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AN INVESTIGATION OF THE COMPETITIVENESS HYPOTHESIS OF THE RESOURCE CURSE

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ABSTRACT

In this paper I investigate the competitiveness explanation of the resource curse: to what extent slow growth in primary producer countries is related to the properties of this pattern of trade specialization. To address this hypothesis that has not been adequately explored in the literature, I estimate cross-country and system GMM panel data regressions, using a sample of 49 developed and developing countries.

The empirical analysis explores most hypothetical explanations of the resource curse using a sensitivity approach and alternative trade specialization measures, elaborated with long-term trade disaggregated data, what constitutes an innovation regarding previous empirical work. The main findings of the paper are: i- that primary specialization hampers growth by reducing intra-industry trade and the dynamism of export demand, and ii- that it is the specialization in natural resource products with no or limited processing the one constraining economic growth, but not the specialization in industrialized resource products. Both facts support the competitiveness hypothesis of the resource curse and suggest that this growth paradox is linked to the limitations of resource abundant countries to diversify their tradable sector, and engage in the trade of products that facilitate the achievement of static and dynamic economies of scale.

Keywords

Economic growth, resource curse, pattern of trade specialization, returns to scale.

JEL Classification: F43, O13, O47

1 INTRODUCTION

In a series of papers Sachs and Warner (1995, 1997, and 1999) showed that natural resource abundance and trade specialization in primary products have a deterring effect for economic development. This is a historical and recurrent theme in economic theory. It has been emphasized by classical authors like Adam Smith and David Ricardo, by the first modern economist Alfred Marshall, and by some of the pioneers of development economics.

Classical economists distinguished primary from industrial production according to differences in their returns to scale, decreasing and increasing in one and the other case, arguing that specialization can lead to stagnation or continuous economic growth, correspondingly. On the other hand, authors in the field of development like Prebisch and Hirschman, encouraged economic diversification in primary producer countries to counteract the secular decline in the relative price of primary commodities and to create productive complementarities and thus incentives to productivity and economic growth.

By contrast to these authors who did not provide any empirical evidence, Sachs and Warner found a robust negative association between natural resource abundance and long-term economic growth, which is based on traditional cross-country regressions. This finding kicked off a significant number of studies of this `paradoxical' empirical regularity that is known as the curse of natural resources.

Recent research at a theoretical and empirical level concentrates on the channels and mechanisms through which natural resource abundance can jeopardize economic development. Different arguments have been proposed and explored empirically.[1] Some authors sustain that natural resource wealth reduces incentives for human capital investment and innovation efforts, whereas others call the attention to the role of economic policies, especially protective ones, and the (mal)functioning of institutions, due to incentives to engage in rent seeking activities.[2]

Yet, despite all the effort devoted to envisage and explore mechanisms through which natural resource wealth can constrain economic development, only limited empirical research investigated Sachs and Warner's competitiveness explanation of why resource abundant countries growth

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[1] See Serino (2004) and van der Ploeg (2006) for a recent and complete review of the arguments.

[2] Constrains for investment in human capital and innovation are emphasized by Gylfason (2001) and Gerlagh and Papyrakis (2005), whereas Sachs and Warner and Mansoorian (1991) concentrate on problems linked to economic policies. Relevant articles regarding institutional aspects of the resource curse are those by Auty (2001), Lane and Tornell (1999), Mehlum, Moene and Torvik (2005) and Murshed (2004). It is also worth noting that some authors also explored limitations on growth linked to the dynamism of primary commodity prices, whether its declining trend or how its volatility promotes an unstable macroeconomic environment that prevents productive investment (De Ferranti, Lederman and Maloney, 2001).

slower than countries with different structural characteristics. This is a dynamic Dutch disease story where having a clear static comparative advantage in primary production, due to abundant or highly productive natural resource endowments, prevents the emergence of other tradable sectors where activities conductive to high economic growth take place.[3] This other tradable sector is the manufacturing or industrial one, where the accumulation of human capital, which spills to the rest of the economy to promote fast economic growth, principally occurs.

Indeed, the argument reproduces the sectoral distinction already put forward by classical economy and development theorists, and is in line with some of the insights of new trade theory and with the ideas developed by Keynesian authors, like Kaldor or Thirlwall. According to these views, it is the pattern of specialization, the way in which a country participates of international trade, and not just trade what matters for economic development.

On the one hand, new trade theory highlights positive supply-side effects of trade in specialized industrial goods for economic growth, because it facilitates the achievement of static and dynamic economies of scale.[4] On the other hand, Kaldor (1981) and Thirlwall (2002) call the attention on both supply and demand aspects of the pattern of specialization. As explained by Amable (2000), specialization in industrialized (primary) products is considered a superior (inferior) pattern of international specialization, because its larger (lower) price and income foreign trade elasticities lead to strong (weak) aggregate demand, which in turn induces fast (slow) productivity and economic growth through cumulative causation processes. (Amable, 2000, p.413)

Taking into account these insights, my purpose in this paper is to further investigate the competitiveness explanation of the curse of natural resources, and, in so doing, fulfil a gap in the empirical literature.[5] The empirical analysis will circle around the following points:

1. the relevance of the transmission mechanisms of the resource curse suggested by the literature.
2. the importance of omitted distinction of natural resource products according to their degree of processing;

And the significance of two transmission channels supporting the competitiveness hypothesis,

3. the limited dynamism of primary products,
4. and the inability of primary producer countries to adapt to the trends of world demand and/or engage in specialized trade of industrial products.

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[3] Matsuyama (1992) and van Wijnbergen (1984) are other authors that developed multisectoral models that also emphasize this point.
[4] See for instance the pioneering article by Krugman (1979) or a more recent work by Ros (2001).
[5] Besides the papers by Lederman and Maloney (2002, 2003), no other authors, to my knowledge, studied systematically this transmission channel.

To address these issues, I extend the conventional sensitivity analysis of the resource curse in a number of ways. In the first place, I use long-term trade disaggregated data from UN's COMTRADE and CEPII's CHELEM databases to construct alternative and more sophisticated product classifications and trade specialization measures. These are considered to be more informative about the presence of a competitiveness channel than commonly used trade shares.

In the second place, I extend the competitiveness story testing the sensibility of primary specialization variables to the inclusion of trade specific indicators of inter and intra-industry trade and the dynamism of world demand, which reflect the hypotheses about the role of the pattern of specialization for economic growth discussed above and stated in points (3) and (4).

The final extension to previous work on the resource curse is that I use a panel data of 49 developed and semi-industrialized countries, covering the relatively extensive period 1960-2005. This database has two important advantages. First, it allows me to elucidate if slow growth only affects poor or underdeveloped countries or is rather a more general problem, affecting most resource abundant countries. Second, it allows me to implement system GMM estimations, in addition to cross-country regressions. This panel data technique contributes to reduce endogeneity problems characteristics of growth regressions, augmenting the robustness of econometric results.

The paper is organized as follows. In section 2 I focus on methodological issues. I first briefly discuss some of the pros and cons of different econometric techniques and justify my option for conventional cross-country and system GMM panel data ones. Subsequently, I explain the sensitivity analysis and I describe the different primary specialization measures and trade specific indicators used in the paper. Section 3 is devoted to the econometric analysis. After presenting evidence of the negative association between economic growth and trade specialization in natural resource products, I explore and find evidence which supports the competitiveness explanation of the resource curse. In section 4 I summarize the results and conclude stressing the need of trade diversification as a mechanism to avoid the resource curse.

2 METHODOLOGY

2.1 Growth econometrics

Most empirical studies of the resource curse estimate regressions of the extended neoclassical model, like the one described in equation (1) below

(1) $$\dot{y}_{j,p} = \ln Y_{j,p} - \ln Y_{j,t-1} = \beta \ln Y_{j,t-1} + \psi S_{j,p} + \alpha R_{j,p} + \varepsilon_{j,p}$$

In equation (1) $y_{j,p}$ *dot* is the log difference of per capita GDP in period *p*, which extends from year t_{-1} to year *t*, and $\ln Y_{j,t-1}$ denotes income at the beginning of the period and is associated to the convergence coefficient β. Among the other right hand side (RHS) variables, researchers include traditional Solow regressors like population growth and variables related to physical and human capital accumulation, all summarized by $S_{j,p}$ in the equation.

When, as in our case, the purpose of the analysis is the exploration of growth determinants, or deterrents, and not to discuss the problem of convergence, empirical studies include additional variables, which are considered to be shifters of the aggregate production function. As explained by Durlauf, Johnson and Temple (2004), in these studies, to which the empirical resource curse literature belongs, the main idea is to investigate to what extent a particular hypothesis finds support in data. Hence, depending on the underlying theoretical model, additional variables included in the growth regression can refer to a vast and different number of phenomena, such as technology, trade, endowments, economic policies or institutions.

In equation (1) most feasible production shifters are represented by $X_{j,p}$ and our variable and hypothesis of interest, associated to natural resource abundance and specialization in primary production and their hypothesized jeopardizing effects for economic development, are symbolized by $Rj_{,p}$.

Two well-known limitations of cross-country growth regressions which deserve especial attention, given that they can give place to biased coefficient estimates, are endogeneity problems associated to reverse causality and the omission of relevant variables. The problem arisen due to the mutual determination of output and the regressors is usually addressed using initial or lagged regressors. Hence, although in equation (1) variables *S*, *X* and *R* are presented as period variables (with a *p* subindex), they are commonly measured at t_{-1}, or are lagged variables measured in previous periods of time.

Alternatively, as many authors do, the problem can be solved instrumenting the variables which are most likely to experience a two way relationship with output growth, such as for instance investment or institutions. This procedure, however, must be taken with care due to the difficulties of finding an appropriate instrument, given that even geographical variables are correlated with the dependent variable (Durlauf, et al. 2004).

Inconsistent estimates due to omitted variables can also occur in a regression like (1) because the natural resource coefficient can be reflecting the effects of other time-invariant country characteristics, not captured by other regressors. This problem can be addressed using regional or other relevant dummy variables, which is among the procedures preferred by Temple (1999), or using a panel data of countries and specific panel data econometric techniques.

As explained by Lederman and Maloney (2002), taking into account the problem of omitted variables implies that equation (1) has to be redefined and include a country specific effect, as that denoted by μ_j in equation (2) below.

$$(2)\quad \dot{y}_{j,p} = \ln Y_{j,p} - \ln Y_{j,t-1} = \beta \ln Y_{j,t-1} + \psi S_{j,p} + \alpha R_{j,p} + \mu_i + \varepsilon_{j,p}$$

Working with panel data can contribute to solve the two econometric problems mentioned above. A first possibility, recommended by Temple (1999), is to run pooled OLS regressions. With this technique, one must use initial or lagged variables to prevent problems associated to reverse causality, as in traditional cross-country regressions, and take advantage of the increased number of observations to include a significant number of regional dummy variables to capture the effects of variables not explicitly taken into account and which may bias the results.[6]

A second possibility, which addresses especially the problem of omitted variables, is to use Within Groups estimates, whether running fixed-effects regressions or differentiating equation (2). These techniques, however, have their own limitations as well. On the one hand, because regressions using fixed-effects eliminate most of the variation in the data and give coefficient estimates seriously biased downwards (Bond, Hoeffler and Temple, 2001). On the other hand, because in growth regressions differentiating to eliminate the country specific effect creates endogeneity problems specific to dynamic panel data models. Taking first differences of equation (2) it is possible to discuss the problem in more detail.

$$(3)\ \dot{y}_{j,p} = \ln Y_{j,p} - \ln Y_{j,t-1} = (1+\beta)\,\Delta \ln Y_{j,t-1} + \psi \Delta S_{j,p} + \alpha \Delta R_{j,p} + \Delta \varepsilon_{j,p}$$

In equation (3) Δ denotes first differences, with $\Delta \ln Y_{j,t-1}$ being the difference between $lnY_{j,t-1}$ and $lnY_{j,t-2}$, and the difference between the present and previous periods (p and p_{-1}) applying to the other variables and the error term. Although in equation (3) we no longer have the country specific effect μ_j and therefore no endogeneity problems due to omitted variables, this problem persists because $lnY_{j,t-1}$ is correlated with $\Delta\varepsilon_{j,p-1}$, and a similar correlation, and hence same source of endogeneity, can also take place between other regressors and the error term.

There are two econometric methodologies which allow researchers to overcome the problems associated to the presence of μ_j and the lagged dependent variable as a regressor, as well as other biases arisen due to measurement errors and the correlation between explanatory variables and the error term. One technique is the first-differenced General Method of Moments (GMM) panel data estimator developed by Arellano and Bond (1991), which uses lagged levels of RHS variables, dated t_{-2} or earlier, as instruments of the differentiated regressors of equation (3).

Because variables in level tend to be poor instruments for differenced variables, this methodology has proven to be deficient in growth regressions. Hence, Bond et al. (2001) recommend using the alternative system GMM methodology. As explained by Lederman and Maloney (2003), "the system GMM rescues some of the cross-sectional data that is lost in the differenced GMM estimator by estimating a system of equations that also includes equation (2) in levels, but with lagged differences of the endogenous variables

[6] To control for autocorrelation and heteroskedasticity one can implement Feasible Generalized Least Squares, though these problems and econometric technique are principally recommended to be used with panels where t is larger than j.

as instruments" (Lederman and Maloney, 2003, p.8). The system GMM thus estimates equations (2) and (3); with equation (3) instrumented using lagged level variables dated t_{-2} or earlier, as before, and equation (2) instrumented using differenced variables dated at t_{-2}. The additional information provided by equation (2) reduces the downward bias found in the first-differenced GMM method, providing better coefficient estimates, while solving endogeneity problems.

In the empirical analysis that follows, I use the least problematic econometric techniques, according to this overview of growth econometrics: traditional cross-country and system GMM panel data regressions.

2.2 Other methodological issues

Sensitivity analysis and alternative trade specialization classifications and indicators

I implement a sensitivity analysis, to investigate if the resource curse is due to competitiveness handicaps of resource abundant countries, as predicted by dynamic Dutch disease models. In this approach, first developed by Levine and Renelt (1992) and widely applied in the empirical resource curse literature, I define a *basic regression* that includes: traditional Solow regressors, i- initial income, and proxies for ii- physical, and iii- human capital accumulation, and iv- a proxy for natural resource abundance or a primary specialization variable. In terms of the previous equations, the *basic regression* includes variables $Y_{j,t-1}$, S and R.

Once identified the effect of the primary specialization variable on economic growth with this *basic regression*, I add additional control variables to check if the impact of our variable of interest, the trade specialization one, continues to be statistically significant and there are no major changes in the magnitude of its effect. In empirical studies of the resource curse, additional control variables are alleged mechanisms through which having abundant natural resources can have an indirect negative effect on economic growth. Commonly, these transmission mechanisms, summarized by variable X in previous equations, are: v- the evolution of the external terms of trade (after Prebisch-Singer hypothesis), vi- macroeconomic instability, linked to the volatility of primary commodity prices, and vi- the functioning of the institutional system, expected to be deficient due to incentives for rent seeking.

A primary specialization coefficient a that holds constant and statistically significant after the inclusion of X variables means that the variable is robust and that its effects on economic growth run through channels that are different to those captured by X. Indeed, Sachs and Warner conclude, from a situation like this, that the alternative transmission channel is no other than the competitiveness one. Absent other sensible and empirically significant hypothesis of the resource curse, this default favouritism for the competitiveness story can be accepted. Nevertheless, I consider that the validity of this channel should be further explored. To do this, which as mentioned in the introduction is the main purpose of the paper, I extend the sensitivity econometric analysis in three different ways, which, to my knowledge, have not been explored yet by the literature on the resource curse.

First, I estimate growth regressions using alternative measures of trade specialization in primary products. I use Sachs and Warner's natural resource export shares (*SXP* and *PXI*) but also other export classifications which, in theory, should capture the competitiveness channel better than these other two traditionally used. If the structure of trade matters for economic development, due to different supply and demand dynamism and returns to scale of primary and industrial products, I hypothesize that econometric results must then be sensitive to the distinction between unprocessed and manufactured natural resource products. This difference is absent in Sachs and Warner's classification, because their broadly defined classification aggregates all natural resource products, irrespective of their degree of processing.

To address this point, I use trade disaggregated data for the period 1962-2000 provided by UN's COMTRADE database. Thanks to the work of Feenstra, Lipsey, Deng, Ma and Mo (2005), which converted SITC Rev 1 codes to SITC Rev 2, it is possible to obtain long-term trade data classified according to the CTP-DATA taxonomy used in the SELA study (1994) and by Peirano and Porta (2000). This classification follows the taxonomy proposed by Pavitt (1984) and adapted from industries to commodities by Gurrieri (1992, cited in Peirano and Porta, 2000), and classifies natural resource products as: i- primary products (*PP*), and ii- manufactured or industrialized natural resource products (*MNR*), which differ in their degree of processing. *Table I* below provides a summarized description of the products considered in each category and *Table A.III* in the appendix compares this classification to Sachs and Warner's one, showing how their natural resource variable includes many industrialized products.

TABLE 1

CTP-Data export classification

PP	Meat, fish and animal foodstuff; cereals and edible and non-edible agricultural products; unprocessed tobacco; raw hides, leather and skins; silk, jute and other textile fibers; natural rubber and cork; crude minerals; iron and other mineral ores; coke, coal, crude oil and natural gas; refined petroleum and related products.
MNR	Meat, fish and other animal food products; beverages and manufactured tobacco; preserved fruit, vegetables and related preparations; sugar products; cereal products and other edible products and preparations; vegetable and animal oils and fats; pulp, paper, paperboard and related products; articles in wood and rubber; basic organic chemicals and manufactured fertilizers; inorganic chemicals; hydrocarbons and derivatives; synthetic rubber and fibers; precious and semi-precious stones; non-ferrous metals

Based on SITC Rev 2 at 3 digit-level

The second extension to previous work is that I run the growth regression using more specific indicators of trade specialization in the different commodity groups recently identified. To the extent that these indices consider different aspects of trade, like for example market penetration efforts, they are also considered to be more informative of the presence of a competitiveness channel of the resource curse than trade shares. One of these indices uses CEPII's primary commodity classification (*PRI*), as defined in CHELEM's database, which is similar to CTP's commodity group with no or limited processing (*PP*). (See *Table A.3*)

CEPII's comparative advantage indicator is one of the more elaborated measures of trade specialization in natural resource products. This is defined as

$$TDIV_{ij} = \left[\left(\frac{X_{ij}}{\sum_{i=1}^{n} X_{ij}} \right)_{t+1} - \left(\frac{X_{ij}}{\sum_{i=1}^{n} X_{ij}} \right)_{t} \right] \times \left[\frac{X_{ij}}{\sum_{j=1}^{n}} \right]_{t+1} \times 100$$

where, X, i, j and t as before. The index shows the change in exports shares of a particular product i, between years t and t_{+1}, and the market share of the country's exports of the commodity group under consideration. In this way, the index takes into account the performance of the country in terms of export diversification and its performance relative to other countries. In other words, it considers changes in the pattern of specialization of a country and its market penetration efforts or comparative trade performance.

In the third place, I extend the sensibility analysis adding other trade specific measures to the growth regression and studying the response of the natural resource or primary specialization variable *R*. These indicators are obtained from CEPII's CHELEM database, which, like COMTRADE, provides long-term disaggregated data, and intend to reflect phenomena like the dynamism of world demand and the importance of intra-industry trade. The addition of these variables to the growth regressions is expected to illustrate if the resource curse is linked to `increasing returns and all that', the expression proposed by Treffler and Wener (2002) to refer to the dynamic benefits of trade.

To study if the slower economic growth of resource-rich countries is associated to the low international demand of its exported products, as predicted for instance by Engels law, I employ the trade dissimilarity indicator (TRDI) used in the papers of Amable (2000) and Busson Villa (1997). The index is defined below

$$TRDIj = \frac{1}{2} \sum_{1<i<N} \left| \frac{X_{ij}}{X_{j}} - \frac{X_{i.}}{X..} \right|$$

where $0 \leq TRDIj \leq 1$. It compares the pattern of specialization of country j with the characteristics of world demand. A high value of *TRDIj* indicates that a country specializes in goods with low international demand, whereas a low value of indicates that exports from country *j* are in line with trends in international trade. *Figure A.1* in the appendix shows the average value of the index for the period 1967-2005, and illustrates how, as expected, resource abundant countries like Algeria, Ecuador, Nigeria and Venezuela have a pattern of specialization which is at odds with international demand.

In addition, I use Michaley's index of inter-industry trade.

$$MICLYj = \frac{1}{2}\sum_{1<i<N}\left|\frac{X_{ij}}{X_j} - \frac{M_{ij}}{M_j}\right|$$

This measures attempts to capture if the economy has clearly defined export and import industries; the higher the value of *MICLYj*, the more dissimilar are trade balances between industries, and the opposite is the case of low values of *MICLYj*. With trade disaggregated in 71 commodity groups, a high value of the index is interpreted as an indication of trade specialization according to static comparative advantages, whereas low values are considered to reflect the presence of intra-industry trade, which facilitates the achievement of scale and specialization economies and contributes to economic growth. As we can see in *Figure A.2* in the appendix, the high value of the index in most resource abundant countries clearly illustrates their difficulties to engage in intra-industry trade.

Sample, other variables definitions and data sources

The analysis is carried out using a sample composed of the 49 countries for which CHELEM's database provides long-term trade information dating back to mid-sixties. The sample is principally composed of developed and middle-income countries (see Table A.I in the appendix for the list of countries). Since the sample does not include neither middle-east oil exporters nor many African countries, two relevant groups of resource abundant countries, it complements other studies and contributes to understand if the resource curse is only a problem of some developing countries or, by contrast, is of a more general nature.

Using this information I construct two databases. A conventional one to perform cross-section type growth regressions, covering the period 1960-2005. A(n unbalanced) panel database composed of five-year periods panels extending from 1960 to 2005 to be used for system GMM estimations. This second database is composed of 9 panels, a large number in comparison to other works.[7]

The data is obtained from various databases, as described in Table A.II in the appendix summarizing variable definitions and data sources. Information on economic growth, trade and the exchange rate is obtained from CHELEM's database, additional trade information is obtained from UN's COMTRADE and World Bank's WDI databases, with the later also providing information about investment and the external terms of trade. Human capital information is taken from Barro and Lee database, whereas Sachs and Warner's database provides information about trade openness and other control variables considered in cross-country regressions, linked to the terms of trade, volatility and institutions. Due to lack of data for the rule of law, in the panel database I use a combined polity score that captures the degree of openness and closeness

[7] It should be noted, however, that information does not exist for some variables in all the 9 periods.

of political institutions, as the institutional variable. This long-term institutional data is part of the Polity IV project, produced by the Centre of International Development and Conflict Management.

3 ECONOMETRIC ANALYSIS

3.1 Is there a curse of natural resources?

I kick off the empirical analysis with the cross-country approach which is tradition in empirical studies of the resource curse, with regression results summarized in *Table II* below. Results in columns (1) and (2) represent the *basic regression* of the sensitivity analysis, which includes initial income ($ln\ Y_{t-1}$), the log of physical and human capital accumulation (*ln INV* and *ln HK*)[8] , and Sachs and Warner's primary specialization measures: the share of primary exports on national income (*SXP*) and primary exports as a percentage of total exports (*PXI*). Regressions (1) and (2) predict conditional convergence, given that countries with a lower income level grow faster, accumulation variables have the expected positive contribution to economic growth, and all variables are statistically significant. A relevant point to note is that all variables included in the basic regression are measured at the beginning of the period to prevent endogeneity problems associated to reverse causality.

As hypothesized in the introduction, our variable of interest, the primary specialization one, constrains economic growth. According to the *basic regression*, a one percent increase in *SXP* reduces the predicted growth rate by 2.5 percent, other things being equal, whereas the reduction in economic growth is of 1 percent if resource abundance is measured by *PXI*. Although the two measures are statistically significant, I elaborate the sensitivity analysis using *PXI* because is the most significant variable and the one that gives the regression with the highest R-square.

Following what is tradition in the literature I include in the regression variables which are transmission mechanisms of the resource curse, and analyze how the primary specialization coefficient responds to the inclusion of these variables. To control for the alleged propensity of resource abundant countries to implement protective policies to promote full-employment, in the first place I test if the previous result holds after including a measure of openness to trade. As shown in regression (3), which uses Sachs and Warner's openness measure, this is actually the case.

[8] In cross-country regressions I use Sachs and Warner's human capital variable, the rate of secondary school enrolment in 1970, and average years of schooling in the panel estimations. I do this: i- to avoid loosing three observations in cross-country regressions, and ii- to use similar variables to those employed by Sachs and Warner. Cross-country regressions display similar results using one or another variable and are available on request to the author.

TABLE II
Natural resource abundance and economic growth.

Dependent variable Δln Yj,t (ln Yj,2005 - ln Yj,1960)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Regressors							
Benchmark regression / Basic regression	**ln *Y* $_{t-1}$**	-0.568 ***	-0.597 ***	-0.597 ***	-0.693 ***	-0.688 ***	-0.676 ***	-0.652 ***
		(0.098)	(0.085)	(0.087)	(0.085)	(0.087)	(0.094)	(0.146)
	ln *INV* $_{t-1}$	1.143 ***	0.643 ***	0.624 ***	0.64 ***	0.675 ***	0.65 ***	0.658 ***
		(0.208)	(0.228)	(0.211)	(0.208)	(0.214)	(0.212)	(0.206)
	ln *HK* $_{t-1}$	1.935 ***	1.431 ***	1.074 ***	0.951 ***	0.87 **	0.855 ***	0.393
		(0.555)	(0.381)	(0.316)	(0.347)	(0.333)	(0.340)	(-0.397)
	SXP $_{t-1}$	-2.486 *						
		(1.264)						
	PXI $_{t-1}$		-1.057 ***	-0.766 ***	-0.648 ***	-0.611 ***	-0.596 ***	-0.453 **
			(0.205)	(0.192)	(0.206)	(0.197)	(0.202)	(0.209)
	SOPEN $_{p}$			0.435 ***	0.29	0.347 *	0.323	0.28
				(0.150)	(-0.182)	(0.200)	(-0.225)	(-0.214)
	INST $_{t-1}$				0.099 *	0.094 *	0.088	0.08 *
					(0.054)	(0.054)	(-0.052)	(0.047)
	VOLRER $_{p}$						-0.875	0.152
							(-2.11)	(-2.598)
	GTOT $_{p}$					-0.155	-0.135	-0.231 *
						(-0.122)	(-0.126)	(0.130)
	D_AF							-0.487 *
								(0.257)
	D_LAC							-0.324
								(-0.237)
	D_ASIA							-0.061
								(-0.257)
	Observations	**49**	**49**	**49**	**49**	**49**	**49**	**49**
	Adjusted R-squared	**0.43**	**0.6**	**0.65**	**0.68**	**0.68**	**0.67**	**0.69**

Robust normalized standard errors in parentheses
* significant at 10%; ** 5% and *** 1% level

Secondly, I take into account another relevant transmission mechanism that received much attention from the literature: the institutional one. As stressed by van der Ploeg (2006), natural resource abundance is considered to be a curse only in countries with deficient institutions, but it does not affect other developed and developing countries like Australia, Botswana, Chile or Norway, characterized, among other things, by their abundant natural resources, efficient government, the respect of property rights and limited corruption. To analyze this point, regression (4) includes Sachs and Warner's proxy for the functioning of the institutional system. Adding a measurement of the respect for the rule of law creates a small reduction in the value of *PXI*, suggesting that institutions can, to some extent, mitigate the negative effect of resource abundance. Yet, by contrast to the findings of Gerlagh and Papyrakis (2004) and Mehlum et al. (2005), the negative association between economic growth and the intensity of a country's primary specialization is as significant as in the previous regressions without an institutional variable. The analysis of transmission mechanisms must go on.

Therefore, in regression (5) in *Table II* I include a variable measuring growth in the external terms of trade (*GTOTp*) between 1960 and 2000. The lack of change in the magnitude of PXI and its statistical significance suggest that *PXI* is not reflecting Prebisch-Singer's terms of trade hypothesis, reproducing the results from Sachs and Warner's (1997) preferred regression.

To cover most of the transmission mechanisms identified in the literature I add to the regression a measure of macroeconomic volatility: the standard deviation in the annual change of the real exchange rate (*VOLRERp*). The inclusion of this variable defines the *benchmark regression* to be subsequently used in the analysis.

As shown in regression (6), also after taking into account all these possible indirect effects the degree of primary specialization of a country has a highly statistically significant negative effect on economic growth. Although the magnitude of the effect has been reduced, in comparison to regression (2), values in column (6) suggest that there are still other ways through which natural resource abundance reduces the rate of growth of an economy. For example, the competitiveness story emphasized in the pioneering articles by Sachs and Warner and to be further explored in this paper.

A final point to note before moving to this issue is that previous results holds after the inclusion of regional dummy variables for African, Latin American and Asian countries (see column (7)) and for the shorter growth period 1970-1990, what I consider as a robustness sign of the results.[9]

3.2 Exploring the competitiveness explanation of the resource curse

In this section I explore the competitiveness explanation of the resource curse. Aware of the limitations of traditional cross-country regressions, in the analysis that follows I also make use of the panel database to run system GMM regressions. This is a technique that has been lately used in empirical analyses of growth, which serves to control that the results are not driven by any omitted variable and, as stressed by Bond et al. (2001), contributes to reduce other endogeneity problems arisen from reverse causality or the presence of measurement errors. In addition, the combination of different econometric approaches undoubtedly makes the results more robust.

In what follows I take regression (6), which includes most of the alleged channels of the resource curse, as the *benchmark regression*. Cross-country regressions also include regional dummy variables, and I use a variable measuring the openness of political institutions as the institutional variable in panel data estimations.

A relevant issue in system GMM estimations is the distinction between endogenous and predetermined variables, the former instrumented with the GMM estimator. I treat accumulation, volatility, the terms of trade and trade specialization variables as endogenous variables, and openness to trade and the external terms of trade as predetermined or exogenous variables. To construct

[9] For reasons of space, I do not present the results from the regression which considers a different time span. This is however available on request.

the GMM estimator, I use lagged level information dated *t-2* and earlier as instruments for the endogenous variables of the differenced equation (3), and lagged differences dated *t-2* as instruments for the endogenous variables of the level equation (2). It should be noted that, to avoid spurious significance, I do not use all lagged level information, as Bond et al (2001) do, but only data dated at *t-2* and *t-3*.

A comparison of alternative primary specialization variables

I start the analysis comparing Sachs and Warner's *PXI* to alternative measures of primary specialization. As mentioned in previous sections, one of the main concerns of the analysis is to what extent a broadly defined variable like *PXI* can capture the sectoral differences in returns to scale that underlie supply-side arguments of the competitiveness hypothesis of the resource curse. To address this point, I also run the *benchmark regression* with export shares classified as primary products, with no or limited processing, and as manufactured or industrialized natural resource products, using the CTP-Data classification. The hypothesis underlying this distinction is that I expect specialization in primary products, which are subject to decreasing returns to scale, to have growth hampering effects, but there is no a priori reason to expect a similar outcome in countries that process their natural resources. This is because, like any other industry, processing industries can benefit from the implementation of human capital and innovation methods and the achievement of scale and specialization economies.

Results are shown in *Table III* below, which only presents the basic statistics (magnitude of the coefficient, standard error, statistical significance and validity tests) of the natural resource variables included in the *benchmark regression*, which are estimated using cross-section and system GMM econometric methods. Complete tables including all regressors are presented in the appendix (see *Table A.IV.a* and *Table A.IV.b*). Following Arellano and Bond (1991), I use the one step procedure to estimate the coefficients of the regression and the two steps to calculate the validity tests.

As we see in the table, *PXI* has the expected negative and statistically significant effect.[10] Regressions taking into account the distinction of natural resource products according to their degree of processing confirm our previous hypothesis. Specialization in primary products, as captured by *PP*, has a negative impact on economic growth, an effect that is larger and as statistically significant as the one associated to *PXI*. (See row (3))

On the contrary, it is not clear what the effect that specializing in *MNR* has for economic growth, as coefficient α is positive in cross-country regressions and negative in panel data ones. In neither case, the effect is statistically significant. (See row (4))

[10] That is not the case, however, of variable SXP, Sachs and Warner's preferred natural resource variable, which is not statistically significant.

TABLE III
Natural resource abundance and economic growth. Comparisson of alternative trade specialization measures

		Cross-country		GMM system		
Dependent variable		n $Y_{j,2005}$ - ln $Y_{j,196}$		(ln $Y_{j,t}$ - ln $Y_{j,t-1}$)		
		R coeff	Adj R2	R coeff	Sargan	AR(2)
	TRADE SHARES					
	Sachs and Warner's trade shares in the benchmark regression					
(1)	***SXP***	-1.00	0.75	-0.08	0.26	.657
		(-0.14)		-0.11		
(2)	***PXI***	-0.45 **	0.76	-0.06	0.25	0.77
		(-0.25)		(0.033) *		
	CTP's trade shares a/ in the benchmark regression					
(3)	***PP***	-0.70	0.68	-0.08	0.44	0.94
		(0.275)**		(0.033) **		
(4)	***MNR***	0.20	0.71	-0.04	0.29	0.96
		-0.39		-0.09		
	TRADE SPECIALIZATION MEASURES					
	Estimations using the benchmark regression					
(5)	$CA_{PRI,p}$	-0.470 ***	0.82	-0.03	0.33	0.92
		(-0.41)		(0.015) **		
(6)	$TDI_{PP,p}$	-0.25	0.69	-0.09	0.41	0.97
		(0.133)*		-0.06		
(7)	$TDI_{MNR,p}$	-0.03	0.66	0.06	0.31	0.81
		(0.018) *		-0.06		

Robust normalized standard errors in parentheses
* significant at 10%; ** 5% and *** 1% level
NOTES
Control variables included in cross-country regressions:
ln Y_{t-1} ln Inv_{t-1} ln HK_{t-1} $SOPEN_p$ $VOLRER_p$ $GTOT_p$ $INST_{t-1}$ D_Reg_j
Predetermined variables in the SYS-GMM: SOPENp GTOTp D_t
Endogenous variables in the SYS-GMM: ln Y_{t-1} ln INV_P ln HK_P $VOLRER_P$ $INST_P$ and

All endogenous variables are used as instruments in the SYS-GMM. For the differenced equation of the SYS-GMM, instruments are level variables dated at t-2 and t-3, whereas instruments used in the level equation are differences dated at t-2
/a CTP-DATA trade shares are measured at the beginning of the period in cross-country regression and as average of the five year panel in SYS-GMM regressions

As shown in the last two columns of the table, which summarize the validity tests, GMM estimations are well behaved. In all cases we reject the hypothesis of second order autocorrelation, which will invalidate the use of instruments dated at *t-2*, and also in all cases we accept the null hypothesis of no over-identifying restrictions that suggests that the instruments used in the GMM are valid.[11]

To complement the analysis, I test the distinction of resource products according to their degree of processing using more specific trade specialization measures. With this purpose, I run the growth regression using the measure of

[11] As a further check for autocorrelation I estimated the system GMM with instruments starting at period *t-3* and obtain the same qualitative results. These regressions are not presented in the paper but are available on request to the author.

comparative advantage in CEPII's primary products (CA_{PRI}), a commodity group which is similar to the group of unprocessed natural resource goods (*PP*) (see *Table A.III*). This variable is estimated as an average of the period 1967-2005 in cross-country regressions and as averages of the five year periods that constitute the panel database. As shown by the regression summarized in row (5), using a more elaborated index of primary specialization, which considers sectoral and global trade deficits relative to the size of the economy and the importance of primary products in world trade, it becomes clear that a specialization with no or limited processing has significant jeopardizing effects for economic development.

Similarly, I also assess the difference between unprocessed and processed natural resources using variable TDIV, the trade diversification index that considers changes in export compositions and market shares. As shown in row (6), the estimation suggests that shocks promoting diversification in unprocessed natural resource products will hamper long-term economic growth, though this effect is only statistically significant in cross-country regressions. Like in the previous regression, the effect is not clear when it comes to diversification in industrialized resource products, like for instance agro-industries (see row (7)); and once more, GMM validity tests suggest that estimations were run correctly.

In sum, it is possible to say that the analysis in this section confirms the hypothesis that it is the pattern of specialization with no or limited processing the one that can engender a resource curse, whereas there is no apparent evidence of growth failure in countries that upgraded and diversified within natural resource products.

Do supply and demand characteristics of the pattern of specialization contribute to explain the resource curse?

To conclude the empirics of the paper I study the sensitivity of natural resource export shares to the inclusion of alternative trade indicators in the *benchmark regression*. In search of more evidence related to the presence of a competitiveness channel, the sensitivity analysis intends to provide an answer to the last two points emphasized in the introduction. Point (3) linking the resource curse to the inability of natural resource goods exporters to follow the trends of world trade and promote aggregate demand and productivity growth. And point (4) associating slow growth to the limitations of these countries to engage in trade of specialized industrial products that facilitates the achievement of static and dynamic economies of scale.

In *Table IV* below I present and summarize the empirical information used for the sensitivity analysis. Yet, as a prior step to this analysis, it is convenient to look at the evidence provided in *Table V* at the end of the section, where I present information about the relation between economic growth and variables *TRDI* and *MICLY*. These are the two measures capturing attributes of the pattern of specialization that I take into account to further explore the competitiveness hypothesis, as stated in points (3) and (4). In line with the predictions from new trade theory and Keynesian authors, the negative coefficient for these two variables indicate that the capacity of countries to adequate to world demand and to participate of intra-industry trade improves their economic performance, though the effect is only statistically significant in the case of *MICLY* (see rows (6) and (7) in the table).

It is possible now to return to the sensitivity analysis and Table IV, which displays the results of the regressions that include the primary specialization variable (*PXI* and *PP*) and the alternative indices *TRDI* and *MICLY*, in addition to other control variables. The table presents only relevant statistics for the primary specialization variable (coefficient, standard error and GMM validity tests). Figures in grey show the value of the natural resource coefficient in the benchmark regression, to which I compare the new estimations to perform the sensitivity analysis. New values of the natural resource coefficient are presented below the benchmark regression, and include within brackets the name of the pattern of specialization measure that was added to the regression (*TRDI* and *MICLY*). As before, complete tables with information for all regressors are left for the appendix.[12]

As it is thus possible to see in rows (2) and (3), Sachs and Warner primary specialization variable *PXI* is sensible to the inclusion of alternative trade indicators. It is no longer statistically significant once we consider the adequacy of a county's exports to the pattern of world demand, and the magnitude of the negative effect of *PXI* is significantly reduced in system GMM estimations (see row (2)). The same occurs with the inclusion of Michaely's index, with the reduction in the magnitude of *PXI* being large in the cross-country regression as well. Whereas in GMM estimations the negative effect of *PXI* is reduced by more than a half, in cross-country regression the effect decreases by one third (see row (3)). This suggests that having clearly defined export and import industries, what I read as a sign of lack or limited intra-industry international trade, can be considered as one of the factors causing the resource curse.

I perform the same sensitivity analysis using variable PP, the share of unprocessed resource products, as shown in the bottom half of Table IV.[13] Empirical results are similar to those concerning Sachs and Warner's specialization measure. There is a reduction in the magnitude of the natural resource coefficient, which in general ceases to be statistically significant, especially when the variable that is added to the regression is the one capturing the importance of intra-industry trade.

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[12] See *Table A.IV.a* and *Table A.IV.b* for information about the benchmark regression and *Table A.V.a* and *Table A.V.b.* for regressions including *MICLY* and *TRDI*.

[13] Because I do not expect that specializing in industrialized resource products will constrain economic growth, I do not include the sensitivity analysis for variable MNR in this table. This information, however, is included in *Table A.V.a* and *Table A.V.b.*

TABLE IV
Natural resource abundance and economic growth. Sensitivity of the primary specialization variable to demand and supply atributes of the pattern of specialization

Dependent variable	Cross-country n $Y_{j,2005}$ - ln $Y_{j,196}$		GMM system (ln $Y_{j,t}$ - ln $Y_{j,t-1)}$			
	R coeff	**SE**	**R coeff**	**SE**	**Sargan**	**AR(2)**
(1) PXI in benchmark reg	-0.45	(0.209)**	-0.08	(0.035)**	0.25	0.77
(2) PXI (+TRDI)	-0.42	-0.27	-0.01	-0.03	0.22	0.80
(3) PXI (+MICLY)	-0.30	-0.29	-0.02	-0.03	0.25	0.56
(4) PP in benchmark reg	-0.70	(0.275)**	-0.08	(0.032)**	0.29	0.96
(5) PP (+TRDI)	-0.66	(0.322)**	-0.02	-0.03	0.30	0.97
(6) PP (+MICLY)	-0.55	-0.33	-0.02	-0.03	0.28	0.89

Robust normalized standard errors in parentheses
* significant at 10%; ** 5% and *** 1% level
Notes
Control variables included in cross-country regressions and endogenous and exogenous variables in SYS-GMM as stated in Table III

It is also important to note that GMM validity tests suggest that estimations were run correctly, and *Tables A.6 a* and *b* shows that, although trade shares and pattern of specialization variables tend to be correlated, this correlation is below 0.8, reducing the risk of multicollinearity problems.

As a final test of the competitiveness hypothesis I estimate regressions that include a variable that interacts (multiplies) export shares with trade specialization variables. These variables are *PXIMIC*, *PXITRDI*, *PPMIC* and *PPTRDI*, with regression results presented in *Table V*.

The logic of using interaction terms is that this term intends to capture how a variable z affects the way in which another variable x insides on the dependent variable y. In this paper, the hypothesis behind the interaction term is that variables reflecting characteristics of the pattern of specialization influence how the natural resource variable affects economic growth. As shown in *Table V* (columns (3) to (6) and (9) to (12)), all interaction terms relating export shares *PXI* and *PP* to *MICLY* and/or *TRDI* have the expected negative effect and highly statistically significant. According to the previous hypothesis, these results suggest that resource abundance constrains economic growth because it implies a pattern of specialization different to world demand and/or limits intra-industry trade.

In sum, estimations from *Table IV* and *V* show that variables *PXI* and *PP* are sensitive to the inclusion of variables which reflect relevant aspects of trade and the pattern of specialization. Notably, the reduction in the magnitude and statistical significance of the primary specialization variables that we observe now did not occur when we included proxies for other alleged transmission mechanisms, providing evidence which support the hypothesis of a competitiveness channel of the resource.

TABLE V

Economic growth, the pattern of specialization and interaction terms.

		Cross-country ($\ln Y_{j,2005} - \ln Y_{j,1960}$)						GMM system ($\ln Y_{j,t} - \ln Y_{j,t-1}$)					
		(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
	Regressors												
(1)	**ln** Y_{t-1}	-0.75	-0.70	-0.70	-0.68	-0.73	-0.72	-0.05	-0.04	-0.03	-0.02	-0.03	-0.03
		(0.145)**	(0.153)***	(0.122)***	(0.127)***	(0.125)***	(0.128)***	(0.017)***	(0.016)**	-0.02	-0.02	(0.016)*	(0.015)**
(2)	**ln** INV_{t-1}	0.80	0.77	0.67	0.67	0.91	0.93	0.11	0.16	0.11	0.13	0.11	0.13
		(0.202)**	(0.211)***	(0.189)***	(0.188)***	(0.206)***	(0.209)***	(0.033)***	(0.037)***	(0.036)***	(0.034)***	(0.034)***	(0.034)***
(3)	**ln** HK_{t-1}	0.70	0.59	0.64	0.62	0.66	0.67	0.04	0.03	0.01	0.01	0.00	0.00
		-0.50	-0.48	-0.43	-0.43	-0.43	-0.44	-0.04	-0.03	-0.04	-0.04	-0.04	-0.04
(4)	$SOPEN_p$	0.18	0.23	0.15	0.16	0.23	0.22	0.03	0.04	0.03	0.03	0.03	0.03
		-0.19	-0.20	-0.21	-0.21	-0.18	-0.18	-0.02	(0.022)*	-0.02	-0.02	-0.02	-0.02
(5)	$INST_{t-1}$	0.12	0.12	0.09	0.09	0.09	0.09	-0.002	-0.001	-0.002	-0.002	-0.001	-0.001
		(0.054)**	(0.061)*	(0.049)*	(0.052)*	(0.046)*	(0.048)*	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
(6)	***MICLYp***	-0.41						-0.08					
		(0.183)**						(0.030)***					
(7)	***TRDI p***		-0.62						-0.07				
			-0.44						-0.09				
(8)	***PXIMIC***			-0.39						-0.06			
				(0.140)***						(0.020)***			
(9)	***PXITRDI***				-0.80						-0.11		
					(0.335)**						(0.047)**		
(10)	***PPMIC***					-0.55						-0.06	
						(0.130)***						(0.020)***	
(11)	***PPTRDI***						-1.23						-0.13
							(0.323)***						(0.042)***
(12)	**D_AF**	-0.37	-0.40	-0.33	-0.34	-0.11	-0.10						
		-0.28	-0.29	-0.26	-0.27	-0.26	-0.27						
(13)	**D_LAC**	-0.26	-0.32	-0.19	-0.23	-0.10	-0.12						
		-0.19	(0.189)*	-0.21	-0.21	-0.20	-0.21						
(14)	**D_ASIA**	-0.09	-0.05	-0.09	-0.07	-0.07	-0.05						
		-0.30	-0.32	-0.25	-0.25	-0.26	-0.26						
	Observations	**49**	**49**	**49**	**49**	**49**	**49**	**317**	**317**	**316**	**316**	**317**	**317**
	Adjusted R-2	**0.68**	**0.66**	**0.72**	**0.71**	**0.75**	**0.74**						
	Sargan							**0.13**	**0.13**	**0.09**	**0.15**	**0.09**	**0.14**
	AR(2)							**0.55**	**0.55**	**0.49**	**0.37**	**0.61**	**0.52**

Robust normalized standard errors in parentheses

* significant at 10%; ** 5% and *** 1% level

NOTES

Predetermined variables in the SYS-GMM: SOPENp D_t

Endogenous variables in the SYS-GMM: ln Y_{t-1} ln INV_P ln HK_P $INST_P$ and trade shares or specialization variables.

All endogenous variables are used as instruments in the SYS-GMM. For the differenced equation of the SYS-GMM, instruments are level variables dated at t-2 and t-3, whereas instruments used in the level equation are differences dated at t-2

4 FINAL THOUGHTS

The empirical analysis has shown that the pattern of trade specialization affects the economic performance of nations. Countries specialized in primary or natural resource products grow slower, on average, than countries that participate differently of international trade.

In this paper I explored the competitiveness hypothesis of this empirical regularity, a hypothesis which, to my knowledge, has not received the attention it deserves. To investigate if the resource curse is associated to the inability of resource abundant countries to diversify their tradable sectors, I implemented a sensitivity analysis. This circled around the following points: *(1)* the relevance of the difference transmission mechanisms of the resource curse suggested by the literature; *(2)* the importance of the distinction of natural resource products according to their degree of processing, and *(3 and 4)* the link between the slow growth characteristic of primary exporter countries and their capacity to follow the trends of world demand or engage in specialized trade of industrial products.

The empirical analysis showed that the primary specialization variable has a clear and statistically significant jeopardizing effect for economic development, an effect that persists after controlling for most of the mechanisms through which resource wealth is hypothesized to deter economic growth. Remarkably, it is only with the inclusion of indices of intra-industry trade and the adaptability of a country's exports to trends in world demand that the negative effects of the primary specialization variable are no longer significant. As a consequence, it is possible to sustain that supply and demand attributes of the pattern of specialization of resource abundant countries contribute to explain their difficulties to achieve high and sustained economic growth.

As discussed in section *3*, econometric results also showed that it is the specialization in natural resource products with no or very limited processing the one constraining economic growth, and not the specialization in processed natural resources. These results are in line with previous expectations and provide additional support to the competitiveness explanation of the resource curse, as they are consistent with the classical explanations of this growth phenomenon which highlights sectoral differences in returns to scale.

I conclude making to final remarks. In the first place, I want to emphasize that using two econometric techniques, cross-country and panel data system GMM regressions, increases the robustness of the results, with the second methodology contributing to limit endogeneity problems so characteristic of growth regressions.

In the second place, I want to emphasize that the findings of the paper have a clear policy implication. Countries specialized in the production of primary commodities must diversify their tradable sectors to escape from the growth traps in which they tend to be captured; and notably, diversification does not need to be in new economic sectors, where countries may not have any expertise. According to the results of the paper, increasing the degree of natural resource processing and therefore diversifying in manufactured natural resource products contributes to avoid the resource curse.

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6 APPENDIX

TABLE A.1
Country List

Algeria	Germany	Pakistan
Argentina	Greece	Peru
Australia	Hong Kong	Philippines
Austria	Iceland	Portugal
BLEU	India	Singapore
(Belgium and Luxembourg)	Indonesia	South Korea
Brazil	Ireland	Spain
Canada	Israel	Sweden
Chile	Italy	Switzerland
China, People's Rep.	Japan	Taiwan
Colombia	Malaysia	Thailand
Denmark	Mexico	Tunisia
Ecuador	Morocco	Turkey
Egypt	Netherlands	United Kingdom
Finland	New Zealand	United States
France	Nigeria	Venezuela
Gabon	Norway	

TABLE A.II
Variables Definitions

Name	Definition	Data source
Δln Yj,t	Real GDP growth	CEPII's CHELEM database
	(ln $Y_{j,t}$ - ln $Y_{j,t-1}$); 1960-2005 in C-C and five year periods in SYS-GMM. ln Yj,t. Log of GDP per capita expressed in PPPs (purchasing power parities) in international prices and converted in constant US dollars (base year 1995)	
Trade specialization variables		
Export shares a/		
SXP	Share of exports of primary exports in GDP. Primary exports defined as Non-fuel (SITC Rev I cat 0, 1, 2, 4, 68) plus fuel exports (SITC Rev I cat 3)	Sachs and Warner 1997 Database.
PXI	Share of primary exports in total exports	Sachs and Warner 1997 Database.
PP	Share of primary products in total exports. Simil Lall's unprocessed products classification	UN's COMTRADE data; adapted by Feenstra et al (2005) and processed by UN's DPAD/DESA
MNR	Share of manufactured natural resource products in total exports.	UN's COMTRADE data; adapted by Feenstra et al (2005) and processed by UN's DPAD/DESA
Trade specialization indicators (see text for indicator definitions) b/		
CA_{PRI}	CEPII's comparative advantage indicator in primary products. Primary products as defined in CHELEM's database. See table A.III for further details	CEPII's CHELEM database
$TDIV_i$	Trade diversification indicator, where i = PP and MNR	Author's estimation using UN's COMTRADE data
TRDI	Trade dissimilarity indicator. Estimated considering 71-products defined in CHELEM database	Author's estimation using CEPII's CHELEM database
MICLY	Michaely's index of inter-industry trade; estimated considering 71-products defined in CHELEM database	Author's estimation using CEPII's CHELEM database
NRiMIC	NR vble * MICLY, where i= PXI, PP and MNR	
NRiTRDI	NR vble * TRDI, where i= PXI, PP and MNR	

TABLE A.II. Cont.

Additional control variables and transmission mechanisms		
ln Y_{t-1}	Initial income. Log of GDP per capita in 1995 PPP	CEPII's CHELEM database
ln INV_{t-1}	Log of the ratio of gross domestic investment to real GDP; Measured at the beginning of the period the C-C and panel database	World Bank WDI database
ln HK_{t-1}	Log of secondary school enrollemenet in 1970 in C-C regressions	Sachs and Warner 1997 Database.
	Average years of schooling in panel data's SYS-GMM estimations. Measured at the beginning of the period in the panel database	Barro and Lee (1994) database
SOPEN	Percentage of years with an open economy regime as defined in Sachs and Warner (1995)	Sachs and Warner 1997 Database.
INST	Rule of Law index. The variable reflects the degree to which citizens are willing to accept the established institutions to make and implement laws and adjudicate disputes. Scored 0 (low) to 6 (high). Measured in 1982	Sachs and Warner 1997 Database.
	Combined Polity Score. Estimated substracting the Autocracy score from the Democracy score. Range = -10 to 10 (-10 = high autocracy; 10 = high democracy).	Polity IV Project. Center for International Development and Conflict Management
VOLRER	Standard deviation of annual change in the real exchange rate	Author's estimation using CEPII's CHELEM database
GTOT	Growth in the external terms of trade; external terms of trade defined as the ratio of an export and an import price index	Author's estimation using World Bank WDI database
D_R	Regional dummy variables. R= AF (Africa); LAC (Latin American countries); ASIA (Asian countries, excluding Japan) and OECD (OECD countries)	

Notes

a / measured in 1970 in C-C and as average of the period in SYS-GMM regressions

b / (Specialization indicators measured as period averages in C-C and SYS-GMM regressions)

Table A.III
Comparission of natural resource products

Code SITCREV_2	CTP-DATA	Sachs and Warner	CEPII
1	PP	SXP / PXI	PRI
11	PP	SXP / PXI	other
12	MNR	SXP / PXI	other
14	MNR	SXP / PXI	other
22	MNR	SXP / PXI	other
23	MNR	SXP / PXI	other
24	MNR	SXP / PXI	other
25	MNR	SXP / PXI	PRI
34	PP	SXP / PXI	other
35	MNR	SXP / PXI	other
36	MNR	SXP / PXI	other
37	MNR	SXP / PXI	other
41	PP	SXP / PXI	PRI
42	PP	SXP / PXI	PRI
43	PP	SXP / PXI	PRI
44	PP	SXP / PXI	PRI
45	PP	SXP / PXI	PRI
46	MNR	SXP / PXI	other
47	MNR	SXP / PXI	other
48	MNR	SXP / PXI	other
54	PP	SXP / PXI	PRI
56	MNR	SXP / PXI	other
57	PP	SXP / PXI	PRI
58	MNR	SXP / PXI	other
61	MNR	SXP / PXI	other
62	MNR	SXP / PXI	other
71	PP	SXP / PXI	PRI
72	PP	SXP / PXI	PRI
73	MNR	SXP / PXI	other
74	PP	SXP / PXI	PRI
75	PP	SXP / PXI	PRI
81	MNR	SXP / PXI	other
91	MNR	SXP / PXI	other
98	MNR	SXP / PXI	other
111	MNR	SXP / PXI	other
112	MNR	SXP / PXI	other
121	PP	SXP / PXI	PRI
122	MNR	SXP / PXI	PRI
211	PP	SXP / PXI	PRI
212	PP	SXP / PXI	PRI

TABLE A.3. Cont

222	PP	SXP / PXI	other
223	MNR	SXP / PXI	other
232	PP	SXP / PXI	PRI
233	MNR	SXP / PXI	other
244	PP	SXP / PXI	PRI
245	PP	SXP / PXI	PRI
246	MNR	SXP / PXI	other
247	PP	SXP / PXI	other
248	MNR	SXP / PXI	other
251	MNR	SXP / PXI	other
261	PP	SXP / PXI	PRI
263	MNR	SXP / PXI	PRI
264	PP	SXP / PXI	PRI
265	MNR	SXP / PXI	PRI
266	MNR	SXP / PXI	other
267	MNR	SXP / PXI	other
268	MNR	SXP / PXI	other
269	other	SXP / PXI	other
271	PP	SXP / PXI	PRI
273	PP	SXP / PXI	PRI
274	PP	SXP / PXI	PRI
277	PP	SXP / PXI	PRI
278	PP	SXP / PXI	PRI
281	PP	SXP / PXI	PRI
282	MNR	SXP / PXI	PRI
286	PP	SXP / PXI	PRI
287	PP	SXP / PXI	PRI
288	MNR	SXP / PXI	PRI
289	PP	SXP / PXI	PRI
291	PP	SXP / PXI	PRI
292	PP	SXP / PXI	PRI
322	PP	SXP / PXI	PRI
323	PP	SXP / PXI	PRI
333	PP	SXP / PXI	PRI
334	PP	SXP / PXI	other
335	PP	SXP / PXI	other
341	PP	SXP / PXI	PRI
351	n.e	SXP / PXI	other
411	MNR	SXP / PXI	other

TABLE A.3. Cont.

423	MNR	SXP / PXI	other
424	MNR	SXP / PXI	other
431	MNR	SXP / PXI	other
511	MNR	other	other
512	MNR	other	other
513	MNR	other	other
514	MNR	other	other
515	MNR	other	other
516	MNR	other	other
522	MNR	other	other
523	MNR	other	other
524	MNR	other	other
562	MNR	other	other
628	MNR	other	other
633	MNR	other	other
634	MNR	other	other
635	MNR	other	other
641	MNR	other	other
667	MNR	other	other
681	PP	SXP / PXI	other
682	PP	SXP / PXI	other
683	PP	SXP / PXI	other
684	PP	SXP / PXI	other
685	PP	SXP / PXI	other
686	PP	SXP / PXI	other
687	PP	SXP / PXI	other
688	PP	SXP / PXI	other
689	PP	SXP / PXI	other
941	n.e	other	PRI

Notes
other refers to a commodity group unrelated to natuarl resource products

Table A.IV.a Natural resource abundance and economic growth. Comparisson of alternative trade specialization measures. Cross-country regressions

Dependent variable Δln Yj,t (ln Yj,2005 - ln Yj,1960)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Regressors								
ln Y_{t-1}	-0.65	-0.70	-0.65	-0.68	-0.63	-0.63	-0.72	-0.67
	(0.146)***	(0.143)***	(0.173)***	(0.132)***	(0.168)***	(0.177)***	(0.164)***	(0.172)***
ln INV_{t-1}	0.66	0.85	0.75	0.84	0.77	0.72	0.83	0.80
	(0.206)***	(0.217)***	(0.218)***	(0.212)***	(0.212)***	(0.214)***	(0.199)***	(0.220)***
ln HK_{t-1}	0.39	0.56	0.21	0.54	0.10	0.13	0.46	0.34
	-0.40	-0.42	-0.43	-0.38	-0.39	-0.44	-0.47	-0.44
$SOPEN_p$	0.28	0.31	0.39	0.42	0.36	0.39	0.27	0.31
	-0.21	-0.20	(0.187)**	(0.155)**	(0.175)**	(0.191)**	-0.19	-0.20
$INST_{t-1}$	0.08	0.08	0.10	0.08	0.11	0.10	0.11	0.11
	(0.047)*	(0.048)*	(0.049)**	(0.042)*	(0.048)**	(0.050)**	(0.050)**	(0.053)**
$VOLRER_p$	0.15	-0.04	0.26	1.51	0.77	0.40	1.37	0.97
	-2.60	-2.43	-2.82	-1.82	-2.53	-2.81	-2.68	-2.73
$GTOT_p$	-0.23	-0.14	-0.28	-0.25	-0.38	-0.30	-0.29	-0.30
	(0.130)*	-0.13	(0.148)*	(0.108)**	(0.151)**	(0.144)**	(0.124)**	(0.135)**
D_AF	-0.49	-0.29	-0.55	-0.15	-0.52	-0.58	-0.42	-0.46
	(0.257)*	-0.29	(0.261)**	-0.21	(0.244)**	(0.265)**	-0.27	-0.28
D_LAC	-0.32	-0.21	-0.45	-0.30	-0.55	-0.47	-0.35	-0.40
	-0.24	-0.26	(0.213)**	-0.19	(0.213)**	(0.220)**	-0.22	(0.224)*
D_ASIA	-0.06	-0.04	-0.05	-0.10	-0.14	-0.05	-0.06	-0.01
	-0.26	-0.27	-0.32	-0.26	-0.33	-0.31	-0.31	-0.32
EXPORT SHARES								
Sachs and Warner's trade shares								
PXI_{t-1}	-0.45							
	(0.209)**							
CTP trade shares								
PP		-0.70						
		(0.275)**						
MNR			0.20					
			-0.39					
TRADE SPECIALIZATION INDICES								
$CA_{PRI,p}$				-0.47				
				(0.129)***				
$TDIV_{PP,p}$					-0.25			
					(0.133)*			
$TDIV_{MNR,p}$						-0.03		
						(0.018)*		
MICLYp							-0.398	
							(0.189)**	
TRDI p								-0.595
								-0.475
Observations	**49**	**49**	**49**	**49**	**49**	**49**	**49**	**49**
Adjusted R-squared	**0.69**	**0.68**	**0.71**	**0.66**	**0.69**	**0.66**	**0.69**	**0.67**

Robust normalized standard errors in parentheses

* significant at 10%; ** 5% and *** 1% level

Table A.IV.b Natural resource abundance and economic growth. Comparisson of alternative trade specialization measures. System GMM Panel data estimations

Dependent variable Δln Yj,t (ln Yj,2005 - ln Yj,1960)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Regressors								
ln *Y* $_{t-1}$	-0.05	-0.05	-0.05	-0.07	-0.04	-0.05	-0.06	-0.06
	(0.018)***	(0.014)***	(0.016)***	(0.015)***	(0.016)**	(0.014)***	(0.016)***	(0.014)***
ln *INV* $_{t-1}$	0.16	0.15	0.14	0.15	0.19	0.17	0.14	0.16
	(0.037)***	(0.036)***	(0.036)***	(0.037)***	(0.043)***	(0.036)***	(0.032)***	(0.034)***
ln *HK* $_{t-1}$	0.08	0.07	0.10	0.10	0.09	0.09	0.10	0.09
	(0.033)**	(0.030)**	(0.033)***	(0.025)***	(0.032)**	(0.029)***	(0.029)***	(0.029)***
SOPEN $_p$	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.02
	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.01
INST p	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.00	0.00
	-0.001	-0.001	(0.001)*	-0.001	-0.001	-0.001	(0.001)*	0.00
VOLRER $_p$	-0.52	-0.51	-0.53	-0.52	-0.52	-0.53	-0.56	-0.59
	(0.114)***	(0.123)***	(0.106)***	(0.114)***	(0.126)***	(0.107)***	(0.107)***	(0.104)***
GTOT $_p$	0.10	0.08	0.09	0.09	0.11	0.09	0.08	0.09
	(0.028)***	(0.028)***	(0.028)***	(0.029)***	(0.031)***	(0.028)***	(0.031)**	(0.030)***
EXPORT SHARES								
Sachs and Warner's trade shares								
PXI $_{t-1}$	-0.060							
	(0.033)*							
CTP trade shares								
PP		-0.08						
		(0.032)**						
MNR			-0.04					
			-0.09					
TRADE SPECIALIZATION INDICES								
CA $_{PRI,p}$				-0.03				
				(0.015)**				
TDIV $_{PP,p}$					-0.09			
					-0.06			
TDIV $_{MNR2,p}$						0.06		
						-0.06		
MICLYp							-0.05	
							-0.03	
TRDI p								-0.05
								-0.07
Observations	**255**	**256**	**256**	**256**	**242**	**245**	**256**	**256**
Sargan	**0.25**	**0.29**	**0.53**	**0.33**	**0.41**	**0.31**	**0.20**	**0.39**
AR(2)	**0.77**	**0.96**	**.94**	**0.92**	**0.97**	**0.81**	**0.952**	**0.856**

Robust normalized standard errors in parentheses

* significant at 10%; ** 5% and *** 1% level

NOTES

Predetermined variables in the SYS-GMM: SOPENp GTOTp D_t

Endogenous variables in the SYS-GMM: ln Y_{t-1} ln INV_p ln HK_p $VOLRER_p$ $INST_p$ and trade shares or specialization variables.

All endogenous variables are used as instruments in the SYS-GMM. For the differenced equation of the SYS-GMM, instruments are level variables dated at t-2 and t-3, whereas instruments used in the level equation are differences dated at t-2

/a CTP-DATA trade shares are measured at the beginning of the period in cross-country regression and as average of the five year panel in SYS-GMM regressions

Table A.V.a Natural resource abundance and economic growth. Sensitivity of the primary specialization variable to demand and supply atributes of the pattern of specialization. Cross-country regressions

Dependent variable Δln Yj,t (ln Yj,2005 - ln Yj,1960)

	(1)	(2)	(3)	(4)	(5)	(6)
Regressors						
ln Y_{t-1}	-0.69	-0.66	-0.73	-0.70	-0.73	-0.68
	(0.159)***	(0.151)***	(0.150)***	(0.147)***	(0.168)***	(0.176)***
ln INV_{t-1}	0.74	0.68	0.88	0.86	0.87	0.85
	(0.237)***	(0.242)***	(0.211)***	(0.225)***	(0.216)***	(0.242)***
ln HK_{t-1}	0.46	0.40	0.60	0.56	0.43	0.32
	-0.45	-0.42	-0.45	-0.43	-0.48	-0.45
$SOPEN_p$	0.25	0.28	0.26	0.30	0.27	0.31
	-0.21	-0.21	-0.19	-0.19	-0.19	-0.19
$INST_{t-1}$	0.09	0.08	0.09	0.08	0.11	0.11
	(0.047)*	(0.044)*	(0.048)*	(0.048)*	(0.051)**	(0.053)**
$VOLRER_p$	0.80	0.28	0.57	0.14	1.36	1.02
	-2.72	-2.68	-2.57	-2.53	-2.70	-2.72
$GTOT_p$	-0.25	-0.24	-0.17	-0.15	-0.26	-0.26
	(0.130)*	(0.138)*	-0.13	-0.14	(0.126)**	(0.134)*
D_AF	-0.43	-0.47	-0.27	-0.28	-0.37	-0.39
	-0.27	(0.278)*	-0.30	-0.30	-0.26	-0.28
D_LAC	-0.31	-0.32	-0.21	-0.21	-0.34	-0.38
	-0.24	-0.24	-0.27	-0.26	-0.22	(0.215)*
D_ASIA	-0.06	-0.05	-0.04	-0.03	-0.05	0.01
	-0.28	-0.26	-0.28	-0.28	-0.32	-0.35
EXPORT SHARES						
Sachs and Warner's trade shares						
PXI_{t-1}	-0.298	-0.42				
	-0.294	-0.27				
CTP trade shares						
PP			-0.55	-0.66		
			-0.33	(0.322)**		
MNR					0.31	0.31
					-0.37	-0.37
TRADE SPECIALIZATION INDICES						
$MICLY_{,p}$	-0.22		-0.20		-0.42	
	-0.26		-0.21		(0.185)**	
$TRDI_{,p}$		-0.10		-0.14		-0.71
		-0.60		-0.50		-0.52
Observations	**49**	**49**	**49**	**49**	**49**	**49**
Adjusted R-squared	**0.69**	**0.69**	**0.71**	**0.70**	**0.69**	**0.67**

Robust normalized standard errors in parentheses

* significant at 10%; ** 5% and *** 1% level

Table A.V.b Natural resource abundance and economic growth. Sensitivity of the primary specialization variable to demand and supply atributes of the pattern of specialization. System GMM regressions

Dependent variable Δln Yj,t (ln Yj,2005 - ln Yj,1960)

	(1)	(2)	(3)	(4)	(5)	(6)
Regressors						
ln Y_{t-1}	-0.06	-0.06	-0.05	-0.05	-0.06	-0.06
	(0.020)***	(0.020)***	(0.018)***	(0.015)***	(0.018)***	(0.016)***
ln INV_{t-1}	0.17	0.18	0.16	0.16	0.14	0.15
	(0.034)***	(0.037)***	(0.032)***	(0.033)***	(0.032)***	(0.031)***
ln HK_{t-1}	0.06	0.06	0.05	0.06	0.08	0.08
	(0.030)**	(0.033)*	(0.029)*	(0.028)**	(0.030)**	(0.029)***
$SOPEN_p$	0.01	0.01	0.01	0.01	0.01	0.02
	-0.02	-0.01	-0.02	-0.01	-0.01	-0.01
$INST_p$	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
$VOLRER_p$	-0.48	-0.47	-0.48	-0.49	-0.46	-0.47
	(0.108)***	(0.103)***	(0.110)***	(0.108)***	(0.108)***	(0.105)***
$GTOT_p$	0.10	0.10	0.08	0.08	0.08	0.09
	(0.027)***	(0.028)***	(0.027)***	(0.028)***	(0.028)***	(0.028)***
EXPORT SHARES						
Sachs and Warner's trade shares						
PXI_p	-0.0150	-0.011				
	-0.030	-0.030				
Lall's trade shares /a						
CTP trade shares						
PP			-0.022	-0.019		
			-0.032	-0.033		
MNR					-0.02	-0.02
					-0.07	-0.08
TRADE SPECIALIZATION INDICES						
$MICLY_{,p}$	-0.06		-0.04		-0.04	
	(0.035)*		-0.03		-0.04	
$TRDI_{,p}$		-0.11		-0.07		-0.06
		-0.08		-0.07		-0.10
Observations	**266**	**266**	**267**	**267**	**267**	**267**
Sargan	**0.22**	**0.25**	**0.30**	**0.28**	**0.21**	**0.28**
AR(2)	**0.80**	**0.56**	**0.97**	**0.89**	**0.99**	**0.96**

Robust normalized standard errors in parentheses

* significant at 10%; ** 5% and *** 1% level

NOTES

Predetermined variables in the SYS-GMM: SOPENp GTOTp D_t

Endogenous variables in the SYS-GMM: ln Y_{t-1} ln INV_p ln HK_p $VOLRER_p$ $INST_p$ and trade shares or specialization variables.

All endogenous variables are used as instruments in the SYS-GMM. For the differenced equation of the SYS-GMM, instruments are level variables dated at t-2 and t-3, whereas instruments used in the level equation are differences dated at t-2

/a CTP-DATA trade shares are measured at the beginning of the period in cross-country regression and as average of the five year panel in SYS-GMM regressions

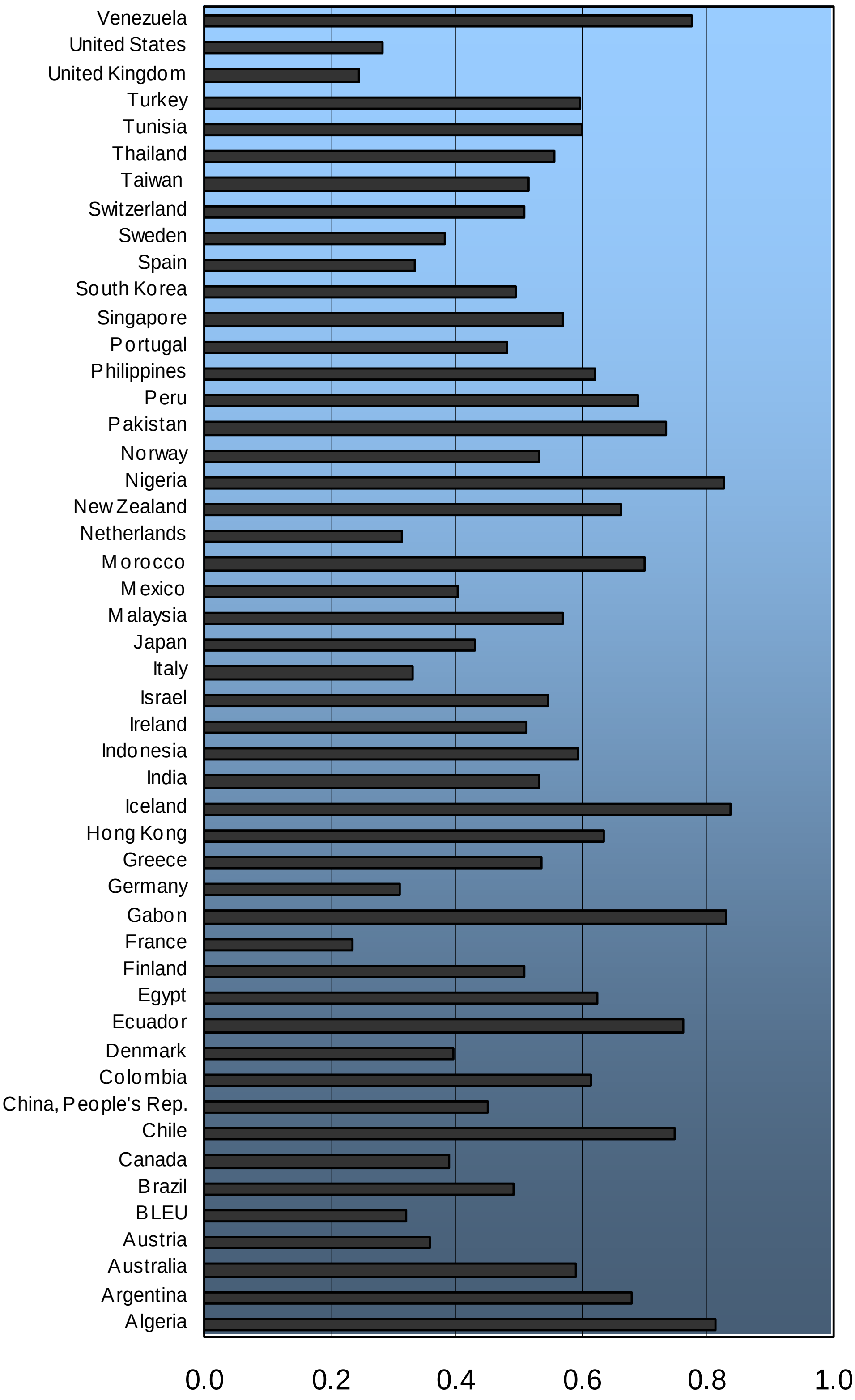
Table A.6.a Correlation matrix. Cross-country database

	$\Delta \ln Yj,t$	$\ln Y_{t-1}$	$\ln INV_{t-1}$	$\ln HK_{t-1}$	$SOPEN_p$	$INST_p$	$VOLRER_p$	$GTOT_p$	PXI_p	PP	MNR	$MICLY_{,p}$	$TRDI_{,p}$
$\Delta \ln Yj,t$	1												
$\ln Y_{t-1}$	-0.340	1											
$\ln INV_{t-1}$	0.165	0.445	1										
$\ln HK_{t-1}$	-0.019	0.700	0.225	1									
$SOPEN_p$	0.405	0.409	0.285	0.480	1								
$INST_p$	0.155	0.722	0.371	0.637	0.671	1							
$VOLRER$	-0.423	-0.255	-0.310	-0.333	-0.557	-0.535	1						
$GTOT_p$	-0.038	-0.043	0.114	-0.111	0.143	-0.051	0.173	1					
PXI_p	-0.460	-0.398	-0.382	-0.389	-0.632	-0.612	0.535	0.047	1				
PP	-0.390	-0.437	-0.155	-0.445	-0.552	-0.604	0.483	0.187	0.806	1			
MNR	-0.081	0.214	-0.136	0.252	-0.021	0.123	0.011	-0.281	0.204	-0.270	1		
$MICLY_{,p}$	-0.325	-0.473	-0.212	-0.442	-0.660	-0.583	0.582	-0.022	0.787	0.759	-0.016	1	
$TRDI_{,p}$	-0.272	-0.421	-0.132	-0.400	-0.612	-0.530	0.517	-0.027	0.720	0.705	0.056	0.928	1

Table A.6.b. Correlation matrix. Panel database

	$\Delta \ln Yj,t$	$\ln Y_{t-1}$	$\ln INV_{t-1}$	$\ln HK_{t-1}$	$SOPEN_p$	$INST_p$	$VOLRER_p$	$GTOT_p$	PXI_p	PP	MNR	$MICLY_{,p}$	$TRDI_{,p}$
$\Delta \ln Yj,t$	1												
$\ln Y_{t-1}$	-0.224	1											
$\ln INV_{t-1}$	0.345	0.084	1										
$\ln HK_{t-1}$	-0.116	0.798	0.057	1									
$SOPEN_p$	0.077	0.566	0.115	0.553	1								
$INST_p$	-0.193	0.550	-0.104	0.564	0.360	1							
$VOLRER$	-0.325	-0.124	-0.141	-0.070	-0.207	-0.193	1						
$GTOT_p$	0.125	-0.010	-0.032	-0.017	0.040	-0.046	-0.004	1					
PXI_p	-0.082	-0.452	-0.098	-0.423	-0.398	-0.292	0.174	-0.079	1				
PP	-0.093	-0.484	-0.097	-0.444	-0.410	-0.295	0.200	-0.081	0.948	1			
MNR	-0.016	0.048	-0.102	0.121	-0.058	0.009	-0.051	0.057	-0.043	-0.139	1		
$MICLY_{,p}$	-0.023	-0.650	0.007	-0.527	-0.534	-0.410	0.209	-0.028	0.687	0.716	0.108	1	
$TRDI_{,p}$	-0.036	-0.595	-0.006	-0.445	-0.481	-0.371	0.169	-0.002	0.639	0.658	0.221	0.899	1

Figure A.1: Trade dissimilarity index, average 1967-2005



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