Trade Openness and Growth: Does Sector Specialization Matter ?

Joffrey MALEK MANSOUR

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Abstract

This paper tries to clarify a number of issues related to the "trade openness and growth" debate. Recent models of endogenous growth have shown that the pattern of sector specialization is likely to play a role in the link between outward orientation and growth. We consider a number of sector specialization indicators and we examine if they indeed affect the link between openness and growth. To that end, we use both cross-section and panel date techniques. We find that both the sector specialization intensity and its pattern are likely to affect significantly the link between openness and growth.

1 Introduction

In these times of globalization and trade liberalization, a crucial issue is to know whether trade openness indeed promotes growth. There is a huge policy debate about what constitute "good" and "bad" policies for these countries that seem to have missed the train of economic development. Should they completely open up to international trade ? Or should they instead, at least temporarily, protect some or all of their industries from the world market forces? Formal arguments have been developed pro and con both theses. Already in the middle of the XIXth century, David Ricardo acknowledged the importance of the gains from trade: it is much more efficient that each country specializes in producing goods for which it has (technical) comparative advantages and imports the other goods. Quite at the same time, John Stuart Mill formalized an old argument, back from the end of the XVIIIth century, that would later become known as the "*infant industry argument*" to justify protectionist policies. The question of whether openness promotes growth and development is thus a very important one. Therefore, much has been said and written about it. A very nice and comprehensive survey of the early literature, from the 70s and the 80s, is to be found in Edwards (1993). This author reviews both casual, multi-country, studies and cross-country econometric studies. He reports that most of the previous studies have found a positive correlation between exports (and *not* trade openness *per se*) and growth. however, he is rather skeptikal about previous results, invoking endogeneity problems, misspecification issues, measurement errors, and so on....

It should be emphasized that the neoclassical growth theory, the one that comes out from the classic paper by Robert Solow in 1956, is rather silent about the relationship between trade and growth. In particular, Solow's model does *not* predict that openness to trade increases long-run growth. The engine that creates steady-state long run growth is technical progress: in the long run, the economy grows at the same pace as "technology". And, in Solow's original formulation, technical change is exogenous and unaffected by trade policy. Opening up to trade may nevertheless increase growth in the short run, since the economy will be free to choose a "better" specialization pattern, i.e. a pattern more in line with its comparative advantage, and thus reach a higher steady-state *level* - as opposed to *growth rate* - of income per capita.

A new body of theoretical literature appeared in the 80's, with the emergence of endogenous growth theory. Contrarily to neoclassical growth models, that assume diminishing marginal productivity of capital and constant returns to scale (and thus need some exogenous external force to sustain growth indefinitely), endogenous growth models - at least those in the spirit of Romer (1986) - assume constant returns to scale at firm level but increasing returns to scale at the aggregate level due to knowledge spillovers across firms or industries. The diffusion of knowledge itself generates dynamic economies of scale through *learning-by-doing* phenomena, i.e. the fact that the more one does something, the better one does it.

This generation of models offers some prediction concerning the impact of trade openness upon growth. Consider two countries opening up to trade with each other, and suppose that the pattern of static comparative advantages pushes a given country to specialize in goods with low learning-by-doing potential, whereas its partner specialize in sectors with high learning-by-doing potential. In the absence of international diffusion of knowledge, the gap between these countries is likely to increase ever and ever, since the latter country will acquire *dynamic* comparative advantages due to learning-by-doing. A nice and clever formalisation of this argument is presented by Young (1991), for instance. The lesson we retain is that the initial pattern of sector specialization may crucially affect the outcome of trade liberalization policies. A country initially specialized in "bad" sectors may very well end up worse-off after opening up to trade.

Ce paragraphe n'est pas bon: il faut le revoir !

In this paper, we try to investate the empirical relevance of this story. Specifically, we regress growth upon openness, an interaction variable between openness and specialization, and some control variables. The rest of the paper is organized as follows: Section 2 presents the main empirical findings on the link between openness and gowth, with and without sector specialization concern. Section 3 sets up the model we wish to estimate. Section 4 describes the data and indicators, Section 5 provides some stylized facts and our empirical findings are presented in Section 5. Finally, Section 6 concludes.

2 A Selected Review of the Literature

Throughout the 90's, a huge body of empirical literature has been devoted to the trade and growth issue. This Section reviews some of the major contributions that have been brought to the debate. We first review some classic papers that did not take sector specialization into consideration and next, we turn to some papers that included sector specialization concerns.

2.1 The Trade and Growth Literature I: Without Specialization Concerns

To begin with, Dollar (1992) brought an important contribution to the trade and growth debate. The author defines openness as the combination of two dimensions: (i) a low level of protection, hence of trade distorsions and (ii) a stable real exchange rate so that incentives remain constant over time. From that very definition, follow two measures openness: a trade distorsion index, and a real exchange rate variability index. The distorsion index measures the the deviations from the Law of One Price after controlling for the impact of nontradables. The variability index captures the variance of the real exchange rate. The author considers a sample of 95 countries over the period 1976-1985 and regresses average per capita growth upon his openness indexes and the average investment rate. Both the distorsion index and the variability index are significantly negatively correlated with growth and the investment rate comes out with a significantly positive coefficient.

Dowrick (1994) tests whether trade openness affects output growth and/or investment. He considers a sample of 74 countries over the period 1960-1990.

As openness indicator, the author considers the residuals of an OLS cross-country regression of the average trade intensity upon a constant and average population. In a second stage, the author runs cross-country OLS regressions of average per capita GDP growth upon the average investment rate, the initial GDP level and his openness indicator. The coefficient on openness is significant and positive. Moreover, dropping the investment rate considerably lowers the overall fit of the model but enhances the coefficient on openness, which, according to the author "suggests that openness works partly through increased investment rates". In a third stage, the author compute decade averages for his variables and turns to panel data techniques, arguing that such techniques "enable some control for time-invariant country-specific factors such as institutional arrangements that might be correlated with the explanatory variables". The author uses labour productivity growth as dependent variable and estimates both fixed-effects and random-effects models. He reports that the coefficient on openness is still significant and positive, but its point estimate is much lower than in the OLS specifiication. In a fourth set of regressions, the author also considers *growth in openness* instead of openness itself. The impact of that variable on growth is still significantly positive as far as developing countries are concerned, but becomes insignificant when turning to the sample of developed countries. The author interprets this as reflecting the fact that "static efficiency effects of trade liberalization are negligible for countries with well-developed markets...". Finally, in its Conclusions, the author cautions that his results, showing the beneficial effects of increased openness, hold *on average*, but are not an universal truth, valid always and everywhere. In particular, he stresses that "trade liberalization can indeed stimulate growth in the aggregare world economy (...). Whilst trade may have such positive effects for some countries, it may conversely lock in other countries into a pattern of specialization in low-skill, low-growth activities".

Sachs and Warner (1995), hereinafter SW, brought a seminal contribution to that literature. Their central hypothesis is that some developing countries fail to grow rapidly enough as to converge because they are simply not open to trade. In their own words: "...convergence can be achieved by *all* countries, even those with low initial level of skill, as long as they are open and integrated in the world economy.". To check their hypothesis, the authors first carefully build and discuss an openness measure, which we will discuss more in depth in Section 3 below. Building upon a sample of 135 countries over the period 1970-1990, they construct an openness dummy variable that is zero if *any* of the 5 following conditions is true: nontariff barriers covering 40% or more of trade, average tariff rate above 40%, black market premium above 20%, the economy is ruled by a socialist system, or there is a state monopoly on exports. Otherwise, if *none* of these 5 conditions is fulfilled, the openness dummy is one. The authors first divide their countries sample into open ones and closed ones, and show that closed countries have grown at about the same rate (essentially about 0.7% a year), no matter whether they are developed or not. By contrast, open developing countries have grown much faster than their developed counterparts (4.49% versus 2.29%). Going beyond these stylized facts, the authors re-do the same regressions as in Barro (1991) and add their openness dummy to them. Without the dummy, the results are sensibly the same as in Barro (1991). After adding the openness dummy in the regressors list, it appears its coefficient is highly significant. Point estimates suggest that open economies grow on average 2.45% faster than closed ones. Moreover, educational attainment variables become even less significant than in Barro (1991), which leads the authors to think that "...growth rate over this period was determined less by initial human capital levels than by policy choices". SW also address a specialization-related issue. Specifically, they test whether trade openness condemns raw materials exporters to nonindustrialisation and whether closed trade promotes industrial exports in the long run. To do this, they regress the change in the share of primary exports on openness. They find that "...open economies tend to export more rapidly from being primary-intensive to manufactures-intensive exporters. The difference in speed of adjustment is statistically significant".

Harrison (1996) starts from the judgement that "it should be evident that no independent measure of so-called 'openness' is free from methodological problem". Therefore, to make her point, she collects as many different openness indicators as she can, namely 7 of them, and she checks the consistency of the results across all these indicators. She uses various samples, whose time spans range from 1960-1988 to 1978-1987, and the country coverage varies from 51 to 17. She first runs typical cross-country growth regressions. It appears that only one measure of openness out of 7, namely the black market premium, has a significant impact on growth. To explain this weak result, the author argues that a pure cross-section specification, based upon long-run averages, is not an adequate one. Indeed, though the use of long-run averages appears as the most natural way to capture the determinants of long-run growth, they may also hide significant variations in individual countries' performances and policies over time. To test this idea, the author re-does her regressions using annual data for the same variables. She uses a panel fixed-effects specification to take into account unobserved country-specific differences in growth rates. Results show a stronger link between openness and growth since 3 indicators become significant at the conventional 5% level. The author next argues that such a yearly frequency is too high if one is interested in long-run growth, since results may be affected by short-term, conjonctural, variations. She therefore considers a third - "intermediate" - specification, based on five-year averages and reports that, again, 3 indicators come out with a significant coefficient. The message from these results, as the author states, is that "the choice of the time period for analysis is critical". However, an interesting regularity appear across all specifications: when openness is significant, it is always in the sense that greater openness is associated with higher growth.

Edwards (1998) also uses an important number of openness indexes to investigate the trade and growth relationship. He considers a sample of 93 advanced and developing countries, and estimate a growth equation with a panel data random effects model. From that model, he computes factor shares, which are then used to get TFP estimates. Concentrating on a cross-section of 1980s averages, TFP growth is finally regressed upon initial income level, initial human capital level, and no less than 9 openness indicators, each one of them in turn. The author reports that "in all but one of the 18 equations the estimated coefficient on the openness indicator has the expected sign and in the vast majority of cases it is significant". Moreover, the coefficient on initial human capital is always significant and positive. Regarding the initial income level, the coefficient is always negative and in 16 cases out of 18, it is significant though very low, which can be interpreted as evidence in favour of (admittedly slow) conditional convergence. To summarize, the authors concludes that his results "are quite remarkable, suggesting with tremendous consistency that there is a significantly positive relationship between trade openness and growth".

An important paper that is able to cast serious doubts about the consistency of the trade-growth relationship, is the one by Rodriguez and Rodrik (1999). These authors consider a series of previous research results, among which Dollar (1992), Sachs and Warner (1995), and Edwards (1998). They re-do the computations in these papers (and other papers in the same vein), but slightly change the specifications (through the addition of some dummies, e.g.), add newly available data to the sample, or slightly change the estimation methods. They are able to demontrate a fundamental lack of robustness of the results in the paper they review.

Frankel and Romer (1999) claim that openness, as measured by the ratio of total trade to GDP, should not be used as explanatory variable in the growth regressions. The trade ratio, the authors argue, is endogenous, and needs to be instrumented. To construct their instrument, the authors first argue that "as the literature on the gravity model of trade demonstrates, geography is a powerful determinant of bilateral trade". And they claim this is also true for total trade. Moreover, geography is completely exogenous. Therefore, the authors consider a database of bilateral trade between 63 countries for 1985 and they regress bilateral trade upon purely geographical indicators[1] . For each country, the fitted values of trade are aggregated over all partners, and this aggregate is finally turned into an "ideal" trade share that can be used as an instrument for the observed one. The authors then estimate growth equations for a cross-section of 150 countries in 1985. They report a substantial impact of trade openness on income growth: increasing the trade share by 1% should raise income by between 0.5% and 2%. These findings are robust to various changes in specifications. The results also suggest that, controlling for openness, larger countries tend to experience higher growth rates, which could simply reflect that citizens living in larger countries engage more in *within-country* trade.

Baldwin and Sbergami (2000) argue that the reason why researchers failed to find a robust relationship between trade and openness is because that relationship is fundamentally nonlinear and non-monotonic. They raise the point that the fundamental engine of growth is human and physical accumulation, and that the link between capital accumulation and trade barriers is, in nearly all models, nonlinear and often even nonmonotonic. They provide a formal $2 \times 2 \times 2$ dynamic model with imperfect competition that gives rise to (i) a U-shaped relationship between ad-valorem tariffs and growth and (ii) a bell-shaped relationship between specific tariffs and growth. This model is then confronted to the data, i.e. for a variety of openness indicators (actually, 10 of them are considered), a quadratic model is estimated. It turns out that, in this new specification, for 6 of the 10 proxies both the linear and the quadratic terms are significant individually. The authors conclude that: "allowing for non-linearity does have a big empirical impact". And they prophetize that a fruitful way for future research is to investigate into the causes and sources of non-linearity.

One possible such route, that predicts a nonmonotonic impact of trade openness upon growth, is to investigate into sector specialization. As we hinted in the Introduction above, it might be the case that trade openness actually worsens the situation of countries specialized in the "wrong" sectors. In the next Section, we review some recent papers that have gone down that road.

[1]As noted by Rodriguez and Rodrik (1999), there is an important point here that is worth underlining: from a conceptual point of view, the authors do not examine per se whether more "'liberal" trade policies are good for growth, they investigate whether higher trade volumes are good for growth. Though both questions are clearly linked, they are conceptually not the same

2.2 The Trade and Growth Literature II: With Specialization Concerns

The first strand of econometric studies we have reviewed insofar tried to explain growth from a series of aggregate country-specific structural characteristics and policy indicators. The overall picture that emerges from that literature is that we have some evidence trade openness would be a priori good for growth. However, as we have shown above, the evidence is far from being robust. The natural question that arises, then, is: why this lack of robustness ? And a natural answer could be that openness is not good for growth always and everywhere. There exist, as we have mentioned in Section 2 above, theoretical arguments in support of the idea that the pattern of sector specialization plays a key role in the trade and growth link. We now review the empirical literature that tries to test these theories.

Busson and Villa (1994) consider a panel of 57 countries over the period 1967-1991. Using international trade data for 69 agricultural and industrial goods, they develop and compute, for each country, 3 trade specialization indicators. First, they build an inter-industry trade index indicating whether a given country's trade is rather specialized in inter- or in intra- industry trade. Next, they engineer what they call a "trade dissimilarity indicator", that provides a measure of the gap between the structure of international demand and the trade specialization pattern of each country. Finally, they compute an index of the growth in international demand adressed to each country. With these indexes in hand, they perform a cross-country regression of per capita growth upon the initial wealth level, the investment rate, the initial human capital stock, a monetary policy indicator (an index of terms of trade variability and an index of real exchange rate undervaluation), a measure of foreign capital inflows, an openness index, and their various specialization indexes. As to the openness index, the authors simply choose the trade share of GDP. Their findings are as follows: first, the most open countries are the one that have experienced the highest growth. However, *inter-industry* specialization is negatively correlated to growth and the authors poivide statistics suggesting that inter-industry specialization has actually declined in high-growth countries. Second, in all specifications, the coefficient on the "trade dissimilarity index" is always negative and significant, which means that the more a country's trade is specialized in goods for which world demand is dynamic, the best it is for its growth. Alternatively, being specialized in the "wrong" goods, identified as those for which international demand is on the decline, appears to be harmful for growth.

Weinhold et Rauch (1997) consider a panel of 39 countries over the period 1960-1990. For each country, they first construct various economy-wide measures of specialization in production based on Herfindahl indexes for the manufacturing sector. They then regesss country-level labour productivity growth upon specialization, openness (as measured by the share of trade in GDP), the inflation rate and the share of government spending in GDP, using fixed-effects dynamic panel data techniques. Their results show that higher specialization leads to higher productivity growth, especially in the less developed countries (the specialization variables, actually, are nonsignificant for the developed countries. The coefficient on the openness indicator is either nonsignificant or negative, but the authors do not comment on that point.

Feenstra and Rose (1997) look at imports in the US from 162 countries, over the period 1972-1994, for 1434 goods defined at the 5-digits disaggregation level of the ISIC. Their approach contains three main steps: first, they rank the goods according to their degree of sophistication; second, they use this ranking to rank the various countries according to the degree of sophistication their exports to the US are specialized in; and third, they relate the degree of trade specialization in sophisticated goods to the macroeconomic performances of the various countries. To rank the 1434 goods they consider, the authors rely upon the "Product Cycle Theory" of Vernon (1966) and assume that the sooner a given good is exported the US, the less advanced it is. Thus, for each country, the authors look at the first year each given good is exported to the US, which provides a ranking of the degree of sophistication of the various goods for each country. The authors then average these rankings over all countries, developing very clever statistical methods to handle possible biases arising from missing data. This provides an overall index of the degree of sophistication of the various goods. Next, this index is mapped upon the export profile of the various countries. The mapping provides an index that measures, for each country, the degree of sophistication its exports are specializated in. Finally, the authors regress per capita GDP growth, GDP level and TFP level upon the investment rate, the initial GDP level, a political stability indicator, an index of the initial stock of human capital, the Sachs-Warner (1995) openness indicator, and their specialization index. The openness coefficient is significantly positive, indicating that openness is good for growth. The coefficient on specialization ranking is highly significant and negative, indicating that "countries which export sooner tend to grow faster". These findings remain unchanged when the dependent variable is GDP level or TFP level instead of GDP growth.

Bensidoun *et.al.* (2001) consider a sample of 53 countries, and 6 subperiods of 5 years over the span 1967-1997. For each sub-period, they regress PPP per capita growth upon the initial GDP level, the average investment rate, an average openness indicator, and a specialization indicator. More specifically, in each regression, the authors introduce an indicator measuring the intensity of specialization and an indicator measuring the “quality” of specialization. For this latter dimension, the authors consider 2 indicators in turn. First, they look at the (weighted) average per capita growth rate of countries that share the same specialization pattern as the one under investigation. Second, they introduce an indicator that gauges whether the country under investigation is specialized in products for with world demand is dynamic. It appears that all specialization variables bear the expected signs and are highly significant. This means that the growth impact of openness to trade indeed depends upon the specialization pattern.

As a conclusion, the general feeling after this brief tour of the literature is that (i) these seems to be a link between openness and growth, although maybe nonlinear and (ii) sector specialization is likely to affect this link. We now proceed to our own empirical investigation of the link between trade openness and growth and of the role sector specialization might play in the picture.

3 The Model

The model we have in mind is, in essence, a “standard” growth equation, relating growth to trade openness. Taking into account the lessons form Section 2, we add the initial income level, the investment rate, and the initial level of human capital. The baseline model thus writes:

$$G_{it} = \beta_0 + \beta_1 \ OPEN_{it} + \beta_1 \ INV_{it} + \beta_2 \ H_{0,it} + \beta_3 \ Y_{0,it} + \varepsilon_{it}$$

Where G_{it} is the growth rate of country i at time t, $OPEN$ is the degree of trade openness, INV is the investment rate, H_0 is the initial human capital level, and Y_0 is the initial income level. Our focus, however, is the impact of sector specialization, which does not appear up until this point. To take this impact into account, we construct an interaction variable between sector specialization, let $SPEC_{it}$ and openness. The model becomes:

$$G_{it} = \beta_0 + \beta_1 \ OPEN_{it} + \beta_1 \ INV_{it} + \beta_2 \ H_{it} + \beta_3 \ Y_{it} + \beta_4 \ (OPEN_{it} \times SPEC_{it}) + \varepsilon_{it}$$

The total impact of trade openness on growth is thus $\beta_1 + \beta_4 \times SPEC_{it}$. The review of the literature presented in Section 2 leads us to expect $\beta_1 > 0$ or $\beta_1 = 0$. Depending upon the particular indicator chosen to measure $SPEC_{it}$, we have different guesses for the sign of β_4. To state things simply, if the indicator under consideration measures the intensity of specialization in the “wrong” sectors, we expect $\beta_4 < 0$, whereas if it measures the intensity of specialization in the “good” sectors, we expect the opposite to occur.

Before entering a dechnical discussion on what precise indicators to choose, the issue arises of how to estimate the model. There are various ways to proceed. If we have, as we actually do, yearly data over an interval $[t_0, t_T]$, we may always consider averages over the whole period, interpret them as long-run averages, and perform a standard OLS regression, which would write:

$$G_i = \beta_0 + \beta_1\, OPEN_i + \beta_1\, INV_i + \beta_2\, H_{0,i} + \beta_3\, Y_{0,i} + \beta_4\, (OPEN_i \times SPEC_i) + \varepsilon_i$$

Where we have voluntarily removed the subscript t, to indicate the fact we are considering long-run averages. We will use this estimation strategy below.

However, OLS estimation on the basis of long-run averages has a number of drawbacks, which are fairly well summarized by Harrison (1996): "First, the use of cross-section data makes it impossible to control for unobserved country-specific differences, possibly biasing the results. Second, long-run averages or initial values for trade policy variables - particularly in developing countries - ignore the important changes which have occured over time for the *same* country." (emphasis from the original author). Therefore, we will aslo consider time-series, cross-section estimation techniques. Specifically, we will consider two panels, one with 5-years averages and the other one with 10-years averages, and estimate the model using a fixed-effect specification:

$$G_{it} = \beta_{0,i} + \beta_1\, OPEN_{it} + \beta_1\, INV_{it} + \beta_2\, H_{0,it} + \beta_3\, Y_{0,it} + \beta_4\, (OPEN_{it} \times SPEC_{it}) + \varepsilon_{it}$$

We do *not* consider a year-by-year panel specification (thus using all available data points), for the simple following conceptual reason: growth theory, and the impact of trade openness on growth, are of long- or medium-run concern. This is why we do not consider frequencies higher that 5 years growth.

4 Data Issues and Indicators

Our dependent variable is (100 times) the per capita GDP growth rate for a panel of countries described below. The source for these data is the CHELEM database published by the CEPII.

4.1 Time and country coverage

We focus upon the period 1970-2000 and a set of 48 countries. The list of countries under consideration is provided in Appendix I below. The choice of the period as well as the choice of the countries were guided by data availability considerations.

4.2 Measuring Initial Human Capital $H_{0,it}$

To measure human capital, we try a whole bunch of indicators. First, the initial gross primary ($PRIM$), secundary (SEC) and tertiary (TER) enrollment rates[2], as provided by the World Bank in its "Global Development Finance and World Development Indicators". We also make use of the celebrated the Barro-Lee (1996)dataset. Specifically we use the percentage of population with no schooling, the percentages of primary, secundary, and higher education attained, and the percentages of primary, secundary, and higher education complete in the total population

4.3 Measuring Openness

This is a difficult issue, as the literature has so often pointed out (see, e.g., Rodriguez and Rodrik, 1999). The share of trade (exports, imports, or both) in total GDP is a very commonly used measure but poses, among others, an endogeneity problem and measures the final outcome of many phenomena (among which trade policy orientation) rather than trade policy orientation itself. We prefer to rely on the Sachs and Warner (1995) openness measure. They define a country as open ($OPEN = 1$) if *none* of the 5 following conditions is fulfilled:

1. Nontariff barriers covering 40% or more of trade;
2. Average tariff rates higher or equal to 40%;
3. A black market exchange rate depreciated by 20% or more with respect to the official one, on decade average;
4. A socialist economic system
5. A state monopoly on major exports

Otherwise, if at least one of the 5 conditions above is fulfilled, the country is defined as closed ($OPEN = 0$). Interestingly, the authors have made their country openness dummy freely available on the Internet, as well as the various components upon which that dummy is built. However, as pointed out by, e.g. Edwards(1998), this openness indicator is really dichotomic: a country is either open or closed, not somewhere inbetween. This might prove an undesirable feature, since there may be substantial heterogeneity

[2] Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Estimates are based on the International Standard Classification of Education (ICSED).

within countries classified in the same category. Rodriguez and Rodrik (1999) also point out at other shortcomings of the Sachs-Warner openness dummy. Though we are aware of the weaknesses of this indicator, we take for granted the fact that no openness indicator is free from shortcomings. The SW indicator is one of the most widely used, despite its shortcomings, and we will thus use it too.

4.4 Measuring Specialization

Measuring specialization is no easy task. The first problem one encounters is that specialization may be used in various meanings and designate different concepts. Are we interested in specialization in trade or in production ? Are we interested in intra-industry vs inter-industry trade specialization ? Are we trying to examine whether it is good to be specialized as such, i.e; the role played by the intensity of specialization, no matter the sector pattern, or are we looking at the importance of the sector specialization pattern, no matter the intensity of specialization ? Should we consider a large number of sectors or only some meaningful aggregates ?

Faced with these problems, we decide to focus upon trade specialization indicators, and to consider a variety of them, covering various complementary aspects of the concept. We consider to categories of indicators: specialization intensity indicators, which measure the intensity of specialization regardless of the sector pattern, and "structure" indicators, which try to capture the sector pattern of specialization and its adequacy to world markets. To save on space, the exact definitions of these indicators as well as the equations for computing them, are provided in Appendix II below. Here, we only introduce the notations, intuitions and the rationales for these indicators.

4.4.1 Specialization Structure Indicators

- I_i is a Michaeli indicator for the importance of intra-industry trade (versus inter-industry trade) in country i. The index is such that $0 \leq I_i \leq 1$. The closer it is to one, the more trade is of an intra-industry nature.

- The adjusted contribution of sector k to the trabe balance of country i, $\widetilde{CTB}_i^k$, as devised by Bensidoun *et. al.* (2001). This variable compares the observed trade balance in the various sectors to what they would be in the absence of specialization. To get rid of size effects, the outcomes are normalized so that positive contributions sum to 100 and negative ones sum to -100 (this is why we say *adjusted* contributions).

- The adjusted contributions to the trade balance can also be used to measure the distance in specialization pattern between any given country i and the various other countries. Then, it is possible to weight the growth rates of these countries by their distance in specialization with country i and to compute the (weighted) average growth rate of countries sharing the same specialization pattern as country i as shown by Bensidoun *et. al.* (2001). We note this index $GSIM_i$ and present the details of its construction insee Appendix II below.

- We also consider the trade dissimilarity index devised by Busson and Villa (1994), which we call A_i. This index compares the structure of exports in country i to the World structure of exports (see Appendix II for technical details). The index is such that $0 \leq A_i \leq 1$. The closer to 1, the more country i exports structure is specialized in sectors with weak international demand. The closer to 0, the more country i exports structure in biased towards sectors where international demand is vigorous.

- As explained by Bensidoun *et. al.* (2001), the adjusted contributions to the trade balance can also be used to devise an adaptation indicator, let AD_i for country i. This index actually compares the various adjusted sector contributions to the evolution of the share of these products in world trade flows. It is comprised between 0 and 1. The closer to 1, the more the specialization pattern of country i rests on dynamic products.

4.4.2 Specialization Intensity Indicators

- The specialization intensity indicator for country i devised by Busson and Villa (1994), noted IS_i, which is the standard deviation (over sectors) of the various sector contributions to the trade balance.

- In the same vein, we also use Herfindahl indicators for exports shares in total trade of country i, which we note $XHERF_i$[3]. These variables are also meant to capture the intensity of specialization

Regarding the optimal degree of sector disaggregation, there is a trade-off. If one considers a very shrewd, detailed, disaggregation, with a large number of very narrowly defined sectors, most economies will appear highly specialized, and most trade will appear as inter-industry. On the other hand, a small number of very large and loosely defined sectors will make most

[3]We are planning to build the same indicator for imports and for total trade (i.e. exports plus imports)

economies weakly specialized and trade will mostly appear as intra-industry. faced with this problem, we have chosen to pursue 2 strategies in parallel: we will consider the various indicators described above both with 2 different sector disaggregation levels. First, we will use the full 69-products disaggregation provided by the CEPII, and build (with obvious notations) $I69_i$, $GSIM69_i$, $A69_i$, $AD69_i$, $IS69_i$, and $XHERF69_i$. Second, the CEPII also provides a 6-sectors disaggregation in terms of production stages: primary goods, basic manufactures, intermediates, equipment goods, mixed goods and (final) consumption goods. We have chosen to consider this disaggregation because it is in line with theories that predict a differentiated impact of openness depending upon trade specialization, and in particular those based upon learning-by-doing phenomena (see, e.g. Young, 1991). This yields, with obvious notations, the indicators $I6_i$, $GSIM6_i$, $A6_i$, $AD6_i$, $IS6_i$, and $XHERF6_i$. We add to that $CTBPRIM_i$ and $CTBCONS_i$, the adjusted contributions to the trade balance from primary and consumption goods, respectively.

The data source for the ingredients needed in building these indicators is the CHELEM database from CEPII.

5 Some Stylized Facts

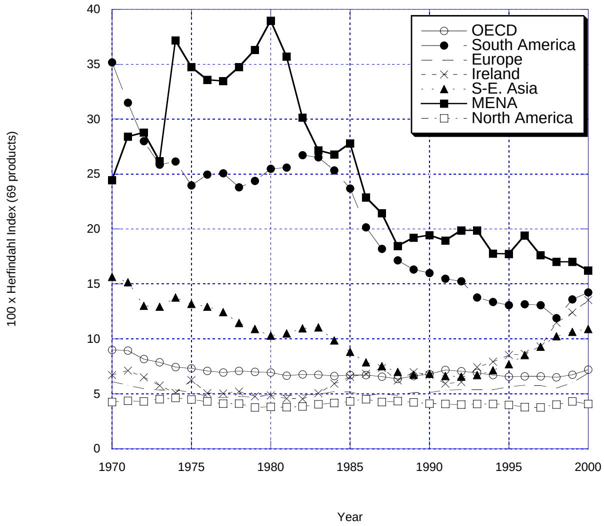
5.1 The Intensity of Specialization

Figure 1 describes the evolution of specialization intensity for selected groups of countries. The intensity of exports specialization has experienced various evolution patterns across these groups over the period 1970-2000. On the one hand, developed countries have started the period with low specialization intensity. Over the period, specialization intensity has remained stable and no sensible evolution has occured, at the exception of Ireland, whose specialization intensity increased a lot from the late 80's on. On the other hand, both the MENA region and South-America experienced a large and monotonous decline in their specialization intensity pattern over the same period. Finally, South-East Asia experienced still another different evolution, with a marked decline in specialization up until the late of the 80's and then specialization increased markedly in the 90's.

5.2 The Nature of Specialization

In order to assess how the nature of specialization has evolved between 1970 and 2000, we have chosen to look at the evolution of the Micheali index for

Figure 1: Herfindahl Index For Exports (69 products)



intra-industry trade for (see eqn. (1) in Appendix II) upon the 69 products decomposition and some selected groups of countries. The closer to 100, the more trade has an inter-industry nature and, conversely, the closer to 0, the more trade has an intra-industry nature. These evolutions are depicted on Figure 2

Everywhere, these seems to be a decline in inter-industry trade and an increase in intra-industry trade. South-East Asia is the region where inter-industry trade declined the fastest. Europe and North-America started from already low levels and followed parallel evolutions. The MENA region first experienced an *increase* in inter-industry trade during the first part of the period under investigation (up until 1985), followed by a slow decrease afterwards. Finally, South-America followed a path parallel to the one of South-East Asia, but started the period at a higher level of inter-industry trade.

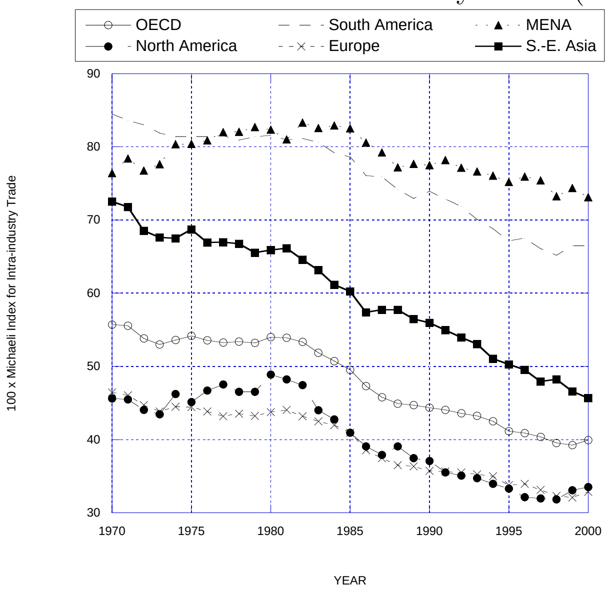
6 Estimation Results

6.1 Cross-Section OLS Estimates

Regarding pure cross-section estimations, we have also considered a number of regional dummies. In particular, we have considered many possibilities:

- A variable indicating whether or not the country belongs to the OPEC;
- A variable indicating whether the country produces oil (OIL = OPEC + Canada, Mexico, Norway, The United Kingdom and the USA).

Figure 2: Michaeli Index For Inter-Tndustry Trade (69 products)



- A series of regional dummies : EAP (East Asia and Pacific), ECA (Eastern Europe and Central Asia), $MENA$ (Middle-East North Africa), SA (South Asia), WE (Western Europe), NA (North America), SSA (Sub-Saharian Africa), LAC (Latin-America and Caribbean), $LANDLOCK$ (a dummy for land-locked countries)
- A dummy for OECD member countries;
- The portion of the country's territory situated in tropical zone.

Among these variables, we have only considered those that remained significant over a large number of specifications. This lead us to retain only EAP, SA and SSA.

Our results are provided in Tables 1 and 2 below, for primary and secundary school enrollment rates respectively. To save on space, we do not report results with the human capital variables, which are qualutatively similar to these ones. For the very same reason, we have also voluntarily dropped the overall constant as well as the coefficients on regional dummies to save on space. The first row corresponds to a base-case specification with no specialization indicator. The subsequent rows correspond to the various specifications under investigation.

The openness dummy is always positive and significant, except when $GSIM$, the average growth of countries sharing the same specialization pattern is considered. The *intensity* of specialization, as measured by Herfindahl indexes for exports, seems to significantly weaken this positive impact of openness upon growth (the p-value of the coefficient on the interaction variable between $OPEN$ and $XHERF$ varies between 7.2 % and 8.6 %). By contrast, the IS indicator is never significant. Regarding the *nature* of specialization, whatever the level of sector disaggregation, the coefficient on I_i is always significantly negative. Which means that the postive effect of openness is reduced for countries engaging mainly in inter-industry trade. On the other hand, the coefficient on $CTBPRIM$ is significantly negative at the 10 % level, indicating that the benefitial effects of openness are reduced for countries specialized in primary products. For both phenomena, specialization in inter-industry trade and in primary products, point estimates suggest however that the negative impact is not large enough to offset the beneficial impact of openness (i.e. the point estimates of the coefficients on $OPEN$ are much larger, in absolute value, than the ones on the interaction variables).

Regarding the initial human capital stock, its coefficient is never significant. By contrast, the coefficient on initial income level is significantly negative across all specifications, which indicates some convergence between initially rich and poor countries.

Table 1: Cross-Section Estimates With Primary Enrollment rate

Variable	INV	$OPEN$	$OPEN \times SPEC$	$PRIM$	Y_0	Nb. Obs	R2
$SPEC$ indicator:							
None	0.0649	1.7340		-0.0017	-0.0001	43	0.61
t-Stat	1.69	4.08		-0.16	-2.67		
$XHERF69$	0.0600	2.3182	-0.0284	-0.0035	-0.0001	43	0.65
t-Stat	1.62	4.46	-1.84	-0.34	-3.30		
$XHERF6$	0.0540	2.9919	-0.0326	-0.0036	-0.0001	43	0.65
t-Stat	1.44	3.78	-1.86	-0.35	-3.33		
$IS69$	0.0647	1.6259	0.0065	-0.0026	-0.0001	43	0.62
t-Stat	1.68	3.53	0.64	-0.24	-2.68		
$IS6$	0.0648	1.7226	0.0002	-0.0018	-0.0001	43	0.62
t-Stat	1.67	3.69	0.06	-0.16	-2.63		
$A69$	0.0681	2.6999	-0.0164	-0.0026	-0.0001	43	0.62
t-Stat	1.76	2.19	-0.84	-0.24	-2.62		
$A6$	0.0637	2.5968	-0.0230	-0.0027	-0.0001	43	0.63
t-Stat	1.67	2.87	-1.08	-0.26	-2.82		
$AD69$	0.0648	1.4289	0.0129	-0.0027	-0.0001	43	0.62
t-Stat	1.68	1.89	0.49	-0.24	-2.68		
$AD6$	0.0671	1.8163	-0.0044	-0.0017	-0.0001	43	0.62
t-Stat	1.72	3.88	-0.45	-0.16	-2.53		
$CTBCONS$	0.0641	1.6551	0.0065	-0.0050	-0.0001	43	0.63
t-Stat	1.68	3.84	1.08	-0.45	-2.61		
$CTBPRIM$	0.0575	1.8669	-0.0062	-0.0045	-0.0001	43	0.65
t-Stat	1.54	4.44	-1.75	-0.44	-3.21		
$I69$	0.0635	3.8711	-0.0327	-0.0041	-0.0001	43	0.66
t-Stat	1.74	3.57	-2.12	-0.41	-3.51		
$I6$	0.0595	3.1703	-0.0325	-0.0028	-0.0001	43	0.67
t-Stat	1.64	4.27	-2.30	-0.28	-3.57		
$GSIM69$	0.0651	2.6706	-0.4342	-0.0020	-0.0001	43	0.62
t-Stat	1.68	1.25	-0.45	-0.18	-2.55		
$GSIM6$	0.0656	2.1982	-0.2188	-0.0019	-0.0001	43	0.62
t-Stat	1.69	1.17	-0.25	-0.17	-2.50		

Table 2: Cross-Section Estimates With Secundary Enrollment rate

Variable:	INV	$OPEN$	$OPEN \times SPEC$	SEC	Y_0	NB. Obs.	R2
$SPEC$ indicator:							
None	0.0681	1.6290		0.0083	-0.0001	44	0.61
t-stat.	1.78	3.76		0.54	-1.99		
$XHERF69$	0.0624	2.2163	-0.0275	0.0046	-0.0001	44	0.64
t-stat.	1.67	4.14	-1.78	0.31	-2.35		
$XHERF6$	0.0552	2.8946	-0.0316	0.0016	-0.0001	44	0.64
t-stat.	1.46	3.48	-1.77	0.11	-2.34		
$IS69$	0.0685	1.5172	0.0063	0.0087	-0.0001	44	0.62
t-stat.	1.78	3.22	0.64	0.56	-2.02		
$IS6$	0.0681	1.6201	0.0002	0.0083	-0.0001	44	0.61
t-stat.	1.75	3.40	0.05	0.53	-1.96		
$A69$	0.0717	2.5566	-0.0159	0.0085	-0.0001	44	0.62
t-stat.	1.85	2.11	-0.82	0.55	-2.14		
$A6$	0.0665	2.4365	-0.0212	0.0065	-0.0001	44	0.62
t-stat.	1.74	2.67	-1.00	0.42	-2.19		
$AD69$	0.0690	1.3021	0.0134	0.0092	-0.0001	44	0.62
t-stat.	1.78	1.70	0.52	0.59	-2.03		
$AD6$	0.0713	1.7167	-0.0052	0.0095	-0.0001	44	0.62
t-stat.	1.82	3.67	-0.53	0.60	-1.99		
$CTBCONS$	0.0701	1.5197	0.0064	0.0109	-0.0001	44	0.63
t-stat.	1.84	3.43	1.10	0.70	-2.11		
$CTBPRIM$	0.0618	1.7552	-0.0059	0.0070	-0.0001	44	0.64
t-stat.	1.65	4.09	-1.69	0.47	-2.34		
$I69$	0.0680	3.6974	-0.0319	0.0087	-0.0002	44	0.66
t-stat.	1.86	3.46	-2.10	0.59	-2.69		
$I6$	0.0614	3.0506	-0.0316	0.0045	-0.0001	44	0.66
t-stat.	1.69	4.03	-2.24	0.31	-2.49		
$GSIM69$	0.0700	2.9292	-0.6133	0.0110	-0.0001	44	0.62
t-stat.	1.81	1.36	-0.62	0.68	-2.05		
$GSIM6$	0.0708	2.4631	-0.4024	0.0107	-0.0001	44	0.61
t-stat.	1.81	1.29	-0.45	0.65	-2.01		

6.2 Fixed-Effects Panel Estimates - 10 year Averages

Regarding panel data estimations, we do not consider the regional dummies, since we have a fixed-effects specification. Our results are reported in Tables 3 and 4 for the primary and secundary enrollment rates, respectively. Again, we have done the computations with our whole set of human capital variables, but our other results are qualitatively extremely similar, so we do not report them here. To save on space also, we do not report the F-stat for the existence of fixed effects, since it is systematically significant at the 1% level.

Regarding the openness dummy, it is significant at conventional levels in 3 cases only: with the Herfindahl indexes and with the trade dissimilarity Index A_i. Moreover, contrarily to the pure cross-section specification above, when openness is significant, it bears a *negative* sign here.

Let us now examine the behaviour of the interaction variable. Regarding the intensity of specialization as measured by $XHERF$, the picture we get is exactly the converse of the pure cross-section estimates: the coefficient on the interaction variable is now significant at the 10 % level, but positive.

The coefficient on initial income is again consistently significantly negative across all specifications, indicating some convergence phenomena. However, we are really puzzled by the fact that the coefficient on initial huuman capital in also significantly negative in nearly all specifications.

Table 3: Panel (10-yrs. averages) Estimates With Primary Enrollment Rate

VARIABLE	INV	$OPEN$	$OPEN \times SPEC$	Y_0	$PRIM$	Nb. Obs.	R2
$SPEC.$ indicator:							
None	0.0090	0.1941		-0.0001	-0.0410	132	0.71
t-stat	0.27	0.49		-4.82	-3.60		
$IS69$	0.0224	-0.3377	0.0237	-0.0001	-0.0404	132	0.72
t-Stat.	0.62	-0.80	1.86	-4.29	-3.78		
$IS6$	0.0091	0.0065	0.0040	-0.0001	-0.0420	132	0.71
t-Stat.	0.27	0.02	0.77	-4.82	-3.62		
$XHERF69$	0.0313	-1.1770	8.0129	-0.0001	-0.0323	132	0.75
t-Stat.	0.92	-2.70	5.60	-3.84	-3.25		
$XHERF6$	0.0232	-1.3265	4.5081	-0.0001	-0.0369	132	0.72
t-Stat.	0.67	-1.86	2.12	-4.52	-3.47		
$A69$	0.0328	-3.3948	0.0584	-0.0001	-0.0355	132	0.72
t-Stat.	0.89	-1.86	1.93	-2.75	-3.37		
$A6$	0.0284	-1.0815	0.0360	-0.0001	-0.0366	132	0.72
t-Stat.	0.77	-1.55	1.84	-3.67	-3.42		
$AD69$	0.0104	-0.0272	0.0102	-0.0002	-0.0410	132	0.71
t-Stat.	0.31	-0.06	0.93	-4.96	-3.60		
$AD6$	0.0131	0.0311	0.0103	-0.0002	-0.0387	132	0.71
t-Stat.	0.39	0.08	1.92	-5.05	-3.62		
$CTBCONS$	0.0216	0.3742	-0.0090	-0.0002	-0.0390	132	0.71
t-Stat.	0.58	0.88	-1.44	-4.85	-3.43		
$CTBPRIM$	0.0143	-0.0514	0.0070	-0.0002	-0.0409	132	0.71
t-Stat.	0.42	-0.14	1.84	-5.06	-3.57		
$GSIM69$	0.0076	-0.2358	0.2232	-0.0001	-0.0395	132	0.71
t-Stat.	0.22	-0.44	0.96	-2.83	-3.65		
$GSIM6$	0.0083	-0.1054	0.1515	-0.0001	-0.0399	132	0.71
t-Stat.	0.24	-0.18	0.60	-2.99	-3.68		
$I69$	0.0136	-0.8297	0.0146	-0.0001	-0.0404	132	0.71
t-Stat.	0.39	-0.71	0.82	-3.47	-3.62		
$I6$	0.0118	-0.5127	0.0155	-0.0001	-0.0402	132	0.71
t-Stat.	0.35	-0.75	1.02	-3.95	-3.63		

Table 4: Panel (10-yrs. averages) Estimates With Secundary Enrollment Rate

Variable	INV	$OPEN$	$OPEN \times SPEC$	Y_0	SEC	Nb. Obs.	R2
$SPEC.$ indicator:							
None	0.014	0.5269		-0.0001	-0.0317	132	0.66
t-stat	0.68	1.22		-2.14	-2.56		
$IS69$	0.0260	0.0586	0.0189	-0.0001	-0.0281	132	0.67
t-Stat.	0.70	0.13	1.50	-2.18	-2.43		
$IS6$	0.0141	0.4628	0.0013	-0.0001	-0.0315	132	0.66
t-Stat.	0.41	1.03	0.30	-2.11	-2.55		
$XHERF69$	0.0389	-0.9456	7.6579	-0.0001	-0.0177	132	0.70
t-Stat.	1.10	-1.89	4.36	-2.39	-1.61		
$XHERF6$	0.0281	-0.8311	3.7767	-0.0001	-0.0245	132	0.67
t-Stat.	0.77	-1.09	1.67	-2.34	-2.15		
$A69$	0.0361	-2.6902	0.0511	-0.0001	-0.0248	132	0.67
t-Stat.	0.94	-1.37	1.58	-1.33	-2.06		
$A6$	0.0324	-0.6970	0.0330	-0.0001	-0.0267	132	0.67
t-Stat.	0.84	-0.96	1.67	-1.68	-2.26		
$AD69$	0.0153	0.2673	0.0121	-0.0001	-0.0319	132	0.66
t-Stat.	0.45	0.56	1.06	-2.22	-2.60		
$AD6$	0.0182	0.3453	0.0092	-0.0001	-0.0285	132	0.67
t-Stat.	0.53	0.85	1.81	-2.47	-2.45		
$CTBCONS$	0.0266	0.6786	-0.0087	-0.0001	-0.0296	132	0.67
t-Stat.	0.69	1.47	-1.34	-2.30	-2.41		
$CTBPRIM$	0.0191	0.3022	0.0060	-0.0001	-0.0305	132	0.67
t-Stat.	0.54	0.75	1.56	-2.32	-2.51		
$GSIM69$	0.0137	0.2426	0.1409	-0.0001	-0.0305	132	0.66
t-Stat.	0.40	0.42	0.58	-1.32	-2.54		
$GSIM6$	0.0138	0.3455	0.0879	-0.0001	-0.0310	132	0.66
t-Stat.	0.40	0.57	0.36	-1.45	-2.57		
$I69$	0.0133	0.6485	-0.0017	-0.0001	-0.0320	132	0.66
t-Stat.	0.36	0.52	-0.09	-1.94	-2.46		
$I6$	0.0159	0.1340	0.0083	-0.0001	-0.0304	132	0.66
t-Stat.	0.45	0.20	0.58	-1.90	-2.46		

6.3 Fixed-Effects Panel Estimates - 5 year Averages

Regarding the specification with 5-years averages, our results are reported in Tables 5 and 6 for the primary and secundary enrollment rates, respectively. As explained above, a series of other qualitatively similar results, obtained with other initial human capital proxies are not reported here for the sake of clarity.

The most striking point in these results is that the openness dummy is no longer significant in any specification. The interaction variable is significant in two cases only, namely the specifications (both of them) with $GSIM$. In these cases, the coefficient is significantly positive, which corresponds to intuition.

As in our previous results, the coefficient on initial income level is significantly negative, which indicates that some convergense process is taking place. However, regarding initial human capital, we are left with the very same puzzle as in Tables 3 and 4, for which we have, for the time being, no consistent explanation.

A possible cause for these bizarre results is the composition of the sample in the panel estimates. One route we will follow is to consider subsamples (Oecd, nonoil producers, developing countries,. . .).

Table 5: Panel (5-yrs. averages) Estimates With Primary Enrollment Rate

Variable	INV	$OPEN$	$OPEN \times SPEC$	Y_0	$PRIM$	Nb. Obs.	R2
$SPEC$. indicator:							
None	0.0253	0.4292		-0.0002	-0.0576	220	0.50
t-Stat.	0.57	0.48		-4.31	-2.90		
$IS69$	0.0278	0.1514	0.0119	-0.0002	-0.0568	220	0.50
t-Stat.	0.61	0.22	0.66	-4.26	-2.87		
$IS6$	0.0256	0.4994	-0.0015	-0.0002	-0.0575	220	0.50
t-Stat.	0.57	0.71	-0.20	-4.32	-2.88		
$XHERF69$	0.0353	-0.5741	5.5157	-0.0002	-0.0513	220	0.51
t-Stat.	0.78	-0.74	1.70	-3.79	-2.56		
$XHERF6$	0.0273	-0.0559	1.3617	-0.0002	-0.0562	220	0.50
t-Stat.	0.61	-0.05	0.53	-4.24	-2.84		
$A69$	0.0317	-1.4278	0.0295	-0.0002	-0.0556	220	0.50
t-Stat.	0.67	-0.57	0.68	-3.00	-2.79		
$A6$	0.0299	-0.2313	0.0180	-0.0002	-0.0559	220	0.50
t-Stat.	0.64	-0.24	0.72	-3.60	-2.81		
$AD69$	0.0254	0.3816	0.0021	-0.0002	-0.0575	220	0.50
t-Stat.	0.57	0.51	0.16	-4.33	-2.89		
$AD6$	0.0284	0.3101	0.0069	-0.0002	-0.0559	220	0.50
t-Stat.	0.63	0.50	1.25	-4.46	-2.82		
$CTBCONS$	0.0268	0.4687	-0.0022	-0.0002	-0.0572	220	0.50
t-Stat.	0.58	0.70	-0.26	-4.31	-2.87		
$CTBPRIM$	0.0262	0.2794	0.0044	-0.0002	-0.0570	220	0.50
t-Stat.	0.59	0.46	1.08	-4.36	-2.88		
$GSIM69$	0.0274	-0.6592	0.5342	-0.0001	-0.0540	220	0.51
t-Stat.	0.61	-0.93	3.38	-2.25	-2.71		
$GSIM6$	0.0301	-0.7914	0.5874	-0.0001	-0.0526	220	0.52
t-Stat.	0.68	-1.10	3.57	-2.14	-2.64		
$I69$	0.0247	0.6494	-0.0031	-0.0002	-0.0578	220	0.50
t-Stat.	0.54	0.39	-0.12	-3.51	-2.90		
$I6$	0.0265	-0.0826	0.0110	-0.0002	-0.0566	220	0.50
t-Stat.	0.59	-0.09	0.62	-3.77	-2.84		

Table 6: Panel (5-yrs. averages) Estimates With Secundary Enrollment Rate

Variable	INV	$OPEN$	$OPEN \times SPEC$	Y_0	SEC	Nb. Obs.	R2
$SPEC$. indicator:							
None	0.0294	0.7049		-0.0001	-0.0286	220	
t-Stat.	0.64	1.12		-2.33	-1.87		
IS69	0.0316	0.4609	0.0098	-0.0001	-0.0270	220	0.46
t-Stat.	0.67	0.66	0.54	-2.39	-1.78		
IS6	0.0304	0.9034	-0.0040	-0.0001	-0.0292	220	0.46
t-Stat.	0.66	1.27	-0.59	-2.33	-1.89		
XHERF69	0.0418	-0.4738	5.9560	-0.0001	-0.0189	220	0.47
t-Stat.	0.89	-0.61	1.80	-2.44	-1.28		
XHERF6	0.0314	0.2709	1.1600	-0.0001	-0.0265	220	0.46
t-Stat.	0.68	0.26	0.46	-2.38	-1.78		
A69	0.0369	-1.2978	0.0313	-0.0001	-0.0253	220	0.46
t-Stat.	0.74	-0.49	0.69	-1.85	-1.61		
A6	0.0354	-0.1006	0.0212	-0.0001	-0.0258	220	0.46
t-Stat.	0.74	-0.10	0.82	-2.08	-1.67		
AD69	0.0295	0.6040	0.0046	-0.0001	-0.0287	220	0.46
t-Stat.	0.64	0.78	0.32	-2.35	-1.87		
AD6	0.0338	0.5317	0.0093	-0.0001	-0.0273	220	0.46
t-Stat.	0.73	0.84	1.70	-2.69	-1.83		
CTBCONS	0.0319	0.7584	-0.0034	-0.0001	-0.0279	220	0.46
t-Stat.	0.67	1.10	-0.38	-2.36	-1.80		
CTBPRIM	0.0305	0.5536	0.0041	-0.0001	-0.0273	220	0.46
t-Stat.	0.66	0.89	1.04	-2.43	-1.79		
GSIM69	0.0324	-0.3947	0.5228	-0.0001	-0.0251	220	0.47
t-Stat.	0.70	-0.55	3.17	-1.05	-1.68		
GSIM6	0.0344	-0.5530	0.5902	-0.0001	-0.0253	220	0.48
t-Stat.	0.75	-0.77	3.54	-0.91	-1.72		
I69	0.0269	1.5971	-0.0121	-0.0001	-0.0306	220	0.46
t-Stat.	0.57	0.87	-0.45	-2.26	-1.87		
I6	0.0306	0.2621	0.0092	-0.0001	-0.0271	220	0.46
t-Stat.	0.66	0.29	0.52	-2.19	-1.75		

7 Conclusions

Our empirical investigations have reached conclusive results with the cross-section specification. As in most of the previous literature an trade and growth issues, openness comes out with a significantly positive coefficient, which implies that outward orientation is good for growth. However, this optimism should be tempered because the very same estimates show that the pattern of sector specialization is not neutral, as suggested by recent models of endogenous growth theory and already evidenced by a few recent papers. When turning to a panel specification, we also show that neither trade openness, nor the pattern of sector specialization are neutral with respect to long-run growth. However, our panel results are inconsistent with both our cross-section estimates and the rest of the literature. We believe that these can be improved a lot.

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APPENDIX I: List of Countries Under Consideration

Algeria	Greece	Pakistan
Argentina	Hong-Kong	Peru
Austria	Iceland	Portugal
Austria	India	Singapore
Belgium*	Indonesia	South Africa**
Brazil	Ireland	Spain
Canada	Israel	Sweden
Chile	Italy	Switzerland
Colombia	Japan	Taiwan
Denmark	Korea (South -)	Thailand
Ecuador	Malaysia	The Netherlands
Egypt	Mexico	The Philippines
Finland	Morocco	Tunisia
France	New-Zealand	Turkey
Gabon	Nigeria	United States of America
Great-Britain	Norway	Venezuela

*: Belgium-Luxembourg Economic Union

**: South-African Economic Union

APPENDIX II: Trade Specialisation Indicators

The aim of this appendix is to provide an account of the various specialization indicators used in this research. We do not intend to discuss their advantages and drawbacks, but simply to present with a uniform notation how they are computed.

Notations:

Throughout this Appendix, we use a very standard and consistent set of notations, that we briefly introduce here (to save on space, possible time subscripts are omitted):

- Y_i : GDP of country i
- X_{ij}^k : Exports from country i to country j in sector k
- M_{ij}^k : Imports into country i from country j in sector k
- X_i^k : Exports from country i in sector k
- M_i^k : Imports into country i in sector k
- C_i^k: Apparent consumption i in sector $k = shipments_i^k + M_i^k - X_i^k$
- X_i : Total exports from country i
- X_{ij} : Total exports from country i to country j
- M_i : Total imports into country i
- X_{ij} : Total imports into country i from country j
- W^k : World thade in good k = world exports of good k = world imports of good k
- W : Total world trade = world total exports = world total imports

Specialization Structure Indicators

The Michaeli Inter-Industry Trade Specialization Indicator

Busson and Villa (1994) make use of the Michaeli trade specialization indicator in order to measure the degree of inter-industry trade specialization. For country i, the index is computed as follows:

$$I_i = \frac{100}{2} \sum_k \left| \frac{X_i^k}{X_i} - \frac{M_i^k}{M_i} \right| \tag{1}$$

The index is such that $0 \leq I_i \leq 100$. The higher the I_i index, the more trade is of inter-industry nature. Conversely, the lower the I_i, the more the country engages in intra-industry trade.

Adjusted Contributions to the Trade Balance

This indicator from rests upon an indicator of contribution to the trade balance described in Bensidoun *et. al.* (2001). This latter indicator is computed as follows:

$$CTB_i^k = \left[\frac{1000}{Y_i}\right] \times \left[\left(X_i^k - M_i^k\right) - \sum_k \left\{\left(X_i^k - M_i^k\right)\left(\frac{\left(X_i^k + M_i^k\right)}{\sum_k \left(X_i^k + M_i^k\right)}\right)\right\}\right] \tag{2}$$

The adjusted contributions to the trade balance, let $\widetilde{CTB}_i^k$, are merely a re-normalization of the various CTB_i^k 's, obtained by multiplying them by a coefficient such that the sum of the positive contributions equals 100 and that the sum of the negative contributions equals -100. Besides, in order to smooth the possibly substantial yearly variations in the sectoral composition of world trade flows, one multiplies all X_i^k and M_i^k by smoothing coefficients e_t^k, which are computed as follows for a base year t_0:

$$e_t^k = \frac{\left[\frac{W^k}{W}\right]_{t_0}}{\left[\frac{W^k}{W}\right]_t}$$

The Specialization Similarity Indicator $GSIM_i$

The distance between two specialization profiles can be computed as:

$$SIM_{ij} = 100 - \frac{1}{4} \sum_k \left| \widetilde{CTB}_i^k - \widetilde{CTB}_j^k \right|$$

With that indicator in hand, it is possible to compute the weighted average growth rate of countries sharing a similar specialization pattern with i. Let thus SIM_{ij}^{0} the base year specialization similarity indicators, and gy_j^T denote country j per capita average GDP growth rate between the base year 0 and the end-of-period year T. The weighted average growth rate of countries sharing a similar specialization pattern with i is given by:

$$GSIM_i = \sum_j gy_j^T \times \frac{SIM_{ij}^0}{\sum_j SIM_{ij}^0} \qquad (3)$$

The Trade Dissimilarity Index A_i

The trade dissimilarity index is computed as follows:

$$A_i = \frac{1}{2} \sum_k \left| \frac{X_i^k}{X_i} - \frac{X^k}{X} \right| \qquad (4)$$

The index thus compares, for each sector k, its share in the total exports of country i to its share of the same sector in world total exports and then aggregates these comparisons. The closer to 0 the index, the more country i trade specialization structure resembles the structure of world demand. by contrast, if the index is close to 1, this means that the trade structure of country i fails to match the structure of world demand.

The Adaptation Indicator AD_i

The adjusted contributions to the trade balance can also be used to devise an adaption indicator, as explained by Bensidoun *et. al.* (2001). This indicator, let AD_i, is given by:

$$AD_i = 100 - \frac{1}{4} \sum_k \left| \widetilde{CTB}_{i,t_0}^k - \Delta \frac{X^k}{X} \right| \qquad (5)$$

The indicator thus compares the adjusted contributions to the trade balance in a base year t_0 for the various products k to the evolution of world market shares for these products over a period starting from t_0 and ending at some prespecified moment. The higher the indicator (there is an upper bound at 100), the more the country was specialized, at start, in products for which world demand would evolve vigorously.

Specialization Intensity Indicators

The Specialization Intensity Indicator IS_i

The Specialization Intensity Indicator devised by Bensidoun *et. al.* (2001) rests upon the various sector contributions to the trade balance, as given by Equation (2) and is given by:

$$IS_i = \sqrt{\frac{1}{K} \sum_{k=1}^{K} \left[CTB_i^k\right]^2} \tag{6}$$

The Herfindahl Specialization Indicator

All the indicators presented above measure specialization in trade. Weinhold et Rauch (1997), by contrast, use the celebrated Herfinfdahl concentration index to compute a series of of *specialization in production* indicators. We use the same idea to build simple trade specialization indicators. For any given country i, and K traded products, these are given by:

$$XHERF_i = 100 \times \sum_{k=1}^{K} \left[\frac{X_i^k}{X_i}\right]^2 \tag{7}$$

We have multiplied the conventional index by 100 to gain on scale homogeneity across variables.