0.30	-0.75
$\widetilde{\tau}_i^e/\widetilde{\tau}_j^s$	1	0.00	-0.23	0.00	-0.23	-0.35	-0.14	-0.05	-0.05	-0.20	-0.12
	2	0.00	-0.12	0.00	-0.11	-0.22	-0.08	-0.03	-0.03	-0.10	-0.06
$\widetilde{\tau}_i^e/\widetilde{\tau}_j^e$	1	0.37	0.23	0.37	0.22	0.16	0.25	0.29	0.25	0.16	0.22
	2	0.31	0.22	0.31	0.23	0.18	0.25	0.27	0.18	0.19	0.22

Notes: Column (C) denotes the country $i \in 1, 2$ with $s_1 = 1/3$ and $s_2 = 2/3$. The first four rows present equilibrium taxes. The remaining rows present the optimal policy response of the home statutory or home marginal tax rate to a 1 percent change in the tax rate mentioned in the first column of the corresponding row. Columns (3) and (4) present responses using the linearized expressions. The remaining columns present simulated responses. For the base cases I use: (i) the linear utility function with parameters $\gamma_2 = 1$ and $\gamma_1 = 1.32$, and; the quasi-linear utility function with parameters $\gamma_1 = 0.72$ and $\gamma_2 = 0.53$. Both are combined with a Cobb-Douglas production function with the capital share in production equal to: $\omega = 0.36$. Finally, the parameter describing the profit-shifting technology is calibrated to be: $\alpha = 1.91$. The columns with *Sym.* indicate that the column is calibrated such that in the symmetric equilibrium $\tau_i^s = 0.3$, $\tau_i^e = 0.3$ and $g_i/c_i = 0.38$, which is identical to the base case calibration. For CES UF this implies $\sigma = 3.46$. Note that especially the choice of g_i/c_i influences the remaining parameters, see Appendix A for a discussion.

5.6 Robustness Analysis: Generalized Production and Utility Functions

This section studies the robustness of our results as I want to stress that my results do not depend either on the production function assumed (Cobb-Douglas) or the utility function. The simulation study shows that the results hold as well for a more general production function, the constant elasticity of substitution (CES) production function, and the quadratic production function often used in the tax competition literature. Furthermore, I show that the results hold for a more general CES utility function. To this

end, I simulate the model for three different utility functions: linear (L-UF), quasi-linear (QL-UF) and CES (CES-UF); and two different production functions: Quadratic (Q-PF) and CES (CES-PF). See Appendix A for a discussion of these functions and the parametrization. Table 5.2 presents the results. I compare the equilibrium taxes (τ_i^e, τ_i^s) and the optimal policy responses to a 1 percent shock in each of the other rates under various parameter configurations. I study an asymmetric case where country 1 has size 1/3 and country 2 has size 2/3. In addition, I compare the linearized optimal responses from Eqs. (5.40)-(5.44) for the base cases to simulated optimal responses from the non-linear model. The base case uses either a linear or quasi-linear utility function combined with a Cobb-Douglas production function.

Before I discuss the main results, first remark that the largest country, country 2, indeed chooses the highest tax rate under all cases presented. With respect to the optimal responses, the most striking result is that the linearized responses for both the linear and the quasi-linear utility function (columns (3) and (4), respectively) are very close to the simulated responses from the non-linear model (columns (5) and (6), respectively). This suggests that our analytical derivations reveal the most important arguments, at least at the margin.[30] This validates the linearization methodology.

Second, we see that in case of a decreasing marginal utility of public goods, the optimal response to an increase in the foreign statutory rate implies a reduction in the own marginal rate (bottom panel of Table 5.2). This holds for all specifications except the linear utility function, where the optimal response is not to change the marginal rate. More general, all coefficients for the quasi-linear utility function are smaller (or more negative) compared to the linear utility function. This illustrates the decreasing marginal valuation of public goods.

Columns (7) - (9) report the results for a CES utility function. Calibrating this function at the symmetric equilibrium (column (8), $\sigma = 1.82$) hardly influences the equilibrium tax rates and the optimal responses. A smaller substitution elasticity (column (7)) implies that the government is more eager to have public and private goods in the preferred proportion ($g_i/c_i = 1$), this implies that lowering tax rates is more costly. The government is less willing to chose low tax rates in response to capital mobility: taxes are increased relative to column (8). Furthermore, the lower substitution elasticity hardly influences optimal responses. A very large substitution elasticity causes the opposite effect on tax rates. Optimal responses are now affected. The large substitution elasticity implies that the population cares less about whether income is consumed in terms of public or private

[30] This result continues to hold for larger shocks. For a 10 percent shock the simulated responses are still close to the linearized responses.

goods. The decreasing marginal valuation of public goods argument is therefore weakened and the optimal responses come closer to the optimal responses under the linear utility function.

In the remaining columns I study the robustness of the results with respect to different production functions while using a quasi-linear utility function. From column (10) we learn that using a quadratic production function calibrated at the symmetric equilibrium hardly changes the equilibrium tax rates. However, the optimal responses are influenced. In general, the marginal and statutory tax rates are stronger internal substitutes, while cross-country the responses are less strong compared to the base case. Potentially, this is due to a smaller capital stock elasticity and paper-profit shifting elasticity under the calibrated quadratic production function compared to the calibrated Cobb-Douglas function. For country 1 the quadratic production function results in $\epsilon_{ii}^{k} = 0.12$ versus 0.38 under the Cobb-Douglas production function. For the paper profits elasticity we find 0.16 versus 0.49, respectively. The same pattern holds for the other country and the cross-country elasticities (ϵ_{ij}^{k} and ϵ_{ij}^{Π}).

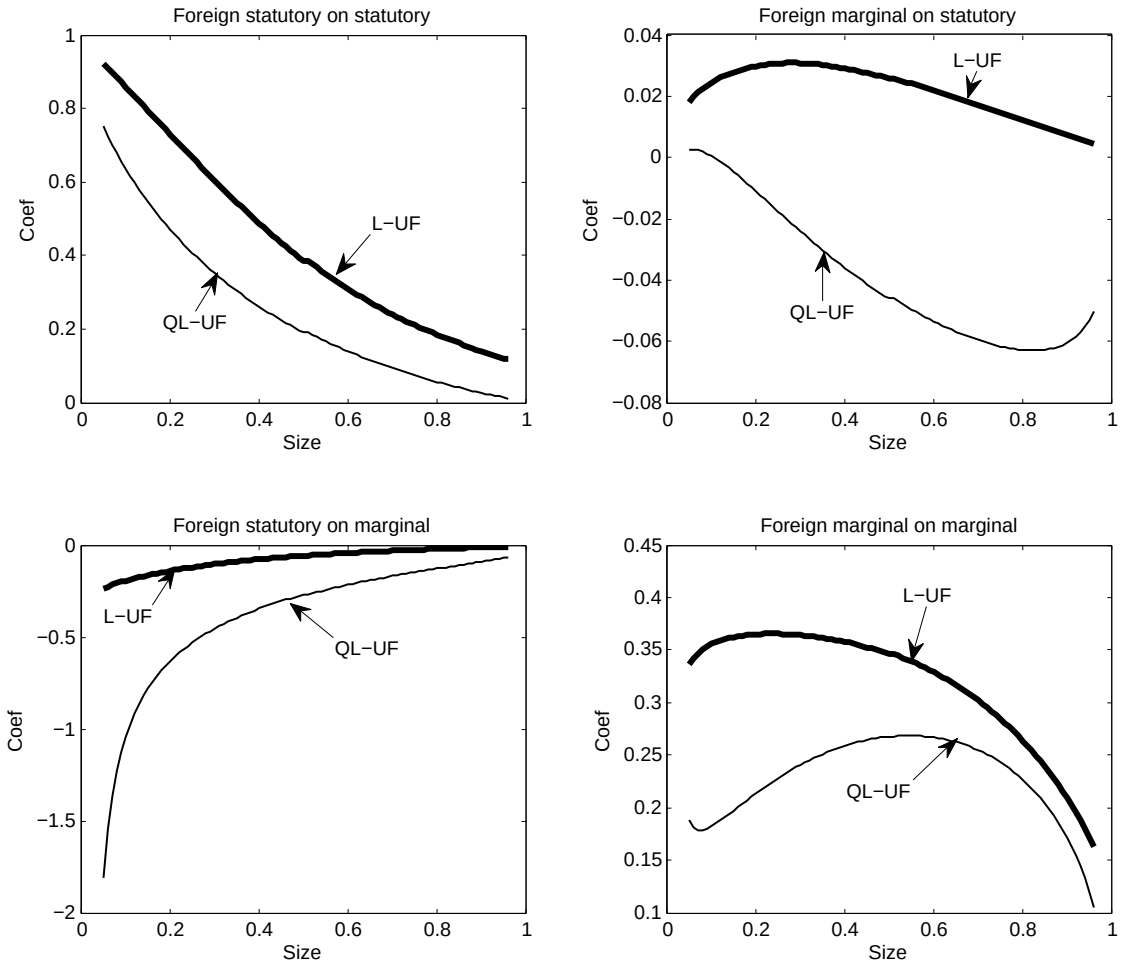
Finally, I check the robustness of the Cobb-Douglas function by allowing a smaller elasticity of substitution between capital and labor and a more realistic capital share in production. We see, in column (11), that a capital share of production of $\omega = 0.4$ hardly influences equilibrium taxes and does not qualitatively change the optimal responses. The smaller elasticity of substitution ($\mu = 0.5$), in column (12), results in a smaller capital stock and paper-profits elasticities and therefore changes optimal responses similar in the same direction as in the case of a quadratic production function: the marginal and statutory tax rates are stronger internal substitutes, while cross-country the responses are less strong compared to the base case.

5.7 Reduced Form: Cross-Country Complements versus Internal Substitutes

I end with a discussion of the size of the coefficients in the reduced-form tax reaction functions as this might be intuitively appealing to some readers and allows for a comparison with the empirical results from Devereux *et al.* (2008). The reduced-form tax reaction function gives an answer to the question: how do *both* home country tax rates change in response to an increase in *either one* of the foreign country tax rates. Note that this still is not a complete response in case the foreign country changes *both* tax rates, but it might provide an intuitive interpretation of the results discussed so far.

In terms of the original model set out in Eq. (5.40) the reduced-form coefficients are given by: $\Xi_{Home}^{-1}\Xi_{Foreign}$. Figure 5.5 presents the coefficients for both the model with a constant MRS (thick solid lines) and the model with a decreasing MRS (slim solid lines).

Figure 5.5: Reduced-form coefficients



We see (left panels) that an increase in the foreign-statutory tax rate leads to a higher statutory tax rate and a lower marginal tax rates at home. The intuition is that the profit inflow expands the tax base for the statutory tax rate and the internal substitutes argument explains the reduction in the marginal tax rate. This latter effect is substantial for small countries (recall that M_{ii}^{es} is decreasing in size). As expected, allowing for a decreasing marginal valuation of public goods implies that the home country responds less strong with its statutory tax rates to an increase in the foreign-statutory tax rate: cross-country complementarity is reduced as the inflow of profits reduces the marginal valuation of public goods. On the other hand, both tax instruments are stronger substitutes internally: the increase in the statutory tax rate reduces the marginal valuation

of public goods even further which leads to a larger reduction in the marginal tax rate compared to the case of a linear utility function.

An increase in the foreign-marginal tax rate (right panels) leads to a higher home-marginal tax rate (cross-country complements) and a small change in the home-statutory tax rate. The former coefficient is somewhat smaller for the large countries (recall that M_{ii}^{se} is decreasing in size). The latter effect is small but positive under a linear utility function and almost zero for very large countries. The increase in both the foreign and home marginal tax rate results in only a small increase in taxable rents: the statutory tax rate is only marginally increased as a result. In case of a decreasing marginal valuation of public goods, the government responds less strong with its home-marginal tax rate to the increase in the foreign-marginal tax rate as the marginal valuation of public goods is reduced through the inflow of capital. Furthermore, this increase in the home-marginal tax rate reduces the marginal valuation of public goods further, which implies that it is now optimal to reduces the home-statutory tax rate.

How do the results obtained in this chapter compare to Devereux *et al.* (2008)? Devereux *et al.* (2008) estimate that, on average, the home-statutory tax rate is a complement to the foreign-statutory tax rate and the foreign-marginal tax rate (insignificant). The correlation with the foreign-statutory tax rate is the strongest. This is in accordance with our predictions; the reduced form response to the same type of tax is the strongest (see Figure 5.5). Furthermore, Devereux *et al.* find that the home-marginal tax rate is a complement with the foreign-marginal tax rate whereas it is a substitute with the foreign-statutory tax rate. Both observations are in accordance with the predictions from the reduced-form model developed in this chapter.

However, Devereux *et al.* only provide estimates and intuition for average responses. I focus on asymmetric cases. In this respect I find that smaller countries respond in general fiercer compared to large countries. Furthermore, I find that the statutory tax rate might be a substitute towards the foreign-marginal tax rate for some countries, depending on the strength of decreasing marginal valuation of public goods argument.

5.8 Conclusions

This chapter is the first to study strategic interaction in an asymmetric tax competition model where governments are allowed to choose two tax instruments: the statutory corporate tax rate and the fraction of the cost-of-capital that is tax deductible. The latter translates into a distortion of the marginal investment decision: a marginal tax rate. I make three contributions to the literature. First, I study two endogenous tax instruments

in a general equilibrium setting. Second, I extend the model of Devereux *et al.* (2008) with cross-country asymmetry. And third, I consider more general production and utility functions.

With respect to the final contribution, Devereux *et al.* assume a quadratic production function, as in the majority of the tax-competition literature, and a linear utility function. This chapter shows that the main results on strategic interaction are robust to a more realistic Cobb-Douglas specification of the production function combined with an *ad valorem* tax rate. Simulation results with a CES production function also support these findings for reasonable parameter values.

Second, with respect to the asymmetric Nash equilibrium I find that the general conclusions from the one-instrument asymmetric tax competition model (see Bucovetsky (1991) and Wilson (1991)) are robust against including a second corporate-tax instrument. The smallest country chooses the lowest corporate tax burden (both statutory and marginal) and enjoys the highest welfare.

Third, since closed form solutions for the optimal tax mix cannot be found in this model, I obtain tax reaction functions by linearizing the optimal policy rules for the government around an initial equilibrium. From this linearization I conclude that within a country the statutory and marginal tax rates are substitutes in the optimal tax policy mix. On the other hand, across countries, while assuming a linear utility function, tax rates are in general complements: an increase in either one of the tax rates of the foreign country gives an incentive to the home country to increase either one of its own rates because the foreign tax increase expands the Laffer curve at home.

With respect to size asymmetry, small countries respond fiercer to changes in tax policy in large countries than the other way around. This because small countries are confronted with relative large shifts in their Laffer curve upon a change in the tax rate of a large country. Also governments that values tax revenues highly, respond fiercer (see also Chapter 4). Finally, allowing for a decreasing marginal valuation of tax revenue strengthens the conclusion of the internal substitutes and makes it possible that cross-country rates are strategic substitutes. This is a generalization of the result obtained in Chapter 4 towards a two-instrument setting.

Finally, I find that the direct cross-country complementarity dominates after a change in foreign tax policy. An increase in the foreign marginal and statutory tax rate is followed by an increase in the own marginal and statutory tax rate, respectively. The change in the remaining tax instrument is determined by the net effect of: (i) cross-country complementarity between foreign and domestic rates, and: (ii) domestic substitutes. The

latter effect dominates for the statutory tax rate. In case of a change in the foreign marginal tax rate, there is hardly a change in the home statutory tax rate.

In future research I will generalize the penalty function of transfer pricing and I want to "activate " the passive subsidiaries. A more general penalty function would not model the penalty from profit-shifting to be dependent on the profit-shifted per employee (or intermediate product traded), rather it would take some measure of absolute profits shifted into a country. Alternatively, one might think of modeling a tax advisory sector that earns the tax compliance costs along the lines of Slemrod and Wilson (2008).

5.A Calibration

Normalization

First, I normalize the capital endowment to 1 and impose $f(e) = 1$. To ensure easy comparison relative to the first best, I normalize parameters such that in the first best (no tax distortions): $GDP = c + g = f(e) - p = 1$. This implies that I normalize the cost of the intermediate input to zero: $p = 0$. Second, I impose that in the first best $g/c = 1$, this implies $g = c = 0.5$.

Calibration

I calibrate the model for the two-country symmetric such that the non-cooperation symmetric outcome replicates a realistic corporate tax system. Therefore, I calibrate the model such that the marginal tax rate is equal to 0.3 while the statutory tax rate is equal to 0.3 which is in accordance with 2005 OECD data as explained in the text. This leads to a reasonable parameter value for the share of the interest costs that are deductible: $a = 0.3$.

If the utility function allows, I want calibrate the model such that under the first best the public-to-private goods ratio is equal to 1. The utility functions used in this chapter are: (i) a linear function: $U = c + \gamma_1 g$; (ii) a quasi-linear function (that has the linear function as a special case): $U = c + \gamma_1(1/\gamma_2)g^{\gamma_2}$; (iii) a CES Utility function to resemble the results in Chapter 4: $U = [\kappa c^{(\sigma-1)/\sigma} + (1-\kappa)g^{(\sigma-1)/\sigma}]^{[\sigma/(\sigma-1)]}$, where σ denotes the substitution elasticity between private and public goods and κ denotes the weight attached to private goods in utility.

Under the first best I have that $U_g/U_c = 1$. At this point it becomes directly clear that the first best is not defined for the linear utility function. For $\gamma_1 > 1$, the optimal level of public goods is one and private goods is zero. This directly reveals the disadvantage of this

Table 5.3: Three production functions

Def.	**Quadratic**	**Cobb-Douglas**	**CES**
$f(k_i)$	$\delta(w-(1/2)k_i)k_i$	k_i^{ω}	$\left[\omega k^{(\mu-1)/\mu}+(1-\omega)\right]^{\mu/(\mu-1)}$
$f'(k_i)$	$\delta(w-k_i)$	$\omega k_i^{\omega-1}$	$\omega\left[f(.)/k_i\right]^{1/\mu}$
$f''(k_i)$	$-\delta$	$-\omega(1-\omega)k_i^{\omega-2}$	$-\frac{1-w_i}{\mu}\frac{f'(.)}{k_i}$

utility structure to study tax competition. For, the quasi-linear and CES utility functions this leads to the restrictions: $MRS=\gamma_1 0.5^{\gamma_2-1}=1$ for the quasi-linear function, and; $MRS=((1-\kappa)/\kappa)(c/g)^{(1/\sigma)}=\kappa/(1-\kappa)=1$, $\kappa=0.5$ for the CES function. However, to calibrate both parameters of the Quasi-linear and CES functions, I need a second equation: the non-cooperative equilibrium. For this I need the value for the MRS in the non-cooperative equilibrium.

I therefore calibrate the remaining parameters under the non-cooperative symmetric equilibrium, using the symmetric equilibrium conditions:

$$\tau^s=\alpha\left(\frac{MRS-1}{MRS}\right)R=0.3, \tag{5.A.1}$$

$$\tau^e=\frac{(1-\tau^s\Sigma)}{\Sigma+(1-\Sigma)\left(\frac{1}{\phi}\right)\left(\frac{MRS}{MRS-1}\right)-(1-\tau^s\Sigma)}=0.3, \tag{5.A.2}$$

$$c=(1-\tau^s)R+\rho, \tag{5.A.3}$$

$$g=\tau^s R+\tau^e\rho, \tag{5.A.4}$$

$$R=f(e)-f'(e), \tag{5.A.5}$$

$$\rho(1+\tau^e)=f'(e), \tag{5.A.6}$$

where I have imposed $p=0$ and $k=e=1$. I calibrate the model such that in the symmetric equilibrium $\tau^s=0.3$ and $\tau^e=0.3$. The production functions used throughout the chapter are described in Table 5.3. For the quadratic production function note that δ measures the decreasing marginal returns from capital, whereas w is a constant that is chosen such that the marginal product will never be negative.

The restriction on GDP: $f(e)=1$, holds immediately for the Cobb-Douglas and CES production functions because $k=1$. Only for the quadratic function it implies a relationship between w and b; it must hold that $w=1/b+1/2$.

The next step in the calibration follows from recognizing that Eqs. (5.A.3)-(5.A.6) can be combined to yield:

$$\frac{g}{c} = \frac{\tau^s(1 - f'(e)) + (\tau_i^e/(1 + \tau_i^e))f'(e)}{(1 - \tau^s)(1 - f'(e)) + f'(e)/(1 + \tau_i^e)} = 1/3, \tag{5.A.7}$$

this non-linear relationship defines the parameter of the production function (the income share of labor and capital). Using Eq. (5.A.7) an interesting relationship can derived that explains the importance of choosing τ^e and τ^s carefully:

$$\tau^e < g/c < \tau^s/(1 - \tau^s). \tag{5.A.8}$$

for $0 < a < 1$, because:

$$\frac{g}{c}/\tau^e = \frac{(\tau^s/\tau^e)(1 - f') + \rho}{(1 - \tau^s)(1 - f') + \rho} > 1, \tag{5.A.9}$$

and

$$\frac{g}{c}\frac{(1 - \tau^s}{\tau^s} = \frac{(1 - \tau^s)(1 - f') + (1 - a)\rho}{(1 - \tau^s)(1 - f') + \rho} < 1, \tag{5.A.10}$$

where I use the definition of τ^e from Eq. (5.8). Either the marginal tax rate is larger than the public-to-private-goods ratio and the latter exceeds the statutory tax rate divided by one minus the statutory tax rate, or vice versa. This is crucial for the calibration exercise; in the non-cooperative symmetric equilibrium I cannot obtain a public-to-private goods ratio larger than the maximum of the tax rates. Given the tax rates, the g/c ratio should be in the range: $(0.3 : 0.42)$. The parameter for the production function depends on the choice of g/c however as it should solve the non-linear relationship in Eq. (5.A.7), Table 5.4 presents the various cases. I have chosen $g/c = 0.38$ as it gives a reasonable value for ω. Finally, for the CES function, the substitution elasticity between capital and labor (μ) is undetermined for now, it will be used as a robustness check to the Cobb-Douglas function with a smaller substitution elasticity.

After the production function is calibrated, the MCF follows from Eq. (5.A.2). This implies that I know the value of the $MCF = MRS$ under the decentralized equilibrium. α can be calibrated by using both the value of the MCF and the equilibrium value of rents:

$$R = 1 - f', \tag{5.A.11}$$

Table 5.4: Calibrate

g/c	0.32	0.34	0.36	0.38	0.40	0.42
ω	0.06	0.21	0.36	0.51	0.67	0.83
$\gamma_{1,L-UF}$	1.20	1.25	1.32	1.47	1.90	14.92
$\gamma_{1,QL-UF}$	0.79	0.76	0.72	0.66	0.52	0.08
γ_2	0.65	0.61	0.53	0.39	0.05	-2.73
σ	4.74	4.16	3.46	2.65	1.68	0.42
α	1.91	1.91	1.91	1.91	1.91	1.91

in Eq. (5.A.1). The final parameter of the utility function can be calibrated by combining the value of $MRS = MCF$ with $g/c = 0.38$ in the expression for the MRS.

5.B Linearizing the Capital Market Elasticities

Linearizing the capital market elasticities ($\epsilon_i^R, \epsilon_i^\rho$ and ϵ_{ii}^k), see Table 5.1 for the definitions, yields straightforward expressions:

$$\widetilde{\epsilon_i^R} = -\frac{\Sigma_i}{1-\Sigma_i}\widetilde{\Sigma_i}, \tag{5.B.1}$$

$$\widetilde{\epsilon_i^\rho} = \frac{1}{1+\tau_i^e}\widetilde{\tau_i^e} + \widetilde{\Sigma_i}, \tag{5.B.2}$$

$$\widetilde{\epsilon_{ii}^k} = \frac{1}{1+\tau_i^e}\widetilde{\tau_i^e} - \frac{\Sigma_i}{1-\Sigma_i}\widetilde{\Sigma_i} - \widetilde{\phi_i}. \tag{5.B.3}$$

Market power (Σ_i) plays a crucial role. More market power implies a larger influence on the interest rate (ϵ_i^ρ increases) and a smaller capital outflow (ϵ_{ii}^k decreases). The larger influence on the interest rate implies that the tax-inclusive-cost-of-capital is less sensitive to changes in the marginal rate (ϵ_i^R decreases) because the increase in marginal tax is compensated by a reduction in the net interest rate. The capital stock and interest elasticities are increasing in the own tax rate. Finally, the marginal tax rate elasticity of capital is decreasing in ϕ_i, the elasticity of the marginal product. When the sensitivity of the marginal product to capital flows increases (larger ϕ_i) less capital needs to flow out of country i to equalize the net-of-tax marginal product with the world interest rate after an increase of τ_i^e.

The linearization of Σ_i depends on the choice of the production function. For the general case, it can be derived that (see Table 5.1 for the definition):

$$\widetilde{\Sigma_i} = (1-\Sigma_i)\left(\frac{e}{s_j k_j}\right)\widetilde{k_i} - (1-\Sigma_i)(\widetilde{\phi_i} - \widetilde{\phi_j}) \tag{5.B.4}$$

where the linearization of ϕ_i (see Table 5.1 for a definition) depends on the production function.

The quadratic production function (Q) is used in the classical tax competition models.[31] For this case the elasticity of the marginal product ($\phi_i^Q(.) = k_i/(w-k_i)$) is increasing in the capital stock:

$$\widetilde{\phi}_i = (1+\phi_i)\widetilde{k}_i > 0. \tag{5.B.5}$$

Therefore, an inflow of capital exerts conflicting effects on the interest rate elasticity. It increases market power directly, but in addition increases the elasticity of the marginal product, which reduces market power. The net effect is ambiguous.

For a Cobb-Douglas production function, the elasticity of the marginal product is constant: $\phi_i^{CD} = 1-\omega$, with ω representing the constant capital share in production:

$$\widetilde{\phi}_i = 0. \tag{5.B.6}$$

In this case, an inflow of capital will unambiguously increase market power for country i, increase the interest elasticity and reduce the capital elasticity.

In case of a CES production function: $\phi_i^{CES}(.) = (1-\omega_i)/\sigma_{kl}$ where ω_i captures the capital share in production in country i. Linearizing gives:

$$\widetilde{\phi}_i = \left(\frac{\omega_i}{1-\omega_i}\right)\left(\frac{1-\sigma_{kl}}{\sigma_{kl}}\right)\widetilde{k}_i. \tag{5.B.7}$$

For the relevant case, $\sigma_{kl} < 1$, this capital share is decreasing in k_i, implying that the elasticity of the marginal product is increasing in the capital stock and conflicting effects on market power arise due to an inflow of capital. The increase in ϕ_i tends to reduce the capital elasticity.

5.C Second-Order Condition for a Global Maximum

Appendix C shows the conditions required for a maximum in the tax setting game described above under the assumption of a constant MRS. The first-order conditions are

[31] The classical tax competition model employs a unit-specific tax rate where market power is not moderated by the elasticity of the marginal product, but by the semi-elasticity of the marginal product: $\phi_i^* = -1/k_i f''(k_i)$. The semi-elasticity simplifies considerably with a quadratic production function: $f_i''(k_i) = -b$, such that the semi-elasticity is decreasing in the capital stock.

given by differentiating $U(c_i, g_i) = c_i + \gamma g_i$ with respect to τ_i^s and τ_i^e:

$$\frac{\partial U(.)}{\partial \tau_i^s} = R_i \left\{ -(1 - \epsilon_i^H) + \gamma(1 + E_i - \epsilon_{ii}^{\Pi}) \right\} = 0, \tag{5.C.1}$$

$$\frac{\partial U(.)}{\partial \tau_i^e} = \rho k_i \left\{ - \left[1 - \tau_i^s \epsilon_i^R - \epsilon_i^\rho + \left(\frac{e}{k} - 1 \right) \frac{\epsilon_i^\rho}{\tau_i^e} \right] + \gamma \left[1 - \tau_i^s \epsilon_i^R - \epsilon_i^\rho - \epsilon_{ii}^k \right] \right\} = 0. \tag{5.C.2}$$

The second-order conditions for welfare maximization are given by:

$$\frac{\partial U(.)^2}{\partial^2 \tau_i^s} = - \left(\frac{R_i}{\tau_i^s} \right) M_{ii}^{ss} < 0, \tag{5.C.3}$$

$$\frac{\partial U(.)^2}{\partial \tau_i^s \partial \tau_i^e} = - \left(\frac{R_i}{\tau_i^e} \right) M_{ii}^{se} < 0, \tag{5.C.4}$$

$$\frac{\partial U(.)^2}{\partial^2 \tau_i^e} = - \frac{\rho k_i}{\tau_i^e} M_{ii}^{ee} < 0, \tag{5.C.5}$$

$$\frac{\partial U(.)^2}{\partial \tau_i^e \partial \tau_i^s} = - \frac{\rho k_i}{\tau_i^s} \tau_i^s \epsilon_i^R (\theta_1/\theta_2 - 1) < 0. \tag{5.C.6}$$

For a maximum I need that the Hessian-matrix is negative definite, which is obtained in case the first leading minor is negative and the second leading minor is positive.

The first leading minor is equal to either the second derivative of the utility function with respect to the statutory tax rate, or the second derivative of the utility function with respect to the marginal tax rate. The sign of both derivatives is determined by M_{ii}^{ss} and M_{ii}^{ee}, respectively. Both are positive for reasonable parameter values, such that the derivatives are negative.

The second leading minor is equal to the determinant of the Hessian matrix. This gives:

$$\frac{R_i}{\tau_i^s} \frac{\rho k_i}{\tau_i^e} \left[M_{ii}^{ss} M_{ii}^{ee} - M_{ii}^{se} M_{ii}^{es} \right]. \tag{5.C.7}$$

The term in between square brackets is identical to the determinant of the matrix of internal policy responses in Eq. (5.40). The second leading minor is therefore positive if the diagonal elements dominate the cross-diagonal elements, which holds for all simulations presented.

Chapter 6

Enhanced Cooperation with Two Corporate Tax Instruments

6.1 Introduction

6.1.1 Contribution

This previous chapter developed a model in which the government maximizes welfare by choosing both the statutory tax rate and the fraction of the cost-of-capital that is tax deductible, while the government takes into account that profits and capital are mobile across countries. The present chapter studies how, in this model, the creation of an ECA under which only one of these tax instruments is coordinated, will change the optimal tax policies and welfare for both the cooperating countries and an outsider country. I therefore extend the previous chapter with a third country. I will show that such an ECA differs from an ECA including all tax instruments as studied in Chapter 4, it yields substantial less tax revenue.[1] The policy relevance of this approach follows from the discussion in the introduction of this thesis. The European Commission (EC) envisages, as a first step towards a more harmonized corporate tax system in the European Union (EU), a common definition of taxable income (the Common Consolidated Corporate Tax Base (CCCTB)), while leaving statutory tax rates uncoordinated (see EC (2011)). This policy initiative is motivated by the political constraints to coordinate of statutory corporate tax rates, politicians are not willing to give up autonomy on such an important (and

[1]This chapter is based on Bettendorf, L. and H. Vrijburg (2011), *Enhanced Cooperation in a Three Country Model with two Endogenous Corporate Tax Instruments*, IIPF conference paper, Michigan. I thank Aart Gerritsen, Albert van der Horst, Bas Jacobs, Jenny Ligthart, and Floris Zoutman for helpfull comments and suggestions. I also benefited from comments of seminar participants at the IIPF conference in Michigan.

visible for the public) tax policy instrument. If politicians fail to reach agreement on an EU wide introduction of the CCCTB, an ECA between a subset of European countries is considered as an alternative.

As already mentioned, this chapter extends the model developed in Chapter 5 with a third country. Next to that, I simplify the analysis by assuming the government maximizes tax revenues instead of welfare. This is important as it simplifies the analysis considerably but removes the potential for strategic substitutes (see Chapter (4). However, as a first step it allows me to focus first on the incentives to change tax policy from the point of revenue maximization. An extension with welfare maximizer is left for future research first.

I must stress that the model allows explicitly for the empirically observed negative correlation between statutory rates and the broadness of the tax base (see Devereux, Griffith and Klemm (2002), Devereux, Lockwood and Redoano (2008) and Haufler and Schjelderup (2000)). Furthermore, the three countries potentially differ in population size. As explained in Chapter 5, asymmetry in population size influences optimal tax policies following the arguments of the asymmetric capital tax competition model by Bucovetsky (1991) and Wilson (1991).

The foremost contribution to the literature is that the model allows for endogenous tax policy choices in a two dimensional corporate tax system by all countries before and after an ECA is imposed. To my knowledge this has not been done in the literature before. In this chapter, an ECA might impose coordination of both tax instruments, or on one of the two tax instruments. This contribution is important as the choices made by participation (the insiders) and non-participating countries (the outsiders) is a crucial determinant for the ultimate welfare effects from coalition formation (see Chapter 5 and the literature discussed below). It is not clear how outsiders will respond to an coordination in only one tax instrument. I combine a simulation analysis with some analytical results. The chapter informs policymakers on the likely long-run changes in tax rates that revenue maximizing governments might under take after an ECA is imposed.

The first result is that insider countries unambiguously increase the coordinated tax rate. Furthermore, when cooperating on a single tax instrument, the uncoordinated rate is reduced as the tax instruments are substitutes in the optimal policy mix for the government.

Next, recall that the literature on tax harmonization finds that all countries (insiders and outsiders) benefit from cooperation when tax rates are complements across countries (see Chapter 2). In line with this, I find that due to relative strong cross-country complementarity of tax instruments and relative weak substitutability between the tax

rates within a country, the creation of an ECA always raises tax revenue in the outsider country and never reduces it for the insider country. The outsider country benefits the most, this because the increase in the tax burden is larger within the coalition compared to the increase in the outsider country: capital and/or profits flow out of the cooperating countries. I find that cooperation on solely the statutory tax rate raises hardly any additional tax revenue for the insider countries, whereas cooperation on the fraction of the cost-of-capital that is tax deductible yields substantial additional tax revenue. The explanation for this is in the size of the tax base, the size of the increase in the coordinated tax rate and the reduction in the uncoordinated rate. The former two are larger under cooperation on the marginal tax rate, whereas the latter is larger under cooperation on the statutory tax rate. Coordination on the broader tax base is the most rewarding.

Finally, I find that the outsider country always increases the statutory tax rate upon the change in tax policy in the cooperating countries. This because both an increase in the marginal tax rate or the statutory tax rate in the insider countries broadens the tax base for the statutory tax rate for the outsider country. This result, reinforces (or partly creates) the result that tax revenues increase strong under an ECA with a coordinated definition of taxable income: both tax instruments in the outsider country are increased.

6.1.2 Relation to the Existing Literature

A limited number of papers have studied enhanced cooperation in corporate taxation, mostly in computable general equilibrium models including multiple tax instruments. Sørensen (2004a) studies cooperation between a subset of countries in which the government chooses, amongst other tax instruments, a single capital tax. He finds an average welfare gain of 0.10 percent of GDP from the formation of an ECA compared to 0.94 percent of GDP under a grand coalition. Capital tax rates are found to be strategic complements across countries. Although Sørensen allows for endogenous policy choices, he does not model a two-dimensional corporate tax system.

To the contrary, Brøchner, Jensen, Svenson and Sørensen (2006) and Bettendorf, van der Horst, de Mooij and Vrijburg (2010) use a model with more country specific institutional detail, including a two-dimensional corporate tax system, and find even smaller welfare gains $0 - 0.05$ percent of GDP. Especially when countries cooperate only via a common definition of the tax base and leave statutory rate uncoordinated, the welfare gains are small. However, these two papers do not model endogenous corporate tax policies, the tax policies are imposed exogenously. Devereux and de Mooij (2011) investigate the welfare implications from introducing and EU wide Allowance for Corporate Equity

(ACE) or Comprehensive Business Income tax (CBIT) system. The former allows a deduction for the complete cost-of-capital. The latter does not allow a deduction at all. Both systems are dominated by a system that allows a partial deduction of the cost of capital (but removes the discrimination of debt versus equity in the classical system). Interesting is their final conclusion that reads that European coordination would render an ACE-type of system more attractive compared to a CBIT type system because base erosion through profit-shifting is reduced.

Finally, Riedel and Runkel (2007) use a more stylized model and study the introduction of a CCCTB in a subgroup of countries with initially differing statutory rates. They find that the subgroup will experience an inflow of profits in the short-run because the effective tax rate in the subgroup will decline after the introduction of the CCCTB. They do not touch upon the issue of an optimal endogenous corporate tax system before and after the formation of the ECA.[2] Furthermore, Eichner and Runkel (2011) study strategic tax setting after formula apportionment in a model that is similar to my model, only they do not use the definition of the tax base as an endogenous policy instrument. Interestingly, they find that the introduction of the CCCTB will reduce tax competition on the statutory tax rate because net-cross country taxation spillovers in the statutory tax rate are reduced.

6.1.3 Structure of the Chapter

The chapter is organized as follows. Section 6.2 introduces the model and discusses the optimal decentralized corporate tax system. Thereafter, in Section 6.3 I discuss how various ECAs change the Nash equilibrium. Section 6.4 presents the final Nash equilibrium under the various cooperation agreements. Section 6.5 concludes.

6.2 The Model

The model used in this chapter is for a large part identical to the model used in Chapter 5. However, contrary to Chapter 5, in the present chapter I assume 3 countries instead of two countries. This allows me to study an ECA between two of the three countries similar to the approach in Chapter 4. Second, I will simplify the objective function of the

[2]Besides the contributions mentioned above, several other papers are related to this chapter. First of all, there is a large literature on coalition formation in general including, besides Kemp and Wan (1992), Burbidge *et al.* (1997), Beaudry *et al.* (2000), contributions by amongst others Bordignon and Brusco (2006) on coalition formation under uncertainty and Alesina *et al.* (2005) on the status quo bias in coalition formation.

government into revenue maximization, see for a discussion the section on the government below.

Consider a model with 3 countries ($i, j, k \in [1:3]$) that are populated by N_i identical citizens who own a *per capita* capital endowment of e which they supply inelastically to the international capital market and a labor endowment L which they supply inelastically to the domestic labor market. Countries differ in the number of citizens, define $s_i = N_i/N$ as the share of the world population (N) residing in country i. I assume that capital is perfectly mobile internationally, but the world-capital stock is fixed:

$$e = \sum_{i=1}^{N} s_i k_i, \tag{6.1}$$

where k_i denotes the per capita capital stock invested in country i. The international mobility of capital ensures that the net-of-tax rate of return to capital (ρ) is equalized across countries.[3]

6.2.1 Industry

Each country hosts a multinational enterprise (MNE_i) which owns a subsidiary in the other countries. The parent company produces output ($y = F(K_i, L_i)$) by combining capital (K_i) and labor (L_i) with intermediate inputs. Each unit of labor requires 2 units of intermediate input (suppressed in the notation) , one from each subsidiary. Furthermore, L represents the fixed factor in production. The production function is concave in K_i and L_i, twice continuously differentiable, and homogeneous of degree one: $f'(k_i) > 0$, $f''(k_i) < 0$, where $f(.)$ is the intensive form of the production function. with $k_i = K_i/L_i$ denoting the per-capita capital stock. The price of output is normalized to unity. Note that the return to the fixed factor (labor) equals: $f(k_i) - f'(k, i)k_i$.

Intermediate inputs are produced by a subsidiary (located in country $j, k \neq i$) at true unit cost $p = 0$ (normalized to zero). The input is subsequently sold to the parent company at transfer price q_j^i. MNE_i shifts profits to low-tax countries by choosing: $q_j^i \neq 0$. Similar to Chapter 5, I think of profit-shifting by MNE_i as an activity at the boundary between tax avoidance (legal) and tax evasion (illegal), this implies that it might be subject to penalties by the losing government.[4] The probability that the actions of MNE_i are detected and labeled tax evasion by the revenue *losing* government

[3]Following Bucovetsky (1991), I assume that $\rho > 0$, ruling out the possibility of an excess supply regime where part of the capital stock is not used.

[4]See the methodological notes in the introduction of this thesis for a discussion.

is $1 > |q_j^i| > 0$.[5] That is, I assume that the probability of detection is increasing in the distance between q_j^i and the true price of the intermediate product (normalized to zero). Note that this implies that per unit tax evasion matters here, not the absolute volume of tax evasion: the government treats large and small multinationals alike which can be defended from a principle of horizontal equity.[6] In case of detection, the MNE_i must pay a fine equal to $\alpha|q_j^i|$, where $\alpha > 0$ can be interpreted as the penalty to illegal profit-shifting in the high-tax country. This yields an expected fine of:[7]

$$\Omega_i = \sum_{j \neq i}^{3} \alpha (q_j^i)^2. \tag{6.2}$$

Consolidated after-tax profit (Π_i) for MNE_i is given by the sum of the net-of-tax profits of the parent company (Π_p^i) and the subsidiaries (Π_j^i) minus the expected fine from transfer-pricing:

$$\Pi_i = \Pi_p^i + \sum_{j \neq i}^{3} \Pi_j^i - \Omega_i. \tag{6.3}$$

Net-of-tax profit of the parent company equals output minus costs and source-based corporate taxes payable:

$$\Pi_p^i = f(k_i) - \rho k_i - \sum_{j \neq i}^{3} q_j^i - \tau_i^s b_i, \tag{6.4}$$

where τ_i^s is the statutory tax rate in country i, and b_i represents corporate taxable income in country i:

$$b_i \equiv f(k_i) - a_i \rho k_i - \sum_{j \neq i}^{3} q_j^i, \tag{6.5}$$

where a_i represents the fraction of the cost of capital that is tax deductable. As explained in Chapter 5, $a_i = 1$ resembles a Comprehensive Business Income Tax (CBIT), whereas $a_i = 1$ resembles an Allowance for Corporate Equity (ACE). Values in between these two cases, $0 < a_i < 1$, describe a classical corporate tax system as used in most OECD

[5] The boundaries defined for q_j^i follow from the assumption that statutory tax rates are between zero and one.

[6] See Chapter 5 for a discussion.

[7] See Haufler and Schjelderup (2000) and Chapter 5 for a discussion on generalizing the cost of transfer-pricing function.

countries. Finally, net-of-foreign-taxes profit from the subsidiary is given by:

$$\Pi_j^i = (1 - \tau_j^s) q_j^i. \tag{6.6}$$

MNE_i maximizes consolidated after-tax profit by choosing investment k_i and the transfer price q_j^i for $j \neq i$. MNE_i chooses k_i by equating the marginal product of capital to the marginal after-tax cost of capital:

$$(1 + \tau_i^e)\rho = f'(k_i), \tag{6.7}$$

where

$$\tau_i^e = \tau_i^s (1 - a_i)/(1 - \tau_i^s), \tag{6.8}$$

denotes the marginal tax rate.[8] Eqs. (6.1) and (6.7) define together the allocation of capital (k_i and ρ) as a function of the set of marginal tax rates.

MNE_i chooses q_j^i for $j \neq i$ by equating the marginal reduction in tax payments through profit-shifting with the marginal increase in the expected fine:

$$\tau_i^s - \tau_j^s = 2\alpha q_j^i, \tag{6.9}$$

which is a function of statutory tax rates only. A sufficient condition for $0 < |q_j^i| < 1$ is $\alpha > 1/2$, because the maximum difference between the losing government statutory tax rate ($\tau_i^s = 1$) and the statutory tax rate of the other government ($\tau_j^s = 0$) is equal to one. The absolute signs are needed to give q_j^i the interpretation of a probability because $q_j^i < 0$ for the low-tax country. Note that Eq. (6.9) implies (apart from the minus sign) identical transfer-prices for MNE_i and MNE_j. This follows naturally from the insight that the tax differential is the same for MNE_i and MNE_j and the assumption that large and small MNEs are treated identical by tax authorities, as explained above.

6.2.2 The Government

The strategic game unfolds as follows. First, governments choose the tax policy mix $\{\tau_i^e, \tau_i^s\}$ that maximizes corporate tax revenue, while they assume that the governments of neighboring countries do not change their policies (I study Nash Equilibria), and taking

[8] Setting $a_i = 1$ implies a tax system that does not distort marginal investments (equivalent to ACE): $\tau_i^e = 0$. Setting $a_i = 0$ implies a pure *ad valorem* tax on the marginal product of capital (CBIT): $\tau_i^e = \tau_i^s/(1 - \tau_i^s)$.

into account that firms shift investments and profits in response to tax changes.[9] Thereafter, firms relocate their investments and profits given the tax differentials they observe. Finally, production and consumption takes place. Below I focus on this first step, taking into account the final two steps.

I assume, following amongst others Eichner and Runkel (2011), that the governments maximize tax revenues, which is not an innocent assumption. As stressed in previous chapters, the objective function of the government determines the strategic game played between countries. Welfare maximization would allow for a decreasing marginal valuation of tax revenues. Besides allowing for strategic substitutes (see Chapters 4 and 5) this complicates the analysis of the tax competition considerably. Therefore I focus on tax revenue maximization first. However, this does imply that governments choose tax rates that are too high from the point of view of welfare maximization. Under decentralization this might be beneficial, as it reduces inefficient under-taxation. But when I allow countries to harmonize their tax systems, it might lead to inefficient over-taxation. The main arguments developed in this chapter however carry over to a welfare function in which governments maximize tax revenues.

Tax revenues (T_i) equal the sum of tax revenue from the domestic parent and the foreign subsidiary. Using $q_j^i = -q_i^j$, Eqs. (6.4) and (6.6) yield:

$$\begin{aligned} T_i &= \tau_i^s b_i + \tau_i^s \sum_{j \neq i}^{3} \frac{s_j}{s_i} q_i^j, \\ &= \tau_i^s R_i(.) + \tau_i^s P_i(s_i, \tau_i^s, \tau_j^s) + \tau_i^e \rho k_i, \qquad (6.10) \\ R_i(.) &= f(k_i) - (1 + \tau_i^e)\rho k_i, \qquad (6.11) \\ P_i(.) &= \sum_{j \neq i}^{3} \frac{s_j + s_i}{s_i} \frac{\tau_j^s - \tau_i^s}{2\alpha}. \qquad (6.12) \end{aligned}$$

Public revenue comes from three sources: rents from production ($R_i(.)$), net profit-shifting by both domestic and foreign subsidiaries ($P_i(.)$) and taxes levied on the cost of capital ($\tau_i^e \rho k_i$). Note that $R_i(.)$ can be interpreted as labor income as labor is the fixed factor in production. The absolute size of net profit-shifting depends, besides the tax rate differential, on the size of country i relative to the size of the other countries. This follows from the assumptions that MNE_j and MNE_k demand N_j and N_k units of intermediate input from their subsidiary in country i and that tax evasion is evaluated on a per-unit basis. The relative size of the subsidiary of MNE_j and MNE_k therefore grows with

[9] Notice that the choice of τ_i^e and τ_i^s implies a value of the deductible fraction a_i.

Table 6.1: Elasticities in Eq. (6.13)-(6.14)

Elasticity	Definition		Elasticity	Definition
Statutory Rate			**Marginal Rate**	
Taxable profits	$\epsilon_{il}^{\Pi,I} > 0$	$-\frac{\partial P_i}{\partial \tau_l^s}\frac{\tau_l^s}{R_i}$	Rents	$0 < \epsilon_i^{R,I} < 1$	$-\frac{\partial R_i}{\partial \tau_l^e}\frac{1}{\rho k_i}$
Profit Export	$E_i(.)$	$P_i(.)/R_i(.)$	Interest rate	$0 < \epsilon_i^{\rho,I} < 1$	$-\frac{\partial \rho}{\partial \tau_l^e}\frac{\tau_l^e}{\rho}$
			Capital stock	$0 < \epsilon_{il}^{k,I}$	$-\frac{\partial k_i}{\partial \tau_l^e}\frac{\tau_l^e}{k_i}$

The definitions of the taxable profits elasticity ($\epsilon_{il}^{\Pi,I}$) and the capital stock elasticity ($\epsilon_{il}^{k,I}$) define either an own elasticity (when $i = l$) or a cross-country elasticity (or cross-country spillover, when $i \neq l$). The cross-country elasticities are used and discussed in Section 6.3.4 below.

the relative size of the population in the parent country. As a result their profit-shifting activities become more important from the perspective of country i when the population of the parent country grows.

Finally, I assume that the costs of monitoring transfer-pricing are equal to the expected revenues in terms of penalties. Therefore, Ω_i does not show up in Eq. (6.10): transfer-pricing results in pure economic waste. See for an extensive discussion Chapter 5.[10]

By choosing its tax policy mix, the government maximizes tax revenues (chooses the top of its two-dimensional Laffer curve):

$$\partial T_i/\partial \tau_i^s = 1 + E_i - \epsilon_{ii}^{\Pi,I} = 0, \tag{6.13}$$

$$\partial T_i/\partial \tau_i^e = 1 - \tau_i^s \epsilon_i^{R,I} - \epsilon_i^{\rho,I} - \epsilon_{ii}^{k,I} = 0, \tag{6.14}$$

while taking into account that firms shift investment and profit. This is captured by the (semi) elasticities: $\epsilon_{ii}^{\Pi,I}, \epsilon_i^{R,I}, \epsilon_i^{\rho,I}$ and $\epsilon_{ii}^{k,I}$, see Table 6.1 for definitions. Furthermore, the coefficient E_i captures tax exportation. The exact mathematical definition of the coefficients depends on the details of the taxation regime in place (indicated by superscript I). The taxation regime can either be decentralization (discussed below) or one out of three ECA regimes (discussed in Section 6.3).

[10] When I generalize the assumption that monitoring breaks even, the first-order conditions to be spelled out below would include a term reflecting the change in net revenues from monitoring. Assuming that these revenues are much lower than tax revenues from the statutory and marginal tax rate this will not change the main conclusions in this chapter.

6.2.3 Decentralized Equilibrium

When all three countries choose their optimal tax policies unilaterally, the Nash equilibrium is defined when Eq. 6.13-6.14 hold for each of the three optimizing governments, and there is equilibrium on the capital market (Eqs. 6.1 and 6.7). To simplify the analysis, I assume that the production technology is Cobb-Douglas ($f(k_i) = k_i^{\omega}$ with $0 < \omega < 1$) and that countries 1 and 2 are of equal size ($s_1 = s_2 = s$) whereas country 3 is either smaller or larger ($s_3 = 1 - 2s$). The Cobb-Douglas production function is attractive as it results in parsimonious elasticity expressions. Using these assumptions, the elasticities for the decentralized equilibrium are defined in Table 6.2.[11] Variables and elasticities evaluated at the decentralized equilibrium are denoted with the superscript "D". Using the elasticities defined in Table 6.2, the optimal policy rules under decentralization read:

$$\epsilon_{ii}^{\Pi,D} - E_i = 1, \tag{6.15}$$

$$\frac{\epsilon_{ii}^{k,D}}{1 - \nu_i^D} = 1. \tag{6.16}$$

with $0 < \nu_i^D = \tau_i^s \epsilon_i^{R,D} + \epsilon_i^{\rho,D} = \tau_i^s - s_i k_i \tau_i^s a_i / (1 + \tau_i^e) < 1$.

The top of the Laffer curve is given by the point where the elasticity of profit-shifting ($\epsilon_{ii}^{\Pi,D}$) corrected for inward or outward shifted profits (E_i) and the elasticity of capital-supply ($\epsilon_i^{k,D} > 0$) deflated by $(1 - \nu_D)$ are both unity.

E_i^D reflects the increase or decrease in domestic taxable rents due to profit-shifting at the current statutory tax rates relative to the rents from production (R_i). To understand why I need this variable, recognize from Table 6.2 that the profit-shifting elasticity is defined using the rent from production which is not the true tax base of the statutory tax rate, it should be corrected for the profits shifted in or out of the country. A low-tax country features inward profit-shifting and hence a positive value of E_i^D: part of the tax burden is exported. This country will choose $\epsilon_{\Pi,i}$ larger than unity. And vice versa for a high-tax country.

$\nu_i^D > 0$ captures the domestic tax leakage following an increased marginal tax rate. It comes from two sources. First, an increased (tax-inclusive) cost-of-capital reduces taxable

[11] By studying Nash equilibria, where the choice of tax policy by each government is optimal given the tax policy of its neighbor, I exclude the possibility that country i or j has expectations regarding the tax policy choices in the other country. See de Mooij and Vrijburg (2010) for a discussion on this topic.

Table 6.2: Elasticities under Decentralization

Elasticity	Definition	Countries 1 and 2	Country 3
	Statutory Rate		
$\epsilon_{ii}^{\Pi,D} > 0$	$\sum_{j\neq i}^{3} \frac{s_i+s_j}{s_i} \frac{\tau_i^s}{2\alpha R_i}$	$\frac{1+s}{s} \frac{\tau_1^s}{2\alpha R_1}$	$\frac{1-s}{1-2s} \frac{\tau_3^s}{\alpha R_3}$
$E_i(.)$	$\sum_{j\neq i}^{3} \frac{s_i+s_j}{s_i} \frac{\tau_j^s-\tau_i^s}{2\alpha R_i}$	$\frac{1-s}{s} \frac{\tau_3^s-\tau_1^s}{2\alpha R_1}$	$\frac{1-s}{1-2s} \frac{\tau_1^s-\tau_3^s}{\alpha R_3}$
	Marginal Rate		
$0 < \epsilon_i^{R,D} < 1$	$1 - \Sigma_i^D$	$1 - sk_1$	$1 - (1-2s)k_3$
$0 < \epsilon_i^{\rho,D} < 1$	$\frac{\tau_i^e}{1+\tau_i^e}\Sigma_i^D$	$\frac{\tau_1^e}{1+\tau_1^e} sk_1$	$\frac{\tau_1^e}{1+\tau_1^e}(1-2s)k_3$
$0 < \epsilon_i^{k,D}$	$\frac{1}{\phi_i} \frac{\tau_i^e}{1+\tau_i^e}(1-\Sigma_i^D)$	$\frac{1}{\phi} \frac{\tau_1^e}{1+\tau_1^e}(1-sk_1)$	$\frac{1}{\phi} \frac{\tau_3^e}{1+\tau_3^e}(1-(1-2s)k_3)$
	Parameters		
Σ_i^D	$\frac{s_i k_i/\phi_i}{\sum_j^3 s_j k_j/\phi_j} < 1$	sk_1	$(1-2s)k_3$
ϕ_i	$-\frac{k_i f_i''(.)}{f_i'(.)}$	$1-\omega$	$1-\omega$

rents ($\epsilon_i^{R,D} > 0$) and hence the tax base for the statutory tax rate. Second, the reduced net-of-tax interest rate ($\epsilon_i^{\rho,D} > 0$) erodes the tax base of the marginal tax rate. [12]

With respect to size asymmetry between countries, an increase in size reduces the *per capita* volume of profit flows between countries as the profit relocation by foreign MNEs is shared among more domestic residents. As a result they choose higher statutory tax rates compared to smaller countries.

Also, the optimal policy rule for the marginal tax rate is affected by size differences. This because, as explained before in Chapters 5 and 4, $\epsilon_i^{k,D}$ and $\epsilon_i^{\rho,D}$ depend crucially on country size because a change in the marginal product of capital depends on the capital flow per resident.[13] Residents from a small country must invest, *per capita*, a relative large amount of capital in a large country to affect the *per capita* capital stock and marginal

[12] I label this channel a domestic leakage as it also exists in a closed economy. If capital cannot escape taxation, the tax incidence falls completely on the domestic capital owners, the net-of-tax interest rate declines with the full amount of the tax. Labor income (R_i) is not affected by the marginal tax rate if capital is immobile: the reduction in the net interest rate implies that capital income is transformed into income for the fixed factor.

[13] Note that the excess burden of the marginal tax rate is identical to the excess burden in the classical tax competition model by Zodrow and Mieszkowski (1986), Wilson (1986) for symmetric countries and Bucovetsky (1991) and Wilson (1991) for asymmetric countries.

product in this country. Therefore, a tax increase in a small country is followed by a relative large outflow of capital to equalize the net marginal returns. As a result, the before-tax return in the small country is substantially increased while the net marginal return is only marginally reduced (large $\epsilon_i^{k,D}$ and small $\epsilon_i^{\rho,D}$). For a large country the opposite holds. The interaction between size and the elasticities of the marginal product is formalized using the weighted inverse elasticity of the worldwide marginal product (Σ_i^D, see Table 6.2) which is a measure of market power on the international capital market.[14]

Summarizing the above, larger countries face smaller international leakages ($\epsilon_{k,i}$ small) and a larger influence on the interest rate ($\epsilon_{\rho,i}$ large). The latter implies a smaller increase in the cost-of-capital and in total a smaller domestic leakage ($\nu_i^D = \tau_i^s - s_i\tau_i^s a_i/(1+\tau_i^e)$ decreases in size *holding constant the tax rates*). Both reduce the marginal excess burden of the marginal tax rate. A given increase in the marginal tax rate leads to more tax revenue in a large country compared to a small country, which implies that large countries will choose a higher marginal tax rate. However, in general, the optimal policy rules in Eq. (6.15)-(6.16) cannot be solved analytically for the optimal tax policy mix. Therefore, the next subsection discusses the Nash equilibrium under asymmetry using a simulation analysis.

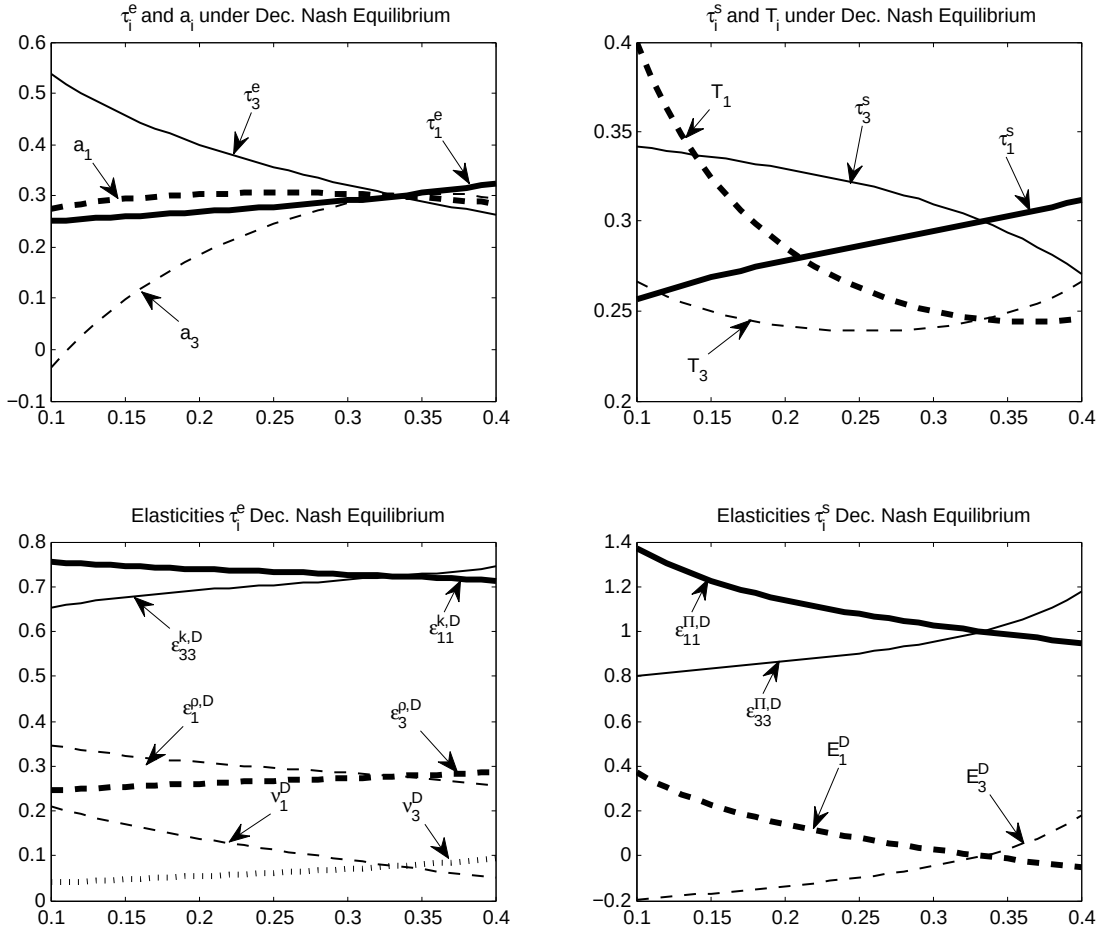
6.2.4 Numerical Illustration

Before discussing the simulated asymmetric Nash equilibrium, I will first discuss the assumptions underlying the calibration (similar to Chapter 5 but slightly different due to the revenue maximization). As mentioned, I use a Cobb-Douglas production function ($f(.) = k_i^\omega$) and assume revenue maximization. The parameter values are calibrated such that the symmetric decentralized equilibrium ($s_1 = s_2 = s_3 = 1/3$) gives a realistic corporate tax structure: $\tau^e = 0.3$, $\tau^s = 0.3$, while the size of the per capital capital stock is constrained at $e = 1$. The calibrate statutory tax rate is close to the median statutory tax rate for OECD countries in 2005 (0.32 percent) and the calibrated marginal tax rate is close to the upper bound of the median marginal tax rate for OECD countries in 2005 (in the range $0.19 - 0.29$ percent, depending on the type of investment).[15] I am restricted in my choice for the statutory and marginal tax rate as together they define the share

[14] Σ_i^D depends (in general) on three parameters. The first is size (s_i); large countries have more market power. The second is the capital stock (k_i); countries with a large capital stock per capita have more market power. The third is the elasticity of the marginal product (ϕ_i, in case of a Cobb-Douglas specification this elasticity is constant); if the elasticity of the marginal product increases, market power decreases.

[15] Data is provided by the Institute for Fiscal Studies (IFS) using the methodology discussed in Devereux and Griffith (2003).

Figure 6.1: Equilibrium tax rates and elasticities for $0.1 < s < 0.4$



of capital costs that are deductible ($a = 0.3$, under the above assumptions). The value of $\omega = 0.79$ follows from Eq. (6.16) assuming symmetry and $k = e$. This leaves only $\alpha = 2.82$ to be determined by Eq. (6.15).[16]

Figure 6.1 illustrates the decentralized equilibrium. As for all figures in this chapter, the x-axis measures population in the range $0.1 < s < 0.4$. Thick lines indicate the Nash equilibrium values for countries 1 and 2, thin lines indicate the Nash equilibrium values for country 3. The upper-left plot gives the Nash equilibrium marginal tax rates for various values of s (solid lines) and the degree of interest deductibility (a_i, dashed lines). The upper-right plot gives the Nash equilibrium statutory tax rates (solid) and tax revenues (dashed lines). The lower-left plot presents the elasticities of the marginal tax

[16]Note that these values differ from the simulation in Chapter 5. This because I have extended the model with a third country, implying that each of the countries becomes smaller relative to the world. Ceteris-paribus, this increases the capital-stock elasticity ($\epsilon_{11}^{k,D}$) and the profit-shifting elasticity ($\epsilon_{ii}^{\Pi,D}$) relative to the two-country case in Chapter 5. To obtain the same equilibrium taxes, α is increased as is the elasticity of the marginal product ($\phi = 1 - \omega$).

rate: $\epsilon_{ii}^{K,D}$ (solid), $\epsilon_{ii}^{\rho,D}$ (dashed), and v_i^D (dotted). Finally, the lower-right plot presents the elasticities of the statutory tax rate: $\epsilon_{ii}^{\Pi,D}$ (solid), and E_i (dashed). Each point on the curves in the figures takes into account that the country is competing with another country: it is the general equilibrium solution.

As a first remark, note that at size 1/3 (the symmetric point) the equilibrium taxes (and a_i) are equal to 0.3. Furthermore, analogous to the one-instrument asymmetric tax competition models by Wilson (1991) and Bucovetsky (1991), the Nash equilibrium marginal tax rate is increasing in size, signalling that market power reduces the excess burden of the marginal tax rate. For very large countries (see thin line and notice that for $s = 0.1, s_3 = 0.8$) the marginal tax rate has the tendency to grow very large (it will grow exponentially when s is reduced further). This because, the capital-stock elasticity ($\epsilon_{k,i}$) is reduced (solid thin line in the lower-left plot); this elasticity measures the excess burden of the marginal tax rate. Furthermore, the large interest elasticity (thin dotted line in the lower-left plot) makes it hard to raise revenue as the tax base erodes. So a high marginal tax rate is needed to obtain the preferred level of public revenues.[17] The relative constant marginal tax rate for the small country follows from reversed arguments. The capital-stock elasticity becomes larger and the interest elasticity is reduced. The former argument erodes the tax base, the latter implies that a higher marginal tax rate leads to a higher cost-of-capital and hence lower taxable rents for the statutory tax rate. This latter argument withholds the government from raising its marginal tax rate.

Also for the statutory tax rates I find that the large country sets the highest tax rate, see the upper-right plot in Figure 6.1. The intuition behind this result is that increases in size reduce the absolute size of the subsidiary of the foreign MNE such that larger countries are less concerned with the profit-shifting activities of this foreign subsidiary: $\epsilon_{\Pi,i}$ decreases (see the lower-right plot of Figure 6.1).[18] And vice-versa for the small country. The statutory tax rates reflect this pattern. The former argument is complemented by the tax exportation argument (E_i), the two arguments sum to one. From the lower-right plot of Figure 6.1 we infer that for small countries this argument can be strong: E_i is positive and decreases in size. For small countries the tax exportation argument is strong which leads to a lower bound on statutory tax rates. For large countries E_i is negative,

[17] When capital is (approximately) immobile ($\epsilon_{ii}^{k,D} \approx 0$) and $\epsilon_i^R \approx 0$, the Laffer curve for the marginal rate is described by: $\partial(\tau^e \rho k)/\partial \tau^e = \rho k(1 - \epsilon_\rho) > 0$, with $\epsilon_\rho = \tau^e/(1 + \tau^e)$. The top of the Laffer curve is reached with an infinitely high marginal rate: $\epsilon_i^{\rho,D} \approx 1$ if $\tau^e \approx \infty$.

[18] The assumption that the absolute size of the MNE is proportional to population size is crucial for this result. Absent this assumption, statutory tax rates would be low in large countries and high in small countries as both tax instruments are substitutes in the optimal policy mix of the government (discussed in the next section). OECD data confirms that larger countries feature higher statutory tax rates, see for example Clausing (2007), and Chapter 3, which validates the assumption made.

but smaller in absolute value compared to a small country, the taxable rents are relatively low as the home multinational has shifted its profits away. This motivates a large country to not choose a high statutory tax rate.

The upper-right plot of Figure 6.1 presents the values for tax revenue (dashed lines). Interestingly, smaller countries always have more tax revenue compared to larger countries. This is because they import profits and capital from abroad. Note that this does not imply that the large countries are on the downward sloping part of their Laffer curves. Holding constant the tax rates of their competitors, each country is on the upward-sloping part of their Laffer curve. Only, in equilibrium a high tax yields less tax revenue compared to a low tax. A large country cannot escape being a large country, imitating a small country would affect marginal productivities and lead to a lower per capita tax revenue then that obtained by a small country currently. To conclude, the two-instrument asymmetric model replicates the results by Bucovetsky (1991) and Wilson (1991): the small country has the lowest taxes and experiences the highest tax revenue.[19]

6.3 Enhanced Cooperation Agreements

The model developed above is suited for analyzing various international cooperation initiatives proposed by, for example, the European Commission in recent years. This section is structured as follows. In Section 6.3.1, I define the three different ECAs between countries 1 and 2 (the insiders) considered in this chapter. In the following three subsections I step-by-step discuss how the different ECAs affect the tax policy within the coalition and in country 3 (the outsider). First, in Section 6.3.2 I investigate, evaluated at constant decentralized equilibrium tax rates, how the exogenously imposed ECA reduces the excess burden in countries 1 and 2. This can be interpreted as an exogenous shock to the optimal policy rules in countries 1 and 2. Second, I need a methodology to predict how countries 1 and 2 will respond to this shock. Therefore, I linearize the optimal policy rules around the decentralized equilibrium, while taking into account that a coalition has been formed. This leads to a system of tax reaction functions similar to those developed in Chapter 5. This system of tax reaction functions is introduced in Section 6.3.3. I use this system of tax reaction functions in Section 6.3.4 to analyze the optimal policy response by countries 1 and 2 (the insiders) to the exogenous shock defined in Section 6.3.2, holding constant tax policy in country 3. Thereafter, Section 6.3.5 explains how country 3 is affected by the ECA and how it will adjust its policy. Interestingly, note that country 3 is only affected

[19] Bucovetsky (1991) and Wilson (1991) derive this conclusion for welfare levels. It can be shown that my conclusion also holds for welfare levels, see Chapter 5.

by the policy change in countries 1 and 2, not by the establishment of the ECA in the first place. The final Nash equilibrium is discussed in Section 6.4. This final section includes the optimal policy responses by both the insider and outsider countries and allows for a comparison of equilibrium tax revenues across regimes.

6.3.1 Enhanced Cooperation Agreements

I study enhanced cooperation between countries 1 and 2. In general, I indicate this cooperation with the label "E", which includes the three alternative international cooperation agreements considered in this paper: $E \in \{B, S, M\}$.[20] The first alternative considers cooperation in both the statutory and marginal tax rate by countries 1 and 2. This regime is labeled "B". Under the second alternative, countries 1 and 2 cooperate only on the statutory tax rate (indicated with label "S"), while under the third alternative they only cooperate on the marginal tax rate (indicated with label "M").[21][22] Interestingly, a partial harmonization as applied in this latter regime implies explicit cooperation on the tax base (a_i) while the statutory tax rates are left uncoordinated. This is the most viable policy proposal in the EU currently.

After forming their coalition, countries 1 and 2 choose the harmonized tax rate(s) together, given tax policy in country 3 and the remaining (if any) uncoordinated instrument, to maximize the tax revenue within the coalition. In doing so, the coalition members internalize tax spillovers for the harmonized tax instrument between themselves, but still ignore tax spillovers to the third country. For regimes S and E the remaining tax instrument is re-optimized given the harmonized rate and the tax policy of country 3. Country 3 re-optimizes its own policy given the policies chosen in the coalition. The policy shock leads therefore to a new Nash equilibrium.

6.3.2 Initial Shock from Cooperation

In this subsection, I study how, evaluated at the decentralized equilibrium, the decision to engage in an ECA changes the optimal policy rule(s) for the government of countries 1 and 2. This change I interpret as a shock ($\Delta^{w,E}$) to the optimal policy rules, where $w \in s, e$ indicate whether the shock is to the optimal policy rule for the statutory (s) or the

[20] Note that this is a subset of the total class of regimes: $I \in \{D, E\}$.

[21] Notice that tax policy under the grand coalition with three cooperating countries is not defined as tax distortions are absent in this case given the fixed world capital stock and the absence of profit-shifting opportunities in this case. Tax revenue would be equal to $f(e)$ with the government indifferent between the two tax instruments.

[22] Note that I used the label S before in Chapter 4 for the Stackelberg leader case. I use the label again as it is the most obvious candidate.

marginal tax rate (e). All expression in this subsection are evaluated at the decentralized equilibrium values for τ_i^s, τ_i^e, k_i and ρ, for notational convenience the superscript "D" is suppressed for these variables. For the remaining variables, I use notation $\overline{X}$ to express that x is evaluated at the decentralized equilibrium. Because countries 1 and 2 are symmetric, I only report the expressions for country 1.

Table 6.3 presents the tax elasticities for all countries after an ECA between countries 1 and 2 is initiated. For regimes S and M, the elasticities for the tax rate on which the countries cooperate change due to internalized tax spillovers. The elasticities of the remaining tax rate remain unaffected and equal to the decentralized values. Under regime B, both elasticities are affected: $B = S \cup M$. The elasticities of country 3 are not affected by the decision of countries 1 and 2 to cooperate, they will be affected by the subsequent tax policy changes though.

After countries 1 and 2 decide to cooperate on their statutory tax rate, their Laffer curve shifts outward because the perceived tax base erosion through profit-shifting is reduced (it is internalized that the other country raises its tax rate as well). This implies that the decentralized tax policy mix is sub-optimal:

$$1 + E_1 - \overline{\epsilon}_{11}^{\Pi,E} = \frac{\tau_1^s}{\alpha R_1} = \Delta^{s,E} > 0, \tag{6.17}$$

for $E \in B, S$ and zero otherwise. Potential flows of profit between the ECA countries are internalized ($\overline{\epsilon}_{11}^{\Pi,E} < \epsilon_{11}^{\Pi,D}$). This can be interpreted as an exogenous shock to the optimal tax policy of countries 1 and 2.

Likewise, due to a reduction in the perceived tax base erosion, the Laffer curve shifts outward when countries 1 and 2 cooperate on the marginal tax rate. This again implies that the decentralized tax policy mix is sub-optimal:

$$1 - \tau_1^s \overline{\epsilon}_1^{R,E} - \overline{\epsilon}_1^{\rho,E} - \overline{\epsilon}_{11}^{k,E} = \left[\tau_1^s + \frac{\omega}{1-\omega}\frac{\tau_1^e}{1+\tau_1^e}\right] sk_1 = \Delta^{E,e} > 0, \tag{6.18}$$

for $E \in B, M$ and zero otherwise, because capital flows between the ECA countries are internalized ($\overline{\epsilon}_{k,1}^{E} < \epsilon_{k,1}^{D}$) and the domestic leakages of the marginal tax rate are decreased: $\tau_1^s \overline{\epsilon}_1^{R,E} + \overline{\epsilon}_{11}^{\rho,E} < \tau_1^s \epsilon_{R,1}^{D} + \epsilon_1^{\rho,D}$.[23] Both arguments lower the excess burden of the marginal tax rate which I interpret as an exogenous shock to the optimal tax policy of countries 1 and 2.

The shocks identified above are simply the revenue spillovers between countries 1 and 2 relative to tax revenues from the domestic tax base ($\tau_i^s R_i$ and $\tau_i^e \rho k_i$). In general, the

[23] This condition can be rewritten until $\tau_1^e/(1+\tau_1^e) < \tau_1^s$, which holds because: $1 - a_i < 1 - \tau^s a_i$.

Table 6.3: Elasticities under cooperation on respective tax rate

	Countries 1 and 2	**Country 3**
Statutory Rate		
$\overline{\epsilon}_{ii}^{\Pi,E} > 0$	$\overline{\epsilon}_{11}^{\Pi,S} = \frac{1-s}{s}\frac{\tau_1^s}{2\alpha R_1} < \epsilon_{11}^{\Pi,D}$	$\overline{\epsilon}_{33}^{\Pi,E} = \frac{1-s}{1-2s}\frac{\tau_3^s}{\alpha R_3} = \epsilon_{33}^{\Pi,D}$
$\overline{E}_i^E$	$\overline{E}_1^S(.) = \frac{1-s}{s}\frac{\tau_3^s-\tau_1^s}{2\alpha R_1} = E_1^D$	$\overline{E}_3^E = \frac{1-s}{1-2s}\frac{\tau_1^s-\tau_3^s}{\alpha R_3} = E_3^D$
Marginal Rate		
$0 < \overline{\epsilon}_i^{R,E} < 1$	$\overline{\epsilon}_1^{R,M} = 1 - 2sk_1 < \epsilon_1^{R,D}$	$\overline{\epsilon}_3^{R,E} = 1 - (1-2s)k_3 = \epsilon_3^{R,D}$
$0 < \overline{\epsilon}_i^{\rho,E} < 1$	$\overline{\epsilon}_1^{\rho,M} = \frac{\tau_1^e}{1+\tau_1^e}2sk_1 > \epsilon_1^{\rho,D}$	$\overline{\epsilon}_3^{\rho,E} = \frac{\tau_1^e}{1+\tau_1^e}(1-2s)k_3 = \epsilon_3^{\rho,D}$
$0 < \overline{\epsilon}_{ii}^{k,E}$	$\overline{\epsilon}_{11}^{k,M} = \frac{1}{\phi}\frac{\tau_1^e}{1+\tau_1^e}(1-2sk_1) < \epsilon_{11}^{k,D}$	$\overline{\epsilon}_{33}^{k,E} = \frac{1}{\phi}\frac{\tau_3^e}{1+\tau_3^e}(1-(1-2s)k_3) = \epsilon_{33}^{k,D}$
Parameters		
$\overline{\Sigma}_i^E$	$\overline{\Sigma}_1^M = 2sk_1 > \Sigma_1^D$	$\overline{\Sigma}_3^E = (1-2s)k_3 = \Sigma_3^D$
ϕ_i	$1-\omega$	$1-\omega$

I have reported for countries 1 and 2 the elasticity that applies when there is cooperation on the respective rate, i.e. I allow for different elasticities for different ECAs. Furthermore, for regime B it holds that: $B = S \cup M$. For country 3 I do not make this distinction as the elasticities of country 3 are not affected at all.

revenue spillover is given by:

$$\frac{\partial T_i}{\partial \tau_j^s}\frac{1}{R_i} = \frac{s_j + s_i}{s_i}\frac{\tau_i^s}{2\alpha R_i} = \frac{\tau_i^s}{\tau_j^s}\epsilon_{ij}^{\Pi,D}, \tag{6.19}$$

$$\frac{\partial T_i}{\partial \tau_j^e}\frac{1}{\rho k_i} = \frac{\tau_i^e}{\tau_j^e}\left[\frac{\tau_i^s a_i}{\tau_i^e} + \frac{1}{1-\omega}\right]\epsilon_j^{\rho,D}, \tag{6.20}$$

for the statutory and marginal tax rate respectively, using Table 6.4. Where $\Delta^{s,S}$ and $\Delta^{e,M}$ are obtained by imposing: $s_j = s_i = s$, and using the definition: $\tau_i^e = \tau_i^s(1-a_i)/(1-\tau_i^s)$.

The three ECAs lead to different combinations of the above identified shocks. When cooperating on both instruments (regime B) both shocks occur, the Laffer curve shifts outward in both dimensions. Cooperating on only one tax instrument (regimes S and M) leads to a single shock ($\Delta^{s,E}$ and $\Delta^{e,E}$ respectively) and an outward shift of the Laffer curve along the dimension of the harmonized tax instrument.

6.3.3 Reaction Function

Following the internalized tax spillovers, countries 1 and 2 change their tax policy mix. In order to understand the change in the policy mix, we must analyze the interdependency between the various tax instruments by studying the tax reaction functions. As closed form solutions are not available, the (system of) tax reaction functions can alternatively be formalized using a total differentiation of Eqs. (6.13)-(6.14):

$$H_i^I \begin{bmatrix} \tilde{\tau}_i^s & \tilde{\tau}_i^e \end{bmatrix}' = \sum_{l \in \{j,k\}} \left\{ N_l^I \begin{bmatrix} \tilde{\tau}_l^s & \tilde{\tau}_l^e \end{bmatrix}' \right\} + \begin{bmatrix} \Delta^{s,I} & \Delta^{e,I} \end{bmatrix}', \tag{6.21}$$

with:

$$H_i^I = \begin{bmatrix} 2\epsilon_{ii}^{\Pi,I} & \omega \left[\epsilon_{ii}^{\Pi,I} - E_i \right] \epsilon_{ii}^{k,I} \\ \epsilon_i^{R,I} \tau_i^s & \Theta_i^{g,k} \epsilon_{ii}^{k,I} \epsilon_i^{\rho,I} + \frac{1}{1+\tau_i^e} \left(\epsilon_i^{\rho,I} + \epsilon_{ii}^{k,I} \right) \end{bmatrix},$$
$$N_l^I = \begin{bmatrix} \epsilon_{il}^{\Pi,I} & \omega \left[\epsilon_{ii}^{\Pi,I} - E_i \right] \epsilon_{k,l}^I \\ 0 & \left(\frac{\tau_i^s a_i}{\tau_i^e} + \frac{1}{\phi} \right) \epsilon_i^{\rho,I} \epsilon_{il}^{k,I} \end{bmatrix},$$

with $l \neq i$ and $i, l \in [1, 2, 3]$). The first line in this matrix expression adheres to the linearization of Eq. (6.13), the second adheres to Eq. (6.14). $\Theta_i^{g,k} = \tau_i^s a_i / \tau_i^s + 1/(1-\omega)$ measures the inward shift of the Laffer curve due to a decrease in the market power caused by an outflow of capital, see Chapter 5 for a discussion. Note that to obtain the linearization, I allow for endogenous tax elasticities as it are changes in the tax base that drive strategic interaction, see again Chapter 5. All coefficients are positive (notice that $0 < \epsilon_{ii}^{\Pi,I} - E_i \leq 1$ by definition). Furthermore, $\Delta^{w,I}$ with $w \in [s, e]$, represents the shock to the system in case of regime I as discussed in the previous subsection. Intuitively, $\Delta^{w,I}$ can be thought of as a shock that induces a shift in the tax reaction function. After cooperation, spillovers are internalized such that for every tax chosen by the competing country(ies), the government finds it optimal to choose a higher tax rate.[24]

Each coefficient (denote with $H_i^I(m,k)$ and $N_i^I(m,k)$) for the element in row m, column k in matrix H and N respectively) reflects the percentage change in the marginal excess burden of the respective tax rate (m) following a percentage increase in τ_l^k under regime I. Hence, the larger the coefficient the more sensitive is the marginal excess burden with respect to a change in the respective tax rate.

[24]See Chapter 5 for a thorough discussion on the reaction functions using more general objective functions for the government: i) a linear utility function, and ii) a quasi-linear utility function. Both modifications tend to reduce the coefficients in the reaction function.

Table 6.4: Spillover effects in Reaction Function

Definition	**Countries 1 and 2**	**Country 3**
	Statutory Rate	
$\epsilon_{il}^{\Pi,D} = \frac{s_i+s_j}{s_i}\frac{\tau_l^s}{2\alpha R_i} > 0$	$\epsilon_{13}^{\Pi,D} = \frac{1-s}{s}\frac{\tau_3^s}{2\alpha R_1}$	$\epsilon_{31}^{\Pi,D} = \frac{1-s}{1-2s}\frac{\tau_1^s}{2\alpha R_3}$
	Marginal Rate	
$\epsilon_{il}^{k,D} = \frac{1}{\phi_i}\frac{\tau_l^e}{1+\tau_l^e}\Sigma_l^D > 0$	$\epsilon_{13}^{k,D} = \frac{1}{1-\omega}\epsilon_3^{\rho,D}$	$\epsilon_{31}^{k,D} = \frac{1}{1-\omega}\epsilon_1^{\rho,D}$

H_i^I summarizes the interdependency between the tax instruments of the home (H) country i, the positive off-diagonal elements indicate that the two tax instruments are substitutes in the optimal policy mix for the government of country i. Increasing the marginal tax rate reduces taxable rents (R_i) and, hence, it is optimal to reduce the statutory tax rate ($H_i^I(1,2) > 0$). Based on the same reasoning, the level of the statutory tax rate determines the tax revenue loss from increasing the marginal tax rate ($H_i^I(2,1) > 0$). The higher the statutory tax rate, the higher this cost and hence the lower the marginal tax rate. In summary, both tax rates increase the marginal excess burden of the other tax rate and this interaction is via taxing the return on the fixed factor ($\tau_i^s R_i(\tau_i^e, \tau_{-i}^e)$. $H(1,1)$ and $H(2,2)$ capture the dependence of the marginal excess burden on the own tax rate, they are positive therefore: the higher the tax rate, the larger the marginal excess burden. The larger the coefficient the smaller is the change in the respective tax rate needed to restore equilibrium (for given values of all other tax rates). Interestingly, in general each of the coefficients is decreasing in size (all elasticities are decreasing in size).

N_l^I summarizes the interdependency between the tax rates of the neighboring (N) country l and the excess burden in country i. The zero indicates that the statutory tax rate of the neighboring country does not influence the excess burden of the home marginal tax rate, because τ_j^s does not appear in Eq. (6.14). The positive value for $N_l^I(1,2)$ follows from the increase in domestic rents (R) due to the capital inflow that follows an increase in the marginal tax rate of a neighboring country. The coefficients on the diagonal, $N(1,1)$ and $N(2,2)$ are also positive. An increase in the foreign statutory tax rate leads to an inflow of profits into the home country, which expands the tax base and therefore reduces the marginal excess burden: $N(1,1) > 0$. A similar reasoning holds for a change in the foreign marginal tax rate, which leads to a capital flow to the home country (which

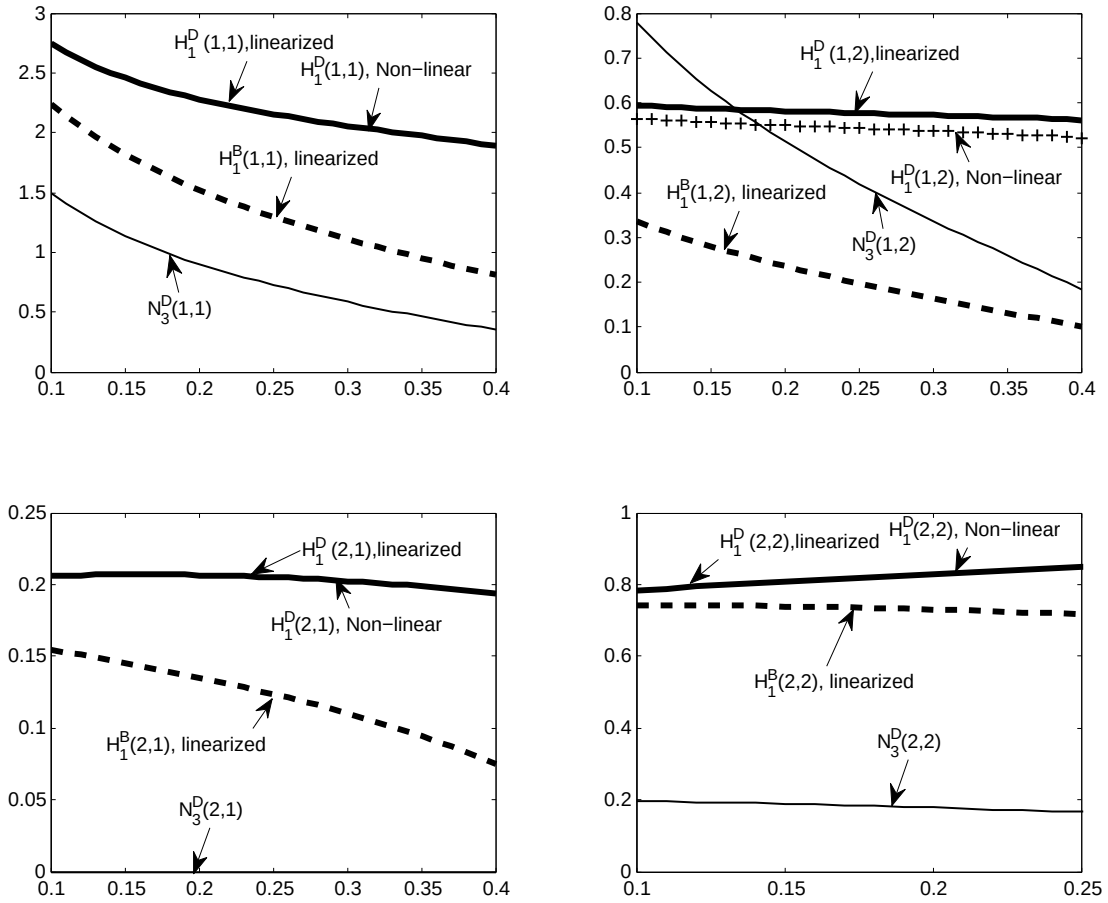
dominates the reduction in the interest rate): $N(2,2) > 0$. Again all effects are decreasing in size as the elasticities are negatively related to size.

Figure 6.2 presents the coefficients for the reaction function of countries 1 and 2. The figure is organized similar to the matrices in Eqs. 6.21, the upper-left plot presents $H(1,1)$ and $N(1,1)$ and similar for the other plots. The thick-solid lines present the coefficients of H_1^D, whereas the shin-solid lines with crosses present the same coefficients but now obtained from simulated optimal non-linear response to a small change in the marginal excess burden (when this line is not visible, it is because it is underneath the thick-solid line). The three most important conclusions are first of all that indeed coefficients tend to decrease in size (although not so pronounced), except for $H^D(2,2)$. Second, the simulated non-linear responses are close to the linearized coefficients validating my methodology. Third, the diagonal elements are larger than the off-diagonal elements, this is required for on interior solution (see the Appendix C to Chapter 5 for a discussion). With respect to the remaining lines, the thin-solid lines present the coefficients of N_1^D. We see that the marginal excess burden is in general more sensitive to the own tax rates compared to the foreign tax rates (the tax rates of country 3 in this case). Only, when country 3 is large, the optimal policy rule for the statutory tax rate of countries 1 and 2 is more sensitive to the marginal tax rate of country 3 than to their own. Finally, the thick-dashed lines present the coefficient of H_1^B, that is the coefficients after enhanced cooperation. Tax coordination reduces the coefficients as less capital and profit flows out of the country following tax increases.

6.3.4 First-Round Policy Response Countries 1 and 2

When countries 1 and 2 agree on ECA type E, their policy rules are changed by $\Delta^{s,E}$ and $\Delta^{e,E}$ following internalized tax spillovers, and they will re-optimize their tax policies accordingly. As a first step, I will analyse this re-optimization while holding constant the tax rates of country 3. This I label the first-round policy response by countries 1 and 2. Under each of the regimes (B, S and M) some restrictions must be imposed on the system in Eq. (6.21) to obtain a linearized optimal response. First, I hold constant the coordinated tax rate(s) of country 3 ($\tilde{\tau}_3^w = 0$) for $w \in \{s, e\}$. This implies that one of the matrices on the right-hand-side of Eq. (6.21), N_3^I, drops out of the equation. Furthermore, under regime B the coefficients in matrix H_i^I take into account that countries 1 and 2 adjust their tax rates simultaneously (it takes $N_{l\in1,2,l\neq i}^I$ into account). This implies that under this regime also matrix $N_{l\in1,2,l\neq i}^I$ drops out of the equation and only the matrix on

Figure 6.2: Coefficients Reaction Function $0.1 < s < 0.4$



the left-hand-side remains (using the elasticities corresponding to the regime) together with the vector containing the policy shock.

Under regimes S and M matrix H_i^I contains a mixture of coefficients from regimes B and D. The elasticities reflect the regime and take into account that tax spillovers between country 1 and 2 are internalized for changes in the coordinated rate while they remain ignored under the uncoordinated rate. In addition, I hold constant the uncoordinated tax rate of the other coalition country, such that also in this case $N^I_{j\in 1,2,l\neq i}$ drops out. For example, when cooperating on the statutory tax rate, I assume that the other coalition country j does not adjust its marginal tax rate: $\tilde{\tau}_j^e = 0$. Again, only the matrix on the left-hand side and the vector of policy shocks on the right-hand side remain.

Under the constraints imposed, the optimal response by countries 1 and 2 to the shock, caused by deciding to join an ECA of type E, can be characterized as follows:

$$\tilde{\tau}_i^s = \frac{H_i^E(2,2)\Delta^{s,E} - H_i^E(1,2)\Delta^{e,E}}{|H_i^E|}, \tag{6.22}$$

$$\tilde{\tau}_i^e = \frac{H_i^E(1,1)\Delta^{e,E} - H_i^E(2,1)\Delta^{s,E}}{|H_i^E|}, \tag{6.23}$$

where the sign of the expressions depends on the cooperation regime. Under regime S: $\Delta^{s,S} > 0$ and $\Delta^{e,S} = 0$, such that: $\tilde{\tau}_i^s > 0$ and $\tilde{\tau}_i^e < 0$. The reversed reasoning applies under regime M: $\Delta^{e,M} > 0$ and $\Delta^{s,M} = 0$, such that: $\tilde{\tau}_i^e > 0$ and $\tilde{\tau}_i^s < 0$. This is formalized in proposition 2:

Proposition 2 *The first round change in tax policy by countries* 1 *and* 2 *in response to establishing an ECA under regime S is given by:*

$$\tilde{\tau}_1^s = \frac{\left[\left(\frac{\tau_1^s a_1}{\tau_1^e} + \frac{1}{\phi}\right)\epsilon_1^{\rho,S}\epsilon_{11}^{k,S} + \frac{1}{1+\tau_1^e}\left(\epsilon_1^{\rho,S} + \epsilon_{11}^{k,S}\right)\right]\Delta^{s,S}}{|H_1^S|} > 0, \quad \tilde{\tau}_1^e = -\frac{\epsilon_1^{R,S}\tau_1^s\Delta^{s,S}}{|H_1^S|} < 0. \tag{6.24}$$

The first round change in tax policy by countries 1 *and* 2 *in response to establishing an ECA under regime M is given by:*

$$\tilde{\tau}_1^s = -\frac{\omega\epsilon_{11}^{k,M}\Delta^{e,M}}{|H_1^M|} < 0, \quad \tilde{\tau}_1^e = \frac{2\epsilon_{11}^{\Pi,M}\Delta^{e,M}}{|H_1^M|} > 0. \tag{6.25}$$

The main lesson to be drawn from this proposition is that the change in policy reflects a "rotation" of the tax policy towards the tax instrument where countries 1 and 2 cooperate on. This implies that Regime S causes higher statutory tax rates and lower marginal tax rates, a movement towards the ACE system, whereas Regime M causes the opposite rotation towards a tax system closer to the CBIT system. Interestingly, of the three regimes considered, Regime M is the closest to the current proposal by the European Commission which would suggest a movement towards the CBIT system. Note that an ACE system is often argued to be more efficient as it is distorts investments less. The result follows from the assumptions made. I will comment on this in the conclusion to this chapter. Finally, the tax changes are proportional to the size of internalized spillovers.

Only under regime B are the expressions ambiguous. That is, both tax rates are only then increased when the diagonal elements $(H_i^B(1,1), H_i^B(2,2))$ dominate the off-diagonal elements $(H_i^B(1,2), H_i^B(2,1))$ and the internalized tax spillovers of the statutory and marginal tax rate are of comparable size: $\Delta^{s,B} \approx \Delta^{e,B}$. When these conditions are

not met, it might be the case that country i decides to reduce the marginal (statutory) tax rates because the argument of internal substitutes following the increased statutory (marginal) tax rate dominates the argument of internalized spillovers on the marginal (statutory) tax rate from establishing the ECA. Proposition 3 formalizes this result:

Proposition 3 *The first round change in the statutory tax rate by countries* 1 *and* 2 *in response to establishing an ECA under regime B is given by:*

$$\tilde{\tau}_1^s = \frac{\left[\Theta_i^{g,k} 2\epsilon_1^{\rho,D}\epsilon_{11}^{k,B} + \frac{1}{1+\tau_1^e}\left(\epsilon_1^{\rho,B} + \epsilon_{11}^{k,B}\right) + \omega\Theta_i^{g,k}\epsilon_1^{\rho,D} - \omega\delta\right]\Delta^{s,B}}{|H_1^B|} > 0, \tag{6.26}$$

where:

$$\delta \equiv \frac{\Delta^{e,B}}{\Delta^{s,B}} = \frac{\Theta_i^{g,k}\epsilon_1^{\rho,D}}{\Delta^{s,B}}, \tag{6.27}$$

is a measure of the relative size of the shocks to the optimal policy rules. Using this definition, it follows that a sufficient condition for the inequality sign to hold is: $\Delta^{s,B} > 1$ *or* $\tau_3^s > 2\tau_1^s$*,using Eq. (6.17). The necessary condition states that the shock in the marginal tax rate should not be too large compared to the shock in the statutory tax rate:*

$$\delta < \frac{1}{\omega}\left[\Theta_i^{g,k}\epsilon_1^{\rho,D}(2\epsilon_{11}^{k,B} + \omega) + \frac{1}{1+\tau_1^e}\left(\epsilon_1^{\rho,B} + \epsilon_{11}^{k,B}\right)\right] \tag{6.28}$$

The first round change in the marginal tax rate by countries 1 *and* 2 *in response to establishing an ECA under regime B is given by:*

$$\tilde{\tau}_1^e = \frac{\left[\left(k_1(1+s)-1\right)\tau_1^s + \frac{\omega}{1-\omega}\frac{\tau_1^e}{1+\tau_1^e}k_1(1-s)\right]\Delta^{s,B}}{|H_1^B|} > 0, \tag{6.29}$$

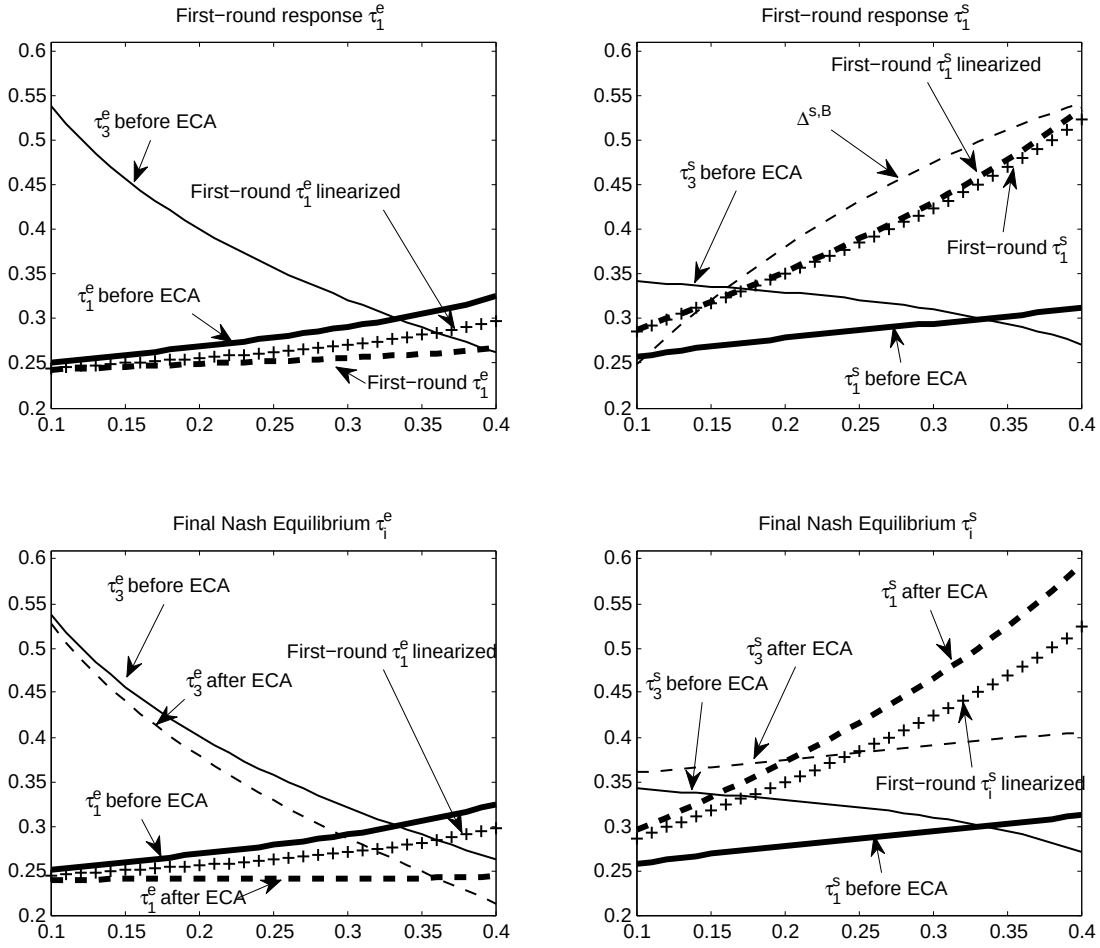
which always holds for small countries which are capital importers ($k > 1$*, sufficient condition) and for large countries when* $k_1 > 1/(1+s)$*, which is the necessary condition.*

The main lesson from Proposition 3 is that, under the conditions stated, cooperating countries will adjust their tax systems towards a CBIT type tax system with both a broader tax base and a higher statutory tax rate compared to the classical system. This is optimal because cross-country spillovers in both marginal investment decisions and profit-shifting are internalized between the cooperating countries.

Numerical Illustration

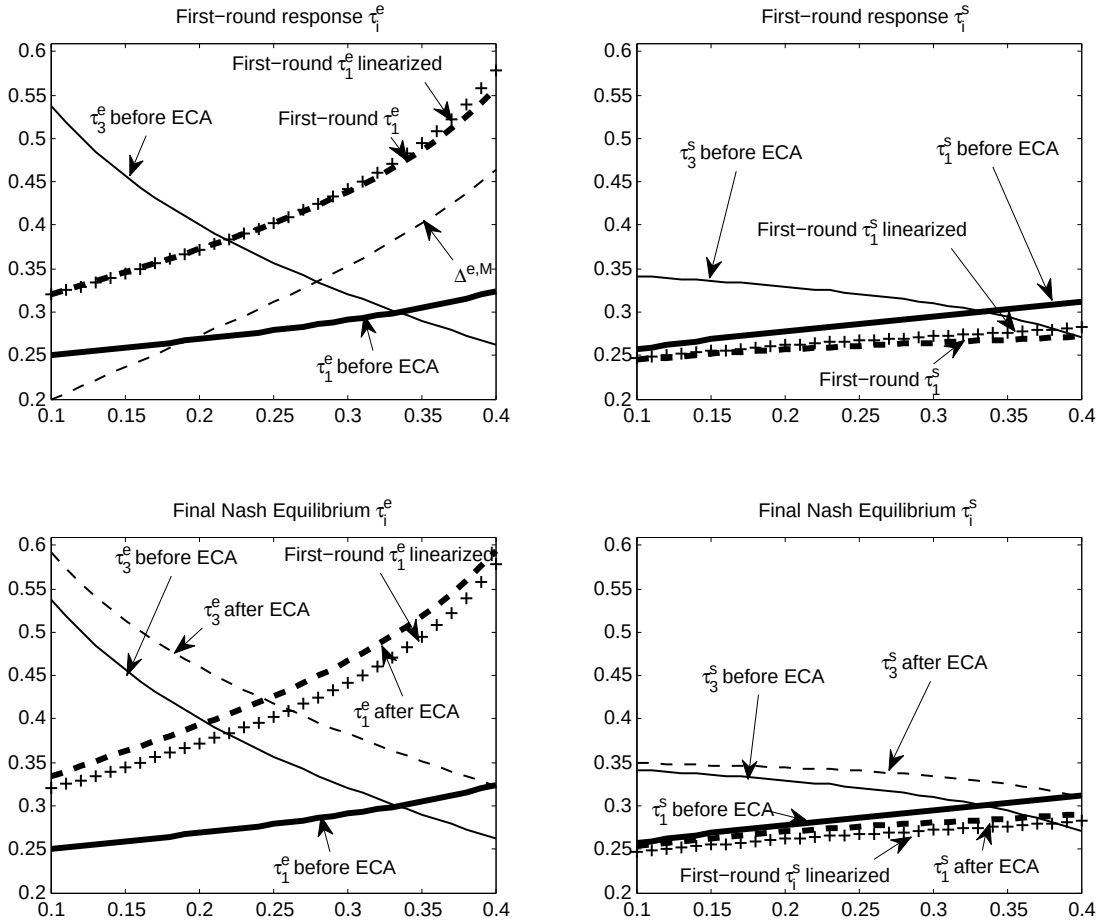
The upper plots in Figures 6.3, 6.4, and 6.5 present the simulated, first-round, responses by countries 1 and 2 after they have formed an ECA under regime S, M, and B respectively. The plots on the left presents the marginal tax rates. The thick-solid lines are the marginal tax rates for countries 1 and 2 under decentralization. The thick-dashed lines represent the optimal simulated marginal tax rates after the ECA is imposed. The marginal tax rate of country 3 is held constant (thin-solid line). Finally, the thin-solid lines with crosses presents the linearized approximation of the optimal response using Eq. (6.26) while the thin-dashed line presents the shock to the marginal excess burden ($\Delta^{e,S}$). The lines in the plots on the right relate to the statutory tax rates and follow the same organization.

Figure 6.3: Tax policy under Regime S in the range $0.1 < s < 0.4$



We see that the propositions stated above hold in the simulations. That is, it is optimal to increase both tax rates under regime B. Under regime S the statutory tax rate is increased whereas the marginal tax rate is reduced, and vice versa for regime M.

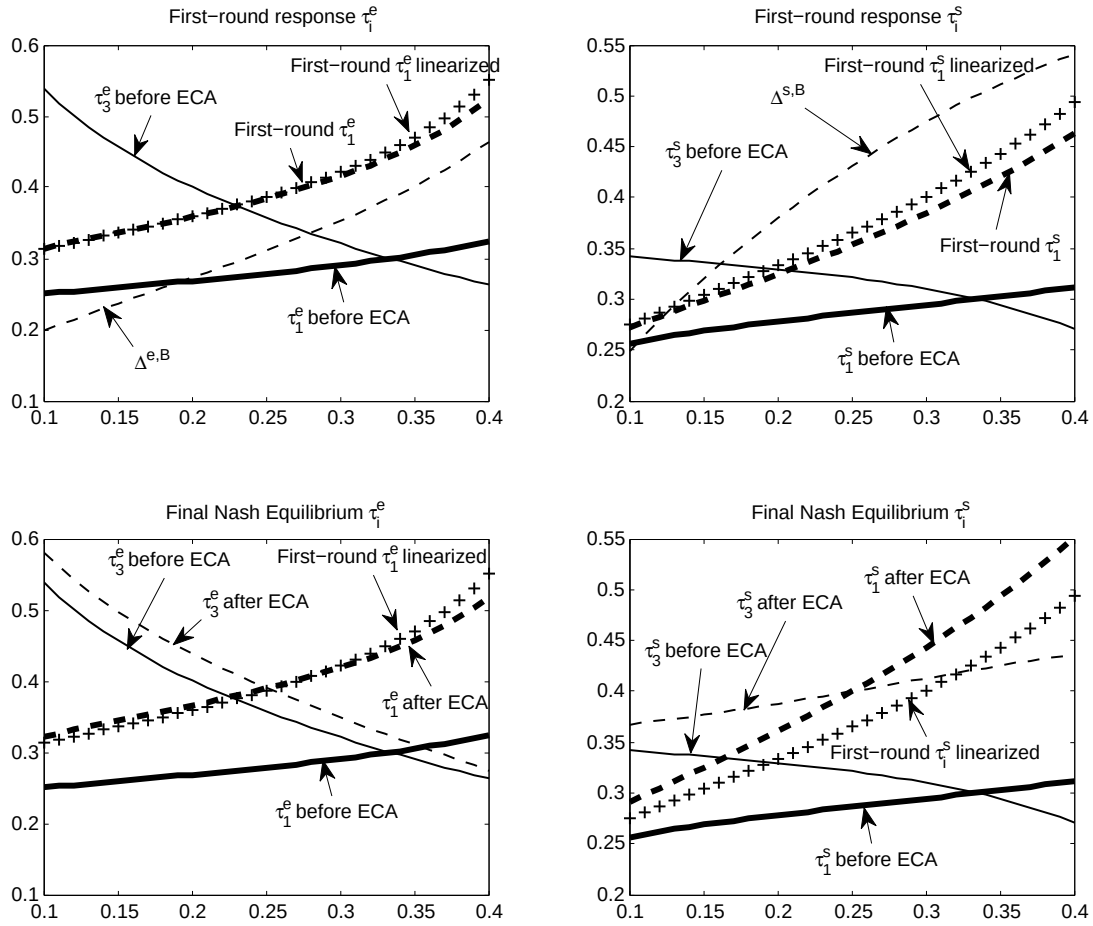
Figure 6.4: Tax policy under Regime M in the range $0.1 < s < 0.4$



Interestingly, the increase in the statutory tax rate is larger under regime S compared to regime B. Intuition for this is that both tax instruments are substitutes in the optimal policy mix for countries 1 and 2. The incentive to increase the marginal tax rate under regime B therefore tempers the incentive to increase the statutory tax rate under regime B and vice-versa. When one of the two policy shocks is absent (regimes S and M), the government substitutes towards the policy instrument that is coordinated and away from the uncoordinated policy instrument. The reduction in the uncoordinated tax rate reinforces the incentive to increase the coordinated rate. Finally, I want to stress that the predicted linearized optimal response is never far from the actual non-linear optimal response. This suggests that the methodology is sound and that most of the intuition can be obtained from the analytical results.

Furthermore, we see that the increase in the coordinated rates, and the decrease in the uncoordinated rates, is larger the larger are the cooperating countries. This is because the internalized tax spillovers are larger (the thin-dashed lines).

Figure 6.5: Tax policy under Regime B in the range $0.1 < s < 0.4$



6.3.5 The Tax Policy Change in Country 3

Besides the insider countries, also country 3 (the outsider) will adjust its tax policy after coordination between countries 1 and 2. Therefore, before studying the final Nash equilibrium, I shortly address the incentives for policy change in the outsider country.

Due to the policy change by the insider countries, the outsider country is confronted with a change in its capital stock and the allocation of profits. This affects the excess burden for both of its tax instruments as described by matrix N_3^D in Eq. (6.21). Notice the superscript "D" which reflects that the coefficients for country 3 do not change due to cooperation between countries 1 and 2. Establishing the ECA in countries 1 and 2 does not change the optimal policy rules of country 3 in itself, the policy *changes* in countries 1 and 2 *after* the ECA is established do affect the policy rules for country 3.

How does country 3 respond? The answer is provide by a reasoning similar to the one followed above. Twice (two countries) the matrix N_3^D multiplied with the first-round

response by countries 1 and 2 (providing an approximation for $\tilde{\tau}_j^s$ and $\tilde{\tau}_j^e$, $j \in \{1,2\}$) leads to a vector ($[\Lambda^s \ \Lambda^e]'$) representing a hypothetical shock to the tax system in country 3. This shock represents the inflow or outflow of profits and capital and the change in the net interest rate following the tax policy change in countries 1 and 2. This shock depends on the regime adopted by countries 1 and 2 and their size. The change in tax policy in country 3 now follows from multiplying this shock with the inverse of matrix H_3^D, this gives the change in tax policy in country 3:

$$\tilde{\tau}_3^s = \frac{H_3^D(2,2)\Lambda^{s,E} - H_3^D(1,2)\Lambda^{e,E}}{|H_3^D|}, \tag{6.30}$$

$$\tilde{\tau}_3^e = \frac{H_3^D(1,1)\Lambda^{e,E} - H_3^D(2,1)\Lambda^{s,E}}{|H_3^D|}, \tag{6.31}$$

which are similar to Eqs. 6.22 and 6.23 above. The change in policy depends crucially on the sign and size of $\Lambda^{s,E}$ and $\Lambda^{e,E}$. Therefore, I will discuss each regime shortly and proof that the signs of the policy changes by country 3 can be established under mild conditions.

Regime S

Under regime S, countries 1 and 2 increase their statutory tax rate and reduce their marginal tax rate after the ECA is established (see Proposition 2). The reduction in the marginal tax rate unambiguously increases the marginal excess burden of τ_3^e because capital flows out of country 3:

$$\Lambda_3^{e,S} = 2N_3^D(2,2)\tilde{\tau}_1^e < 0, \tag{6.32}$$

where I use $N_3^D(2,2) > 0$.

For the statutory tax rate matters are more complicated because the marginal excess burden of the statutory tax rate of country 3 is increasing in both the statutory tax rate and the marginal tax rate of countries 1 and 2 (both $N_3^D(1,1)$ and $N_3^D(1,2)$ are positive):

$$\Lambda_3^{s,S} = 2N_3^D(1,1)\tilde{\tau}_1^s + 2N_3^D(1,2)\tilde{\tau}_1^e. \tag{6.33}$$

However, under the conditions stated in Proposition 4, the increase in the statutory tax rate by countries 1 and 2 dominates the reduction in the marginal tax rate:

Proposition 4

$$\Lambda_3^{s,S} = \frac{\left\{\Theta^s \Delta^{s,S}\left[\Theta_1^{g,k}\epsilon_1^{\rho,S}\epsilon_{11}^{k,S} + \frac{1}{1+\tau_1^e}\left(\epsilon_1^{S,\rho} + \epsilon_{11}^{k,S}\right)\right] - \omega\epsilon_1^{\rho,S}\epsilon_{11}^{k,S}\left(\frac{\tau_i^s a_i}{\tau_i^e} + 1\right)\right\} 2\Delta^{s,S}}{|H_1^S|} > 0, \tag{6.34}$$

with,

$$\Theta^s = \left(\frac{1-s}{1-2s}\right)\left(\frac{k_1}{k_3}\right)^{\omega} > 0. \tag{6.35}$$

Θ^s *describes the relative size of the flow of profits into country* 3 *following the increased tax rates in countries* 1 *and* 2*. The larger this flow, the more likely it is that the marginal excess burden of the statutory tax rate is reduced. The necessary condition for to sign Eq. (6.34) states:*

$$\Delta^{s,S}\Theta^s > \frac{\omega\epsilon_1^{\rho,S}\epsilon_{11}^{k,S}\left(\Theta_1^{g,k} - \frac{\omega}{1-\omega}\right)}{\Theta_1^{g,k}\epsilon_1^{\rho,S}\epsilon_{11}^{k,S} + \frac{1}{1+\tau_1^e}\left(\epsilon_1^{S,\rho} + \epsilon_{11}^{k,S}\right)} > 0. \tag{6.36}$$

From the above, we can conclude that under regime S, and the conditions stated in Proposition 4, the marginal excess burden of τ_3^s is reduced whereas the marginal excess burden of τ_3^e is increased. Country 3 will unambiguously increase its statutory tax rate and reduce its marginal tax rate.

Regime M

Under regime M, countries 1 and 2 increase their marginal tax rate (they broaden the tax base) and reduce their statutory tax rate, the tax policy moves into the direction of a CBIT system. This policy change will unambiguously reduce the marginal excess burden of τ_3^e because capital moves into country 3:

$$\Lambda_3^{e,M} = 2N_3^D(2,2)\tilde{\tau}_1^e > 0, \tag{6.37}$$

because $N_3^D(2,2) > 0$.

Again, the increased marginal tax rate and the reduced statutory tax rate in countries 1 and 2 have opposing effects on the marginal excess burden of the statutory tax rate. The former increases the taxable rents in country 3, the latter leads to an outflow of profits and hence a smaller tax base for the statutory tax rate in country 3. However,

under the conditions in Proposition 5, the marginal excess burden of the statutory tax rate is *reduced* as well:

Proposition 5

$$\Lambda_3^{s,M} = \frac{\left[\frac{2k_1(1+s)}{1-2skk_1} - \Theta^s\right] 2\omega\epsilon_{11}^{k,M}\Delta^{s,B}\Delta^{e,M}}{|H_1^M|} > 0, \tag{6.38}$$

when:

$$\frac{2k_1(1+s)}{1-2sk_1} > \Theta^s. \tag{6.39}$$

Note this condition always holds under symmetry ($k_1 = k_3 = 1, s = 1/3$) which is therefore a sufficient condition for the result.

It is interesting to report that the condition stated in Proposition 5 always holds for the simulations studied in this chapter. This implies that country 3 always has an incentive to raise its statutory tax rate. How country 3 chooses its tax policy depends on the relative size of $\Lambda^{s,M}$ compared to $\Lambda^{e,M}$ as described in Eqs. (6.30) and (6.31). But assuming that the shock to the own marginal excess burden dominates, country 3 will increase both tax rates.

Regime B

Finally, the analysis under Regime B is relatively straightforward under the conditions of Proposition 3 as in this case both the marginal tax rate and the statutory tax rate in countries 1 and 2 are increased. The marginal excess burden of both the marginal and the statutory tax rate of country 3 are reduced. This is formalized in Proposition 6 below, where I make use of proposition 3:

Proposition 6 *When countries* 1 *and* 2 *cooperate under regime* B*, the marginal excess burden for the statutory tax rate in country* 3 *is reduced:*

$$\Lambda_3^{s,B} = 2\epsilon_{31}^{\Pi,D}\tilde{\tau}_1^s + 2\omega\epsilon_{31}^{k,D}\tilde{\tau}_1^e > 0, \tag{6.40}$$

when $\Delta^{s,B} + \Theta_1^B > \omega/(2+\omega)$ *and* $k_1 > 1/(1+s)$*. For the marginal tax rate, I obtain:*

$$\Lambda_3^{e,B} = 2\left[\frac{\tau_3^s a_3}{\tau_3^e} + \frac{1}{\phi}\frac{\tau_3^e}{1+\tau_3^e}\right]\epsilon_3^{\rho,D}\epsilon_{31}^{K,D}\tilde{\tau}_1^e > 0. \tag{6.41}$$

when: $k_1 > 1/(1+s)$.

How country 3 chooses its tax policy depends on the relative size of $\Lambda^{s,B}$ compared to $\Lambda^{e,B}$ as described in Eqs. (6.30) and (6.31). But assuming that the shock to the own marginal excess burden dominates, country 3 will increase both tax rates.

This completes my analysis of the tax policy response in country 3. Assuming all conditions stated in Propositions 2-6 hold, the statutory tax rate in country 3 is unambiguously increased following the formation of an ECA between countries 1 and 2 because taxable rents in country 3 increase following the flows of profit and capital. The marginal tax rate in country 3 is increased under an ECA imposing regime B and M, whereas it is reduced under regime S.

6.4 Final Nash Equilibrium

Section 6.2 has discussed the decentralized equilibrium corporate tax system under asymmetric countries. In Section 6.3.1 I introduced enhanced cooperation agreements and discussed how these affect the corporate tax systems of the countries in our model. That is, I focused on the incentives to change tax policy by insider and outsider countries. These in-between steps yield important insights that help us understand the final Nash equilibrium under policy cooperation which I study in this subsection. This section presents the new Nash equilibrium and compares this to the decentralized equilibrium.

The lower plots in Figures 6.3, 6.4, and 6.5 present the Nash equilibrium values for both countries 1 and 2 (thick lines) and country 3 (thin lines). Both the equilibrium tax rates before cooperation (solid lines) and after cooperation (dashed lines) are presented. The left plot shows the marginal tax rates, the right plot the statutory tax rates. For completeness, also the (linearized) predicted change by countries 1 and 2 is included (thin line with crosses).

We see that the Nash equilibrium after cooperation is characterized by tax policy changes that are in accordance with our first-round predictions. Countries 1 and 2 always increase the coordinated tax rate and reduce (if any) the uncoordinated tax rate. As a response, country 3 increases both tax rates under regimes B and M while under regime S, the statutory tax rate is increased and the marginal tax rate is decreased. The change in the tax rates is proportional to the size of the cooperating countries, which reflects the size of the internalized spillovers. The increases in the statutory and marginal tax rate under regimes S and M, respectively, are larger than their increase under regime B. This because under regime B both tax rates are increased, such that the increase in one tax rate tempers the increase in the other tax rate.

Figure 6.6: Tax revenues comparison in the range $0.1 < s < 0.4$

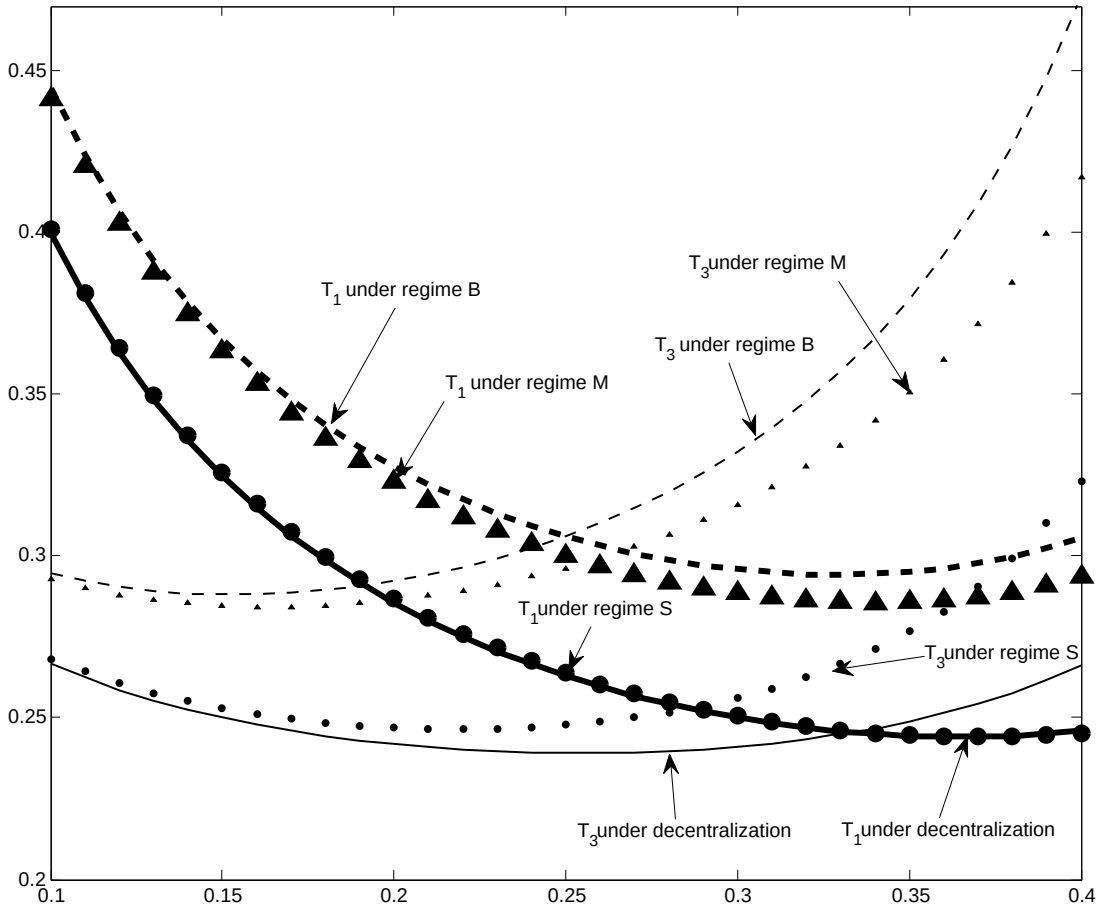


Figure 6.6 presents the tax revenues in the three regimes and under decentralization. Again, thick lines refer to countries 1 and 2 and thin lines refer to country 3. De solid lines represent tax revenues under decentralization. Two conclusions can already be drawn here. First, a small country has more tax revenue than a large country due to inflows of capital and profits. Second, after any ECA is imposed tax revenues are increased. However, especially under an ECA with regime S (dotted lines) there are hardly tax revenue gains under the current simulation. The extra tax revenues from increased statutory rates are lost due to lower marginal tax rates. Now recall that taxable rents equal: $R = (1-\omega)k_i^{\omega}$ with a value of $\omega = 0.79$, implying a relative small tax base for the statutory rate compared to the tax base of the marginal tax rate, the return to capital: ρk_i with $\rho \in [0.52 - 0.64]$ for the simulations presented. The revenue gain is small because the cooperation is on the smaller tax base. Under regime B (dashed lines) the increase in the tax revenues is the largest, in both dimensions the Laffer curve is widened. Furthermore, country 3 acts as a strategic complement, it also increases both tax rates,

which prevents a massive outflow of capital and profits. Under regime M (lines with triangles) the increase in tax revenues is substantial compared to regime S, what again can be explained from the size of the tax bases. Countries cooperate on the tax instrument with the broad tax base, and therefore gain substantial tax revenues. Also the increased statutory tax rate in country 3 is welcomed by the cooperating countries, this prevents a massive outflow of profits. Finally, observe that the outsider country, country 3, always gains from cooperation between countries 1 and 2, implying that all countries gain from the establishment of an ECA, at least in terms of tax revenue. This is due to the (overall) cross-country complementarity of tax rates, which is imposed by the assumption of a tax revenue maximizing government.

6.5 Conclusions

This chapter studies cooperation in corporate taxation using a model of three asymmetric countries in which governments maximize tax revenues by choosing both the statutory corporate tax rate and a parameter that determines the tax deductibility of the cost-of-capital and, hence, the definition of taxable income. Firms are allowed to shift profits and capital across the three countries. I combine a simulation analysis with analytical results. The two tax instruments imply that I allow explicitly for the empirically observed negative correlation between statutory rates and the broadness of the tax base.

I contribute to the literature by studying tax cooperation between two of the three governments (the insiders) on either one or both of the tax instruments and by allowing each of the governments to endogenously re-optimize its tax instruments. The literature until now either imposes the harmonized tax rates and studies only the re-allocation of profits and capital, or allows only one tax instrument to be adjusted endogenously. Real world corporate tax systems consists of at least two dimensions, the tax rate and a definition of the tax base. Furthermore, the recent harmonization initiatives in by the European Union (EU) intend to harmonize only one of these two tax instruments, the definition of the tax base. Our paper informs policymakers on the likely long-run changes in tax rates that revenue maximizing governments might under take.

The first result is that insider countries unambiguously increase the coordinated tax rate. Furthermore, when cooperating on a single tax instrument, the uncoordinated rate is reduced as the tax instruments are substitutes in the optimal policy mix for the government. This is an important argument missing from the studies by Brøner *et al.* (2006) and Bettendorf *et al.* (2010), who assume that the insider countries will choose

the coordinated tax rate equal to the weighted average of the pre-coordinated tax rates. Welfare gains from tax harmonization are larger from this argument.

Next, recall that the literature on tax harmonization finds that all countries benefit from cooperation when tax rates are complements across countries (see Chapter 2). In line with this, I find that due to relative strong cross-country complementarity of tax instruments and relative weak substitutability between the tax rates within a country, the creation of an ECA always raises tax revenue in countries that do not participate in the ECA (the outsiders) and never reduces it for the insider countries. The outsider country benefits the most, this because the increase in the tax burden is larger within the coalition compared to the increase in the outsider country: capital and/or profits flow out of the insider countries towards the outsider countries. I find that cooperation on solely the statutory tax rate raises hardly any additional tax revenue for the insider countries, whereas cooperation on the tax-deductible fraction of the cost-of-capital yields substantial additional tax revenue. The explanation for this is in the size of the tax base, the size of the increase in the coordinated tax rate and the reduction in the uncoordinated rate. The tax base for the tax-deductible cost-of-capital is, in the simulations presented, relatively large compared to the tax base for the statutory rate: the rents from production. Furthermore, the increase in the coordinated tax rate is larger when coordination is on the tax-deductible cost of capital, whereas reduction in the statutory tax rate is relatively small in this case. Coordination on the broader tax base is the most rewarding. From a policy perspective, it would be interesting to measure the size of the tax base for the tax-deductible cost-of-capital relative to the above normal returns.

Finally, I find that the outsider country always increases the statutory tax rate upon the change in tax policy in the cooperating countries. This because both an increase in the marginal tax rate or the statutory tax rate in the insider countries broadens the tax base for the statutory tax rate for the outsider country. This result, reinforces (or partly creates) the result that tax revenues increase strong under an ECA with a coordinated definition of taxable income: both tax instruments in the outsider country are increased.

In relation to the existing literature these are interesting findings. First of all, Devereux and the Mooij (2011) state that tax coordination in the EU would make adoption of an Allowance for Corporate Equity (ACE) system more attractive because profit-shifting spillovers are internalized. My analysis confirms this conclusion in case of coordination on the statutory tax rate. The intuition is that coordination in the statutory tax rate makes it attractive to increase the statutory tax rate. Being substitutes in the optimal policy mix, the optimal tax-deductible cost-of-capital is now higher (smaller distortion on the margin). However, when coordination also involves the definition of the tax base, the

optimal tax system will move into the direction of a Comprehensive Business Income Tax (CBIT), where a smaller fraction of the cost-of-capital is tax deductible. This because under such a system precisely the spillovers from capital reallocation are internalized, making it attractive to increase the tax on the marginal investment.

Also the relation to Riedel and Runkel (2007) and Eichner and Runkel (2011) is interesting who study introducing the Common Consolidate Corporate Tax Base (CCCTB) in models similar to the one used in this chapter. Although introducing the CCCTB in a subgroup of countries is a non-trivial policy shock that I want to analyse in the future, it changes all taxation spillovers in the model, the present chapter does give some idea on the results. First, Riedel and Runkel (2007) show dat introducing the CCCTB will lead to an inflow of profits from outsider countries in the short-run, because the CCCTB will reduce the average effective tax rate within the coalition. This chapter shows that this might also be the case in the long-run. The outsider country increases its statutory tax rate relative to the cooperating countries because the choice of the harmonized tax base by the coalition causes a capital inflow that broadens the tax base in the outsider country. Furthermore, Eichner and Runkel (2011) show that introducing the CCCTB will lower competition on statutory tax rates. Based on the results by Eichner and Runkel, my expectation is that introducing the CCCTB would lead to an outcome in between a coordinated tax base with an uncoordinated statutory tax rate and coordination of both tax instruments. This would result in a broader tax base but a less ambitious increase in the statutory tax rate then in the case of coordination on both tax instruments. If the spillovers internalized on the definition of the tax base dominate, the statutory tax rate might even be reduced.

For future research I consider extending the model with an endogenous savings decision and a more general government objective. The first extension introduces an additional distortion from taxing the marginal investments. This will reduce the benefits from cooperating on the definition of the tax base, the tax spillover related to this definition of the tax base is reduced relative to the tax spillover of the statutory rate. This potentially leads to a policy change towards an ACE system when cooperating on both tax instruments. The second extension mainly affects the strategic game played between the governments, it might lead to strategic substitutes which I stressed in previous chapters can be crucial. Furthermore, as mentioned, I want to generalize the model into a three country asymmetric model with "active" instead of "passive"' subsidiaries in order to study the implications of introducing the CCCTB into our framework along the lines of Eichner and Runkel (2011).

Nederlandse Samenvatting (Summary in Dutch)

Introductie

In dit proefschrift bestudeer ik de concurrentie tussen nationale overheden voor de winsten en investeringen van internationaal opererende bedrijven door middel van hun vennootschapsbelastingstelsel. Ik heb een theorie ontwikkeld die uitlegt hoe landen reageren op een verandering in het vennootschapsbelastingstelsel in het buitenland. Verder meet ik hoe veranderingen in het vennootschapsbelastingstelsel gemiddeld genomen de overheidsfinanciën beïnvloeden. Zoals hieronder uitgelegd, wordt de concurrentie tussen landen vaak als nadelig voor de samenleving als geheel gezien. Politici proberen daarom door internationale samenwerking deze concurrentie te verminderen. Ik gebruik de ontwikkelde theorie om te analyseren hoe verschillende vormen van samenwerking onze welvaart beïnvloed. Echter, voordat ik tot de samenvatting van de hoofdstukken kom, zal ik eerst kort de onderliggende problematiek uitleggen.

De concurrentie tussen landen met de vennootschapsbelasting leidt tot verschillende ongewenste uitkomsten. De eerste ongewenste uitkomst is dat deze concurrentie tussen overheden erg veel verliezers kent. Als alle landen hun belastingtarieven verlagen, omdat ze verwachten anders bedrijven of winsten te verliezen aan buurlanden, zullen uiteindelijk bijna alle landen lagere belastingopbrengsten hebben. Door globalisering is de druk op overheden om hun belastingtarieven te verlagen toegenomen. Juist in een tijd waarin de overheidsfinanciën onder druk staan, is deze concurrentie strijd erg vervelend.

Belastingconcurrentie komt voort uit het gegeven dat overheden van verschillende landen zelf beslissen over hun belastingstelsel. Deze autonomie zorgt voor een lappendeken van verschillende belastingstelsels in Europa. Deze lappendeken ligt ten grondslag aan twee andere ongewenste uitkomsten van belastingconcurrentie. Ten eerste zien economen graag dat bedrijven beslissingen nemen gebaseerd op een analyse van de werkelijke sociale opbrengsten en werkelijke sociale kosten van een investering. Deze sociale opbrengsten

en kosten zijn de opbrengsten en kosten opgeschoond voor overheidsingrijpen, tenzij dit overheidsingrijpen gerechtvaardigd is doordat de desbetreffende markt niet goed functioneert. Overheidsingrijpen zou de beslissingen van bedrijven niet moeten beïnvloeden. Echter, verschillen in belastingstelsels tussen landen beïnvloeden de keuzes van bedrijven. Teveel bedrijven zullen zich in lage belastinglanden vestigen, dit gaat ten koste van de welvaart van de wereldbevolking als geheel omdat sommige bedrijven productiever zouden zijn geweest in het hoge belastingland.

Ten tweede moeten internationaal opererende bedrijven kosten maken aan belastingadviseurs om te voldoen aan de belastingregels van alle verschillende landen. Hier staat voor deze bedrijven een lagere belastingdruk tegenover, maar vanuit het perspectief van de samenleving kan dit geld productiever worden aangewend. Dit is het tweede nadelige gevolg van de lappendeken aan belastingstelsels in Europa.

Europese politici zijn daarom al zeker vijftig jaar opzoek naar mogelijkheden om de belastingstelsels iets meer te uniformeren. Voor de BTW is dit al gelukt, er zijn minimum en maximum tarieven afgesproken. Voor de vennootschapsbelasting wil dit echter niet lukken, omdat naast voorstanders van uniformering er ook tegenstanders zijn. Deze tegenstanders zijn vooral landen die op dit moment voordeel hebben van belastingconcurrentie. Sommige, vooral de kleinere landen, profiteren van een grote instroom van winsten en bedrijven. Deze landen zitten niet te wachten op een centraal ingestelde vennootschapsbelasting omdat hun concurrentie voordeel dan verloren gaat.

Verder zijn politici niet bereid om de autonomie over een belangrijke inkomstenbron op te geven. Dit tweede punt is fundamenteel. Niet voor niets hebben landen autonomie op bepaalde beleidsgebieden. De inwoners van deze landen hebben over het algemeen een gezamenlijke geschiedenis en cultuur. Dit betekent dat ze relatief eenduidige ideeën hebben over wat een overheid zou moeten doen en hoeveel belastingen dat zou mogen kosten. De lappendeken die ik eerder besprak, is niet alleen het gevolg van een competitief gekozen belastingstelsel, het is ook het gevolg van verschillen in voorkeuren voor de publieke zaak. Het uniformeren van belastingstelsels zal deze pluriformiteit aan voorkeuren geweld aan doen. Naast de voordelen van een centraal geleid vennootschapsbelastingstelsel moet ook deze kostenpost mee worden genomen in de beslissing.

Het bovenstaande in acht nemende heeft de Europese Commissie (EC) in maart 2011 een nieuw voorstel gelanceerd. Om dit voorstel te begrijpen moet ik eerst uitleggen dat het vennootschapsbelastingstelsel bestaat uit grofweg een definitie van het belastbare inkomen en een statutair tarief. Het statutaire tarief bepaald hoeveel belasting er moet worden betaald over het belastbare inkomen. Het voorstel van de EC is om in een groep van Europese landen een eenduidige definitie van de belastinggrondslag te introduceren.

Verder worden de geconsolideerde winsten van internationaal opererende bedrijven met een verdeelsleutel toebedeeld aan de deelnemende landen. Het voorstel wordt de *common consolidated corporate tax base* (CCCTB) genoemd. Landen mogen zelf kiezen of ze deelnemen aan het voorstel, of er liever buiten blijven. Landen die niet deelnemen noem ik de niet-deelnemers in het vervolg van deze samenvatting. Dit betekent dat de landen autonomie houden over hun statutaire belasting tarief, maar de autonomie over de definitie van het belastbare inkomen moeten opgeven. Dit voorstel roept een aantal vragen op die nog niet zijn beantwoord in de economische literatuur en die ook niet kunnen worden beantwoord met de huidige economische modellen. Bijvoorbeeld, welke landen zullen deelnemen aan dit voorstel? Hoe gaat het vennootschapsbelastingstelsel van deze landen eruit zien? En hoe gaat het stelsel van de niet-deelnemers er uiteindelijk uitzien? En belangrijk, worden we welvarender van het voorstel? Mijn proefschrift probeert op deze vragen een antwoord te vinden.

Samenvatting resultaten

Hoofdstuk 2: Samenwerking op het gebied van de vennootschapsbelasting

In dit hoofdstuk geef ik een overzicht van de literatuur op het gebied samenwerking tussen landen toegepast op de vennootschapsbelasting. In het algemeen is te stellen dat samenwerking tussen landen niet vanzelfsprekend is. Vaak zijn er tegengestelde belangen, zodat landen niet tot overeenstemming komen over het te voeren beleid. Vaak is het voor een enkel land aantrekkelijk om buiten een samenwerkingsverband tussen andere landen te blijven. Dit land heeft de mogelijkheid om haar beleid net iets competitiever te kiezen dan de landen in het samenwerkingsverband.

De literatuur laat zien dat de opbrengst van samenwerken afhangt van de keuzes die de deelnemers en de niet-deelnemers maken. Als de niet-deelnemers hun beleid in dezelfde richting wijzigen als de samenwerkende landen, zal de welvaart in alle landen stijgen. Als dit niet het geval is, zal één van beide groepen er in welvaart op achteruit gaan. Om dit te begrijpen is het belangrijk om te herkennen dat de beleidswijziging in de samenwerkende landen aangeeft wat er mis was met de situatie van ieder voor zich, door samenwerken wordt deze inefficiëntie verminderd. Als de niet-deelnemers deze wijziging volgen ondersteunen ze het opheffen van de inefficiëntie.

Met betrekking tot belastingconcurrentie betekent dit dat samenwerkende landen hogere effectieve belastingtarieven zullen kiezen. Met effectief belastingtarief bedoel ik

de gecombineerde belastingdruk van het statutaire tarief en de definitie van de belastingbasis. Als niet-deelnemers hierop reageren door ook een hoger effectief tarief te kiezen, zal de welvaart in de EU toenemen. In de belastingconcurrentie literatuur wordt doorgaans aangenomen dat dit het geval is.

Tot slot laat de literatuur aangaande belastingharmonisatie zien dat gedetailleerde economische simulatie studies geen grote welvaartswinsten van het huidige voorstel van de EC verwachten. Deze laatste bevinding roept de vraag op waarom de EC dan zo geïnteresseerd is in het voorstel. Missen de simulatie studies misschien een belangrijk argument? Ja, er missen in ieder geval twee argumenten. Ten eerste, de verwachte afgenomen kosten aan belastingadviseurs die ik in de inleiding heb genoemd zijn niet meegenomen. Dit argument mist, omdat hier geen goede schattingen voor bestaan en er ook onzekerheid bestaat over de vraag of deze wel zullen afnemen. Het tweede argument is dat de gedetailleerde simulatie studies niet toestaan dat overheden, nadat een samenwerkingsverband is aangegaan, hun belastingstelsel aanpassen. Aangezien ik eerder al stelde dat de opbrengst van samenwerken afhangt van het gedrag van de deelnemers en de niet-deelnemers, is het evident dat dit opnieuw optimaliseren van het belastingstelsel een belangrijke invloed kan hebben op de welvaartswinsten. Hoofdstukken 4, 5 en 6 gaan in op de vraag hoe deelnemers en niet-deelnemers van een samenwerkingsverband hun vennootschapsbelastingstelsel wijzigen. Echter, voordat ik deze hoofdstukken samenvat zal ik eerst in hoofdstuk 3 kort de vraag beantwoorden of er wel belastingconcurrentie bestaat.

Hoofdstuk 3: Heeft de vennootschapsbelasting in het buitenland invloed op de binnenlandse belastinggrondslag?

Voor het bestaan van belastingconcurrentie is er één alles bepalende aanname. Het belastingtarief in het buitenland moet invloed hebben op de binnenlandse belastinggrondslag. Dit omdat het gekozen (effectieve) belastingtarief door de overheid onder andere afhangt van de grote van de belastinggrondslag. Dit is als volgt te begrijpen. Als de overheid haar (effectieve) belastingtarief verhoogd met één procent, ontvangt zij één procent maal de volledige huidige belastinggrondslag als extra inkomsten. Deze extra inkomsten moet de overheid corrigeren voor een daling in de belastinggrondslag doordat winsten of bedrijven uit het land vertrekken, of omdat mensen minder hard werken. De netto opbrengsten die hieruit volgen moeten minimaal positief zijn om het tarief in de eerste plaats te verhogen. Een stijging van het (effectieve) belastingtarief in het buitenland zal de belastinggrondslag in het thuisland vergroten. Hierdoor brengt een belastingverhoging meer op en dit

beïnvloedt het optimale tarief voor de overheid van het thuisland. De theoretische hoofdstukken gaan hier dieper op in.

Hoofdstuk 3 meet of deze afhankelijkheid bestaat en vindt hier overduidelijk bewijs voor. De methode die ik hiervoor gebruik is nieuw voor de empirische literatuur op het gebied van de vennootschapsbelasting. Ik introduceer een maatstaaf voor het gemiddelde tarief van de belangrijkste buurlanden van een bepaald land. Belangrijkste kan bijvoorbeeld afstand zijn, het tarief van directe buren wordt zwaarder gewogen dan het tarief van landen aan de andere kant van de wereld. Maar ook grote kan belangrijk zijn, of handelsrelaties, ik gebruik verschillende varianten. Deze maatstaaf is erg belangrijk in de analyse, zonder de maatstaaf wordt mogelijk een meetfout gemaakt omdat de belastingtarieven van het thuisland gecorreleerd zijn met deze maatstaaf van buitenlandse tarieven. Daarnaast corrigeer ik voor het feit dat er een constante opgaande lijn is in de belastinggrondslag en constante dalende lijn in de belastingtarieven.

Ik vind overduidelijk bewijs voor de afhankelijkheid van de belastinggrondslag van zowel het tarief van het thuisland (negatief) als de maatstaaf voor buitenlandse tarieven (positief). Een hoger tarief in het thuisland leidt tot het wegtrekken van bedrijven en winsten en daarom een lagere belastinggrondslag. Een verhoging in het buitenland zorgt voor het omgekeerde effect. Ik vind dat het effect sterker is voor het statutaire belastingtarief dan voor het effectieve tarief op investeringen. Investeringen lijken minder sterk te reageren op tariefswijzigingen dan winsten. Ik vind dat gemiddeld genomen het statutaire tarief dicht tegen het belastingontvangsten maximerende tarief aanzit. Een verdere verhoging zal daarom, gemiddelde genomen, waarschijnlijk weinig extra belastinginkomsten genereren. De resultaten uit dit hoofdstuk zijn een goede opstap naar de theoretische hoofdstukken aangezien het bewijst dat er afhankelijkheid tussen landen bestaat met betrekking tot de vennootschapsbelasting.

Hoofdstuk 4: Optimaliseren van het belastingstelsel na samenwerking

In hoofdstuk 4 bestudeer ik hoe overheden hun vennootschapsbelastingtarief kiezen. Ik doe dit zowel in het geval waar elk land voor zich het meest competitieve belastingstelsel kiest, en in het geval waarin er samenwerking is tussen een subgroep van de landen. Ik gebruik hiervoor een model met drie landen van verschillende grote en een erg simpel vennootschapsbelastingstelsel: er is slechts één enkel tarief dat gekozen kan worden. In hun keuze houden overheden rekening met de gevolgen van het verhogen van het belastingtarief. Ze herkennen dat een hogere belasting leidt tot minder kapitaal binnen de

landsgrenzen. Netto zal de belastingverhoging leiden tot meer belastinginkomsten (tot een bepaald maximaal tarief), dit gaat echter ten koste van het inkomen voor de inwoners van het land, er is immers minder werk. De overheid vergelijkt de kosten van het verhogen van het tarief met de waarde die zij hecht aan hogere belastinginkomsten.

Ik vind dat grote landen hogere tarieven kiezen in vergelijking met kleinere landen. Dit omdat na een belastingverhoging, de uitstroom van kapitaal relatief minder groot is voor grote landen omdat deze landen groot zijn ten opzichte van de wereldeconomie. Groot betekent in dit geval dat het buitenland relatief klein is: kapitaal heeft meer moeite om de vennootschapsbelasting verhoging te ontwijken, omdat er relatief weinig investeringsmogelijkheden buiten dit grote land zijn. De kleine landen zijn echter welvarender, door het lage belastingtarief wordt hier relatief veel kapitaal geïnvesteerd. Beide resultaten zijn al bekend in de literatuur. Daarnaast vind ik dat samenwerken leidt tot hogere tarieven in de samenwerkende landen, ook dit is bekend, de overheden concurreren niet meer met elkaar voor kapitaal en bedrijven.

Mijn contributie zit in het bestuderen van het strategische gedrag van de landen in dit model. Hoe verandert een land zijn tarief in reactie op een verandering in het buitenland? De literatuur neemt eigenlijk altijd aan dat een verhoging in het ene land wordt gevolgd door een verhoging in het andere land. Ik laat zien dat dit niet noodzakelijkerwijs het geval is. De verhoging in het buitenland heeft de belastinggrondslag in het thuisland verbreed, hierdoor stijgen de belastingontvangsten direct. In zijn keuze voor de optimale reactie maakt de overheid nu een afweging. De verbreding van de belastinggrondslag maakt het namelijk aantrekkelijk om het tarief te verhogen, dit is het standaard argument dat ik hierboven noemde. Echter, de directe verhoging van de belastingontvangsten maakt het mogelijk aantrekkelijk om het tarief te verlagen. Dit is het geval als de waarde die de overheid aan belastingontvangsten hecht afneemt in de hoeveelheid belastinginkomsten (of te wel: hoe meer inkomsten de overheid heeft, hoe minder graag ze haar inkomsten wil vergroten). Als dit tweede argument domineert, en het is niet uitgesloten dat dit geldt voor sommige landen, zou het zo kunnen zijn dat de niet-deelnemers aan een samenwerkingsverband, hun belastingtarief verlagen in reactie op het stijgende tarief voor de samenwerkende landen. Dit kan leiden tot een welvaartsverlies voor de samenwerkende landen, of voor de niet-deelnemers indien de samenwerkende landen het gedrag van de niet-deelnemers al hebben voorzien.

Verder laat ik zien dat samenwerking tussen twee grote landen (die al hoge tarieven hebben) leidt tot grotere verschillen in belastingstelsels in de wereld, de lappendeken wordt minder egaal. Als een gevolg worden de beslissingen van bedrijven ernstiger verstoord dan

voordat het samenwerkingsverband er was, meer bedrijven zullen zich gaan vestigen in het kleine land.

Tot slot laat ik zien dat de winst van samenwerking klein is voor kleine landen en veel groter voor grote landen. Kleine landen profiteren van concurrentie met het grote land, ze hebben weinig voordeel van samenwerking, temeer omdat ze relatief weinig last van elkaars competitieve beleid hebben. Grote landen zijn relatief meer geïnteresseerd in elkaar, de kleine landen doen er minder toe vanuit hun perspectief. Door samen te werken kunnen ze de kostbare onderlinge concurrentie bedwingen. Dit beantwoord de vraag welke landen zullen deelnemen aan het voorstel van de EC, de grote landen. Het is echter onduidelijk of dit gunstig zal zijn voor de welvaart in de EU als geheel.

Let wel, het resultaat gevonden in dit hoofdstuk is niet afhankelijk van versimpelde voorstelling van zaken. Het is enkel afhankelijk van het argument dat er een mate van verzadiging van belastingontvangsten moet zijn. Dit lijkt een acceptabele aanname. Alleen als dit niet zo is, zoals bij een overheid die belastingontvangsten maximaliseert, is het argument verdwenen.

Hoofdstuk 5: Belastingconcurrentie met zowel het statutaire tarief als de definitie van de belastingbasis

In het voorgaande hoofdstuk heb ik uitgelegd dat overheden niet per definitie de tariefswijziging in het buitenland volgen. Echter, het economische model dat hier aan ten grondslag aan ligt is erg simpel, er is enkel een statutair belastingtarief, dit terwijl realistische vennootschapsbelastingstelsels bestaan uit zowel een statutair tarief als een definitie van de belastbare grondslag. In dit hoofdstuk bestudeer ik de vraag hoe landen die verschillen in grote of waarvan de overheid verschillende doelstellingen heeft, verschillend reageren op tariefs- en grondslagwijzigingen in het buitenland. De belastinggrondslag wordt hier gemeten met de fractie van financieringskosten (rente en dividend) dat aftrekbaar is voor de belasting.

In de literatuur is hier nog geen gedetailleerde beschrijving van gegeven. Er zijn een aantal auteurs die gekeken hebben naar belastingconcurrentie in het geval overheden twee belastingtarieven hanteren, maar in deze modellen wordt doorgaans symmetrie tussen de landen aangenomen en wordt er niet naar de doelstelling van de overheid gekeken.

De belangrijkste aanname die ik voor deze analyse maak, is dat kleine landen gevoeliger zijn voor winstverschuiving door multinationals. De grote hoeveelheden winst die door multinationals over de wereld worden verplaatst zijn relatief groot ten opzichte van het binnenlandse bedrijfsleven voor een kleine economie. Het gevolg hiervan is dat kleine landen

relatief lage vennootschapstarieven kiezen ten opzichte van grote landen. Verder kiezen kleine landen een relatief smalle belastinggrondslag. Het argument hiervoor volgt uit eenzelfde redenatie als in hoofdstuk 3. Kapitaal investeringen reageren op de breedte van de belastinggrondslag omdat dit bepaalt hoeveel belasting er over de laatste geïnvesteerde euro moet worden betaald. Kleine landen hebben meer last van deze kapitaal verplaatsingen. Het eerste resultaat in dit hoofdstuk is daarom dat in een model met twee tarieven dezelfde conclusies gelden als in het simpele model van hoofdstuk 3. Dit is nog niet eerder vastgesteld in de literatuur.

In het kiezen van het optimale stelsel is er voor de overheid een tegenstrijdigheid. De overheid wil, om meer belastingontvangsten te genereren, de aftrekmogelijkheden beperken en een hoger tarief stellen. Echter, deze twee mogelijkheden om belastingontvangsten te genereren bijten elkaar. Als er minder aftrekbaar is, zal kapitaal uit het land vertrekken wat leidt tot een smallere belastinggrondslag voor het statutaire tarief. Deze smallere belastinggrondslag leidt tot een lager optimaal statutair tarief. Ook andersom geldt de tegenstrijdigheid. Het statutaire tarief bepaald hoeveel belasting ontvangsten verloren gaan als een gedeelte van de belastinggrondslag het land verlaat. Als het statutaire tarief wordt verhoogd, stijgen daarmee de kosten die de overheid ervaart bij het kiezen van de aftrekmogelijkheden. De overheid zal meer aftrek toestaan.

Ook tussen landen zijn de tarieven afhankelijk. Hier gelden dezelfde argumenten als aangehaald in hoofdstuk 3. Een hoger statutair tarief in het buitenland zorgt ervoor dat er winst naar het thuisland stroomt, hierdoor wordt het aantrekkelijk voor de overheid om haar statutaire belastingtarief te verhogen (deze belast pure winst). Tegelijkertijd verruimt het de aftrekmogelijkheden: smaller belastingbasis. Als in het buitenland de aftrekmogelijkheden worden beperkt, stroomt er kapitaal naar het thuisland, dit verhoogt niet alleen de winst in het thuisland, maar verbreedt de belastingbasis in het algemeen. Hierdoor overweegt de overheid om de effectieve belastingdruk te verhogen door zowel het statutaire tarief te verhogen als de aftrekmogelijkheden te verminderen.

De hierboven genoemde effecten worden beïnvloed door de doelstelling van de overheid en de grote van het land. Ik laat zien dat vooral kleine landen agressief reageren op tariefswijzigingen in het buitenland. Dit omdat de overheden in kleine landen worden geconfronteerd met een, vanuit het perspectief van het kleine land, grote toevlucht van kapitaal en/of winsten als gevolg van een belastingstelsel wijziging in een groot land. Verder reageert een overheid die puur alleen uit is op het maximaliseren van belastingontvangsten agressiever dan een overheid die vooral de welvaart van haar burgers wil maximeren. De eerste groep ziet alleen de verbreding van de belastingbasis en wil vanuit dit argument haar tarief verhogen om zo efficiënt mogelijk belastingopbrengsten te gene-

reren. De tweede groep overheden wordt echter geconfronteerd met twee argumenten die haar tegenhouden om het effectieve belastingtarief te verhogen. Aan de ene kant herkent deze overheid dat een hoger tarief niet alleen meer belastinggeld oplevert, maar het ook direct het inkomen van haar burgers treft. De overheid zal voorzichtiger opereren. Aan de andere kant geldt ook het argument dat in hoofdstuk 3 is geïntroduceerd nog steeds. Als de waardering voor belastingontvangsten daalt als gevolg van gestegen belastingontvangsten veroorzaakt door de instroom van winst en kapitaal, zal de overheid minder geneigd zijn haar tarief te verhogen, of misschien wel te verlagen.

Dit hoofdstuk heeft een nieuw model tot leven geroepen waarmee realistische belastingharmonisatie voorstellen kunnen worden geanalyseerd, het volgende hoofdstuk gaat hiermee verder.

Hoofdstuk 6: Hoe veranderen belastingstelsels in de EU onder het huidige voorstel van de EC?

Al het voorgaande leidt tot het hoofdstuk waarin ik een poging doe om de toekomst van de vennootschapsbelasting in de EU te bestuderen. De EC heeft in maart 2011 een voorstel ingediend dat moet leiden tot een uniformering van de belastinggrondslag in de EU. De landen die geïnteresseerd zijn in deelname kunnen toetreden tot een samenwerkingsverband die deze CCCTB zal introduceren. De overige landen blijven buiten het voorstel. Het model geïntroduceerd in het vorige hoofdstuk, met drie landen deze keer, helpt mij om een idee te vormen van hoe de deelnemers en de niet-deelnemers hun belastingstelsels zullen wijzigen. Dit is een ruwe voorspelling, omdat de CCCTB naast een geüniformeerde belastinggrondslag ook voorstelt om de geconsolideerde winsten van internationaal opererende bedrijven te verdelen via een verdeelsleutel. Deze laatste stap heb ik nog niet gemodelleerd. Verder maak ik de aanname dat de overheden belastingontvangsten maximaliseren en niet kijken naar de welvaart van haar burgers. Deze aanname vergemakkelijkt de analyse maar is, zoals eerder uitgelegd, niet zonder gevolg. Het is echter de doelstelling die de meeste economen (en beleidsbepalers) gebruiken in het analyseren van belastingconcurrentie.

Onder deze aannames bestuur ik het geval waarin twee landen samenwerken door gezamenlijk te beslissen welke kosten aftrekbaar zijn voor de vennootschapsbelasting. In vergelijking met de keuze die ze maakten voordat ze gingen samenwerken, zullen de samenwerkende landen minder aftrek toestaan. Dit omdat de overheden nu minder bang zijn voor het wegstromen van kapitaal uit hun gezamenlijk economie: de partner vermindert immers ook de toegestane aftrek. Toch zal er iets van kapitaal wegstromen en dit leidt

tot minder winst in de samenwerkende landen. Als reactie hierop zal de overheid haar statutaire tarief verlagen. De vermindering van de aftrekbare kosten is echter van een veel grotere orde.

Het land dat niet deelneemt wordt geconfronteerd met een grote toevlucht van kapitaal en een kleine uitstroom van winsten. Als reactie hierop verbreed ook dit land de belastingbasis door minder aftrek van kosten toe te staan. Verder zal het statutaire tarief worden verhoogd, omdat per saldo de belastingbasis is toegenomen door de toevlucht van kapitaal (zie ook het vorige hoofdstuk). Beide reacties zijn gunstig voor de samenwerkende landen, waardoor uiteindelijk alle landen, zowel de deelnemers als de niet-deelnemers, meer belastingontvangsten genereren.

Nu kan ik alle gestelde vragen, al dan niet bevredigend, beantwoorden. De deelnemers zullen kiezen voor een vennootschapsbelastingstelsel met minder belastingaftrek en lager statutair tarief. Ook de niet-deelnemers kiezen voor een stelsel met minder belastingaftrek maar met een iets hoger statutair tarief. Echter, vooral deze laatste conclusie moet misschien naar beneden worden bijgesteld als overheden de welvaart van hun burgers nastreven. Deze laatste nuancering bepaalt ook welke landen een welvaartswinst in het voorzicht kunnen zien. Dit is dus eigenlijk het fundamentele punt waar we helaas nog veel te weinig informatie over hebben.

Ik wil graag afsluiten met het subsidiariteitsbeginsel dat stelt dat de EU alleen die taken moet uitvoeren die het duidelijk beter kan uitvoeren dan de nationale overheden. Voor mij is het na vier jaar nog niet duidelijk dat de EU, met het huidige voorstel, voor een hogere welvaart voor de burgers in de EU zal zorgen. Een volledige geharmoniseerde vennootschapsbelasting zou dit misschien wel kunnen. Echter, het huidige voorstel is dit bij lange na niet, zelfs bedrijven mogen zelf kiezen of ze mee willen doen. De EC moet oppassen dat het niet een vennootschapsbelasting systeem creëert waarbij de winnaars van het belastingconcurrentie spel van vandaag, nog grotere winnaars morgen zijn. De les van belasting economie is dat slimmeriken (in bedrijven of in de overheid) de gaten in het systeem zullen vinden en gebruiken. Het huidige voorstel kent door politieke druk teveel gaten.

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