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HOW EXPORTS MATTER: TRADE PATTERNS OVER DEVELOPMENT STAGES

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ABSTRACT

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In this paper we first propose a proxy for the maturity of a country's export bundle based on product life cycle theory. Employing a conditional latent class model, we then examine the effect of maturity of countries' exports on their economic growth for 98 countries over the period 1988 to 2005. We find that this effect is different across three endogenously determined growth regimes and that real GDP per capita predicts the regime membership. We show that the richest countries grow faster when they specialize in less mature products in an advanced country regime. The effect of maturity turns insignificant for the least advanced countries in our developing country regime. And at intermediate levels of GDP per capita, in an emerging country regime, countries grow faster and exhibit strong convergence by exporting more mature products. Our results confirm earlier evidence that what you export matters for growth. But more importantly, our analysis shows that when you export matters too. Countries in early stages of development should focus on acquiring market share in mature markets with routine technologies whereas emerging economies face the challenge of at some point switching from mature to new products as they approach the technology frontier. At that frontier they must join the advanced economies who continuously switch into (increasingly) less mature innovative products to stay ahead of increasing competition from abroad.

JEL Classification: F14 and O00
Keywords: conditional latent class model, economic growth, export dynamics, maturity and product cycle

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How Exports Matter: Trade Patterns over Development Stages

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Abstract

In this paper we first propose a proxy for the maturity of a country's export bundle based on product life cycle theory. Employing a conditional latent class model, we then examine the effect of maturity of countries' exports on their economic growth for 98 countries over the period 1988 to 2005. We find that this effect is different across three endogenously determined growth regimes and that real GDP per capita predicts the regime membership. We show that the richest countries grow faster when they specialize in less mature products in an advanced country regime. The effect of maturity turns insignificant for the least advanced countries in our developing country regime. And at intermediate levels of GDP per capita, in an emerging country regime, countries grow faster and exhibit strong convergence by exporting more mature products. Our results confirm earlier evidence that *what* you export matters for growth. But more importantly, our analysis shows that *when* you export matters too. Countries in early stages of development should focus on acquiring market share in mature markets with routine technologies whereas emerging economies face the challenge of at some point switching from mature to new products as they approach the technology frontier. At that frontier they must join the advanced economies who continuously switch into (increasingly) less mature innovative products to stay ahead of increasing competition from abroad.

Keywords: Product Cycle, Export Dynamics, Maturity, Economic Growth, Conditional Latent Class Model
JEL: F14, O00

1. Introduction

Competitiveness in global markets seems to be the key to development and higher standards of living. Specializing in the "right" products and markets helps countries move ahead, whereas a focus on the "wrong" export bundle can keep a nation in a poverty trap (Redding, 2002; Bensidoun et al., 2002; Hausmann et al., 2007). But despite the fact that much of the academic literature on this topic stresses the dynamic nature of comparative advantage, it fails to consider that "right" and "wrong" are not absolutes. The right products in early stages of development may well be different from the right products in advanced countries and the bundle of right and wrong products changes over time as products mature over their life cycle. In this paper we propose an index for product maturity and show that the growth performance of a country depends on the maturity of its exports in a non-linear way over three development stages.

☆We would like to thank Jaap Bos, Clemens Kool, Claire Economidou, Charles van Marrewijk, John Sutton, Steve Klepper, Andrew Bernard and seminar participants at DIME Workshop: Economic Geography and Industrial Dynamics 2010 in Utrecht, Singapore Economic Review Conference 2011 in Singapore, European Economic Association Annual Meeting 2011 in Norway for their valuable comments. Lu Zhang gratefully acknowledge the financial support from Netherlands Organization for Scientific Research(NWO). The usual disclaimer applies.

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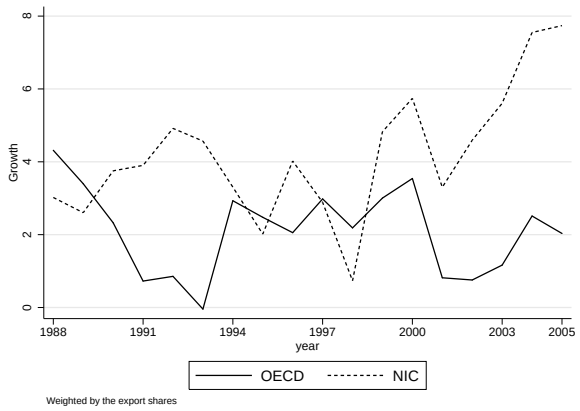
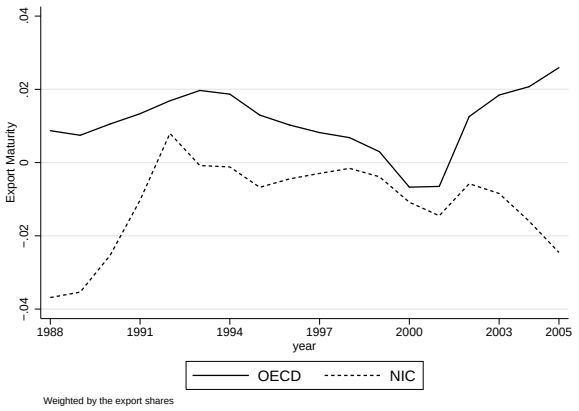
Linking the product life cycle stage of exports to a country's growth performance helps us explain a few of the most salient features of global trade and development in recent decades. Figure (1a) shows growth in the OECD was depressed in the early 90s and 00s and has not reached more than 4 percent since 1988. The Newly Industrializing Countries (NIC) by contrast show a period of volatile and relatively depressed growth in the mid 90s and a strong recovery after 2000 with (average) growth rates reaching 7 percent. Over this period we also know the NICs and most notably China have integrated in global markets and increased their volume and share in global trade (OECD, 2005). We hypothesize that these developments can be linked to the dynamics in the global pattern of specialization in general and the composition of exports over product life cycle stages in particular (Audretsch and Sanders, 2007). Figure (1b) shows how OECD countries have maintained a comparative advantage in young, less mature products, whereas emerging economies rapidly closed the gap over the early 90s but NICs remain specialized in more mature markets, increasingly so since 2000. But the figures do not tell an unambiguous story and the challenge is to find an adequate measure of life cycle maturity at the product level. The purpose of this paper is to address that issue by zooming in on empirically measuring product maturity and investigating the differential impact of countries' export maturity on economic growth across a wide range of developing and developed countries.

Figure 1: Economic Growth and Export Maturity

(a) Economic Growth



(b) Export Maturity



Our paper is motivated by recent advances in two long traditions in the literature. The first strand, pioneered by Vernon (1966), applies stylized life cycle models to explain the shift of dynamic comparative advantages and the evolvement of trade patterns over time (Hirsch, 1967; Krugman, 1979; Jensen and Thursby, 1986; Dollar, 1986; Flam and Helpman, 1987; Grossman and Helpman, 1991; Lai, 1995). An important prediction in this line of literature is that developing countries will increasingly compete in those products that reach the later stages of the product life cycle, implying that the advanced economies must "run to stand still" (Krugman, 1979). A steady flow of new product innovations is necessary to maintain international income differentials. In these models the assumed relative abundance of cheap, unskilled labour is the source of dynamic comparative advantage for a less developed South in copying mature products and technologies from a more advanced North. If, in such a context, globalization and trade integration imply that populous developing economies enter global market competition, then advanced economies experience a shift of their comparative advantage towards new products that are in the earliest stages of the product life cycle (see e.g. Lai, 1995; Audretsch and Sanders, 2007). From this theoretical literature we draw our hypothesis that exporting more mature products has a growth-enhancing effect for emerging economies below the global technology frontier, whereas it has the opposite effect on growth for advanced economies.

We extend this theoretical literature to develop our hypotheses that exporting more mature products has a growth enhancing effect for emerging economies below the global technology frontier. By contrast, exporting more mature products would have exactly the opposite effect on growth for advanced economies.

The second strand of literature relevant to our work documents extensively the effect of trade and more specially exports on economic growth. The vast bulk of early empirical literature asks: "Do Exports Matter?".[1] Most of these studies include either a measure of export (growth) or trade openness in a standard regression framework covering a wide range of countries, time periods and using a variety of estimation techniques. Consistent with the difficulties in establishing robust empirical evidence linking growth to fundamentals in general (Temple, 1999; Durlauf et al., 2005), the evidence is rather mixed. Some find a significant positive relationship between export (growth) and per capita GDP growth, while others caution us not to assign the direction of causality (Rodriguez and Rodrik, 2001). A salient feature of this literature is that the measure of export/trade openness is typically broadly defined. As a result, the channels through which international trade influences economic growth remain unclear.

A number of studies examines the relationship between the structure of exports and long-term economic performance in more detail and asks: "How do Exports Matter?".[2] In particular, this literature has focused on the relationship between export diversification and growth. Export diversification is widely seen as a desirable trade objective in promoting economic growth (Herzer and Nowak-Lehnmann, 2006). Diversification makes countries less vulnerable to adverse terms of trade shocks. By stabilizing export revenues it is then easier to channel positive terms of trade shocks into growth, knowledge spillovers and increasing returns to scale, creating learning opportunities that lead to new forms of comparative advantage.[3] In a dynamic growth framework, some recent studies have uncovered a non-linear link between export diversification and economic growth (Aditya and Roy, 2007; Cadot et al., 2007; Hesse, 2008). The main insight is that developing countries benefit from diversifying their exports, whereas developed countries perform better with export specialization.[4] What remains unclear from this literature, however, is whether the mix of particular products, diversified or specialized, has any implications for growth.

That raises the question: "Does What We Export Matter?" and our paper is close to a handful studies that have started to address that question by zooming in on the specific characteristics of exports in relation to economic performance. The earliest studies distinguished between primary and manufacturing exports. Exporting primary products, which suffer from unfavorable price trends and from great price variability, can be suspected to lead to poor growth performance (Rodriguez and Rodrik, 2001), whereas the expansion of manufactured exports has been a vital source of growth for many countries (Cline, 1982; Ranis, 1985; Martin, 1993; Cline, 2010). Thanks to the increasing availability of highly disaggregated trade data, first in the OECD and then for other parts of the globe, the research focus has recently shifted to the product characteristics of exports. Dalum et al. (1999) demonstrat that exports with higher levels of technological opportunity and higher income elasticities tend to have greater impact on growth among OECD countries and Feenstra and Rose (2000) developed a procedure to order countries according to how soon they export advanced commodities to the US market. They found that countries exporting sooner to the United States tend to grow faster. Bensidoun et al. (2002) show that countries specializing in products for which the share in international trade has increased, grow faster than those that maintained a comparative advantage in stable or declining products. An and Iyigun (2004) compute the skill content of exports based on the US industry-wide R&D expenditures as a share of gross sales revenue as the benchmark. They showed that a

[1] This literature is massive. Giles and Williams (2000) provides a comprehensive survey of more than 150 papers that test the export-led growth hypothesis alone. Singh (2010) provides a recent survey of a growing body of studies that explore linkages between trade openness and growth.

[2] The structure of imports may have direct impact on economic performance as well. Earlier studies show that imports of quality foreign capital goods serves as a means to acquire foreign technology through reverse engineering (Connolly, 1999). Lee (1995) and Lewer and den Berg (2003) find that capital-importing countries benefit from trade because trade causes the cost of capital to fall. However, others do not reveal any significant role for the composition of imports in economic growth (An and Iyigun, 2004; Wörz, 2005). In line with recent papers that analyze the importance of export structure for better economic performance, this paper focuses on the export side and leave the import side for future research.

[3] In a similar vein, export concentration is found to be associated with slow growth, in particular when export concentration reflects the predominance of primary products (Sachs and Warner, 1995; Gylfason, 2004; Klinger and Lederman, 2006).

[4] This finding is consistent with Imbs and Wacziarg (2003) who find a similar pattern using production and employment data.

higher skill content of exports generates a higher growth rate. Lee (2010) adds to the evidence that countries have tended to grow more rapidly when they have increasingly specialized in exporting high-technology as opposed to traditional or low-technology goods.

A seminal study by Hausmann et al. (2007) develops a theoretical model where local cost discovery generates knowledge spillovers to show that a country's specialization pattern becomes partly indeterminate in the presence of such externalities and conclude that the mix of goods that a country produces may therefore have important implications for economic growth. They construct a product-specific sophistication measure based on the income of the *average* exporter and then compute "export sophistication", i.e. the income level of a country's export, to test their hypothesis and find that exporting more sophisticated products is positively associated with subsequent growth. In practice, the development strategy suggesting that developing countries should shoot for the stars and export what the developed countries were exporting is far from trivial. Developing countries may lack the capability to produce complex products. The supply side constraints faced by these countries, such as the lack of physical infrastructure and skilled labour force, poor institutional qualities render them unable to put the upgrading in place. Sutton and Trefler (2010) caution us to interpret the evidence of Hausmann et al. (2007). They develop a model postulating that a country's wealth and its export mix are simultaneously determined by its capability, i.e. the country's productivity and quality level of each product. Thus, economic growth can be achieved either through the shift to a different mix of products or through the improvement in quality/productivity of its existing mix of products. Empirically, they demonstrate that the income differences between the richest and poorest exporters of the same product, i.e. product range, is huge, raising concerns about the the informativeness of Hausmann et al. (2007)'s measure. As a consequence, they illustrates that changes in export mix substantially over-predict economic growth for developing countries. Exporting more sophisticated products may not turn out that beneficial for growth. [5]

In line with these recent studies we propose a simple measure to characterize exports according to the maturity of each product in the global market and show that the overall maturity of a country's export mix is significantly associated with their economic growth performance in a non-linear way. Our paper aims to contribute to the literature in two distinct manners.

The first contribution lies in our proxy that captures the maturity of a country's export mix and brings back the perhaps somewhat forgotten product life cycle perspective to the empirical trade literature[6]. To this end, we introduce a product-specific maturity measure using a well established empirical regularity over the product life cycle (e.g. Hirsch, 1967; Klepper, 1996). Over the typical life cycle total sales in the market first increase at an increasing rate, then at a decreasing rate and finally decline. Following Hirsch (1967), Audretsch (1987) and Bos et al. (2007), we thus proxy for the life cycle stage of a product by the first (growth) and second (growth in growth) moment in its global total export volume. We then calculate an aggregate maturity measure for a country's export bundle by weighing the product maturity by the shares of these products in a country's export mix. With this proxy, we are thus able to explore whether the maturity of a country's export basket matters for its economic performance.

The second contribution of this paper is to employ a conditional latent class model to analyze the data. To the best of our knowledge, this approach is quite new to this literature and brings several advantages over more standard econometric techniques. First, instead of assuming ex ante what countries are likely to be in an ex ante assumed number of different growth regimes and then use the data to verify these assumptions, we turn the procedure around and let the data tell us how many different regimes best fits our data,

[5] An interesting finding that emerges from Hausmann et al. (2007) is that China has ended up with an export basket that is substantially more sophisticated than what would normally be expected for a country at its income level, which could be an important determinant of its recent rapid growth (Rodrik, 2006; Wang and Wei, 2010). However, studies also show that the sophistication index based on Hausmann et al. (2007)'s methodology overestimate the sophistication level of Chinese exports due to the underestimation of the income level of its exporting regions (Xu, 2010) and the failure to take into account product quality (Xu, 2010) and processing trade, i.e. the practice of assembling duty-free intermediaries (Amiti and Freund, 2010). In all, the sophistication level of Chinese exports may not be that exceptional. Indeed, Schott (2008) show that China exports a low-quality version of a product, not in direct competition of OECD countries who mainly export the high-quality version. Furthermore, Jarreau and Pocet (2009) find that the growth-enhancing benefits from export upgrading are restricted to the sector of ordinary trade, for which the main part of the value chain is being produced in China, not processing trade.

[6] see Mullor-Sebastian (1983) for an overview of the early empirical literature on the product life cycle in the 60s

given that growth is modeled to depend on the usual suspects and export maturity. We then show that the levels of GDP per capita have explanatory power in predicting in which of the endogenously determined three growth regimes our countries fall. Second, the latent class model allows for parameter heterogeneity. Addressing heterogeneity has become one of the most debated issues in the growth literature (Temple, 1999; Durlauf et al., 2005) and in light of this issue, conventional empirical approaches have often been deemed unsatisfactory. [7]

In short, our modeling approach enables us to avoid the pitfalls of imposing a common relationship between export maturity and growth for all countries but yields results that are comparable across countries and time. [8]

We analyze Statistics Canada's version of the UN-COMTRADE database that contains the export data on 430 Standard International Trade Classification (SITC) four-digit products for 98 countries over the period 1988-2005. This comprehensive database gives us the unique opportunity to zoom in on more precisely defined products and generalize trade patterns across more countries than most studies to date. Our results are easy to summarize. We find evidence that i) developed countries (with high GDP per capita) are exporting products in the early stages of their (global) life cycle, whereas the opposite is true for developing countries. And ii) our results suggest the existence of three quite distinct growth regimes and we demonstrate that for the most advanced countries' regime, countries tend to grow more rapidly when they export new (less mature) products, whereas this effect is insignificant for the developing countries' regime. In stark contrast, we can identify an emerging countries' regime where countries grow faster when exporting more mature products. These findings have important implications for trade and economic development theory and policies.

The remainder of the paper proceeds as follows. In Section 2, we develop our maturity proxy and discuss our data and estimation strategies. The empirical results are then presented in Section 3. And section 4 discusses the implications and limitations of our paper and concludes.

2. Methodology and Data

We first develop a measure of product maturity drawing on the insights from the product life cycle theory and then compute the maturity of a country's export mix. We then describe the estimation strategy, as well as the data before turning to the empirical results in section 3.

2.1. Measuring Product Maturity

We develop a measure that captures the maturity of a specific product by examining its export dynamics in the global market. Our measure is based on one of the well established empirical regularities found in the product life cycle literature. Total sales of a product in the market first increase at an increasing rate, then at a decreasing rate and finally decline (Klepper, 1996), tracing out an S-shaped diffusion curve. Following Audretsch (1987) and Bos et al. (2007), we characterize the life cycle stage of a product using the first and second moment in the global export volumes and estimate the following equation:

[7] The most common practice is to include regional dummies or country fixed effects in a panel framework and the major drawback of these approaches is that they do not allow for differences in the marginal effect of regressors across regimes. Our conditional latent class model estimates regime-specific parameters. In other words, countries in the same regime share a common parameter vector, but this vector will differ across regimes.

[8] Our approach is closely related to recent studies that apply conditional latent class (or finite mixture) models to examine the the heterogeneity of growth and convergence patterns across countries. Owen et al. (2009) apply a conditional finite mixture model based on the similarity of the conditional distribution of growth rates for a broad set of countries for the period 1970-2000, and find evidence of two distinct clubs, each with its own distinctive growth dynamics and institutional quality is a good predictor of the club membership. Bos et al. (2010) estimate a latent class production frontier and uncovers three different growth regimes using human capital, openness to trade, financial development, and the primary sector share as regime predictors for a sample of 77 countries during the period 1970-2000. Paap et al. (2005) apply a latent class analysis to sort a number of developing countries according to their average growth rates over the period 1961-2000. Alfo et al. (2008) develop a mixture of cross-sectional growth regression to uncover multiple regimes of per capita income convergence across EU regions for the period 1980-2002. Vaio and Enflo (2010) support that growth patterns were segmented in two worldwide regimes, the one characterized by convergence in per capita income, and the other by divergence based on a sample of 64 countries over a very long horizon 1870-2003.

$$ln(exp_{it}) = \gamma_0 + \gamma_{1i}t + \gamma_{2i}t^2 + \gamma_3 ln(exp_t) + \varepsilon_{it} \quad (1)$$

where $ln(exp_{it})$ is the log of global exports of product i at time t in constant dollars; t and t^2 are time (1 in 1988) and time squared, respectively; $ln(exp_t)$ is the log of global total exports of all products to control for the global business cycle; ε_{it} is the disturbance term.

We then construct a measure of maturity, M_{it}, by considering the effect of an increase in time t on the log of global exports $ln(exp_{it})$. By evaluating the semi-elasticity of $ln(exp_{it})$ with respect to t, M_{it} is then defined as

$$M_{it} = \frac{\partial ln(exp_{it})}{\partial t} = \gamma_{1i} + 2 \times \gamma_{2i} \times t, t = 1, 2...18 \quad (2)$$

Given the typical S-shaped pattern of sales over the life cycle we can derive that the lower (more negative) M_{it} is, the more mature a product is. For early stage products both coefficients are positive, for more mature products first γ_{2i} and then γ_{1i} will turn up negative in the regression.

We calculate M_{it} for each of the 430 SITC four-digit products over the period 1988-2005 using global-level export data retrieved from the COMTRADE database. [9] To do so we estimate equation (1) in a rolling window of 9 years, namely 1988-1996, 1989-1997, 1990-1998, 1991-1999, 1992-2000, 1993-2001, 1994-2002, 1995-2003, 1996-2004, 1997-2005 and then calculate M_{it} accordingly, taking the average of all M_{it} estimated using different sub-samples. In this way, we allow for maturity to change over time in a non-linear fashion.[10]

Three other aspects of our measure M_{it} are worth noting. First, in contrast to a binary measure to classify industries into either "growing" or "declining" in Audretsch (1987), our measure is continuous.[11] This property permits a sensible ranking of products based on its maturity level in the global export market. Second, our measure is time-varying. In other words, products can move from one stage of the life cycle to the next and back. This latter property may seem undesirable, but in fact there are good reasons not to exclude it by construction. For example, mature products can rejuvenate themselves through the upgrade of existing products and/or the introduction of new product varieties to drive up global sales. In this respect, our measure differs from Bos et al. (2007) who evaluates equation (2) at the mean of t for all industries and does not allow for the changes of product maturity over time. Lastly, we derive our measure based on the global indicator of a product, which in part reflect its inherited characteristics and carry some exogenous elements that reflect the growth potential of products in the global market place. Therefore, it is less prone to measurement and endogeneity problems than using country-specific export data.[12]

Table 1 provides descriptive statistics on these products, aggregated to the one-digit level.[13] According to Table 1, we find that manufacturing products account for more than 70 percent of world total exports. The product maturity exhibits significant cross-section and time-series variations, suggesting that products differ in terms of both their maturity in the global market and the maturity changes over time.

[9] For the estimation purpose, we keep products that have at least have 5 observations during 18 years. The average number of observations per product is 16. We drop 180 products that are in the residual categories "X" since the export data on those products are subject to serious measurement problems. These products only account for on average less than 1 percent of the global export over our sample period.

[10] We also estimated equation (1) using all information 1988-2005, computing M_{it} at each time t. That is an approximation of our approach, which makes maturity linearly dependent on time. The pairwise correlation of maturity measures computed in both ways is 0.23 (significant at 1 percent), spearman rank-order correlation is 0.38 (The null hypothesis that both measures are independent is rejected), suggesting some similarity in their ability to rank products. Based on these results we chose the rolling window approach as our preferred measure.

[11] Audretsch (1987) suggests to consider the sign and significance of γ_{1i} and γ_{2i} to classify industries. An industry is classified as growing when either γ_{2i} was positive and statistically significant at the 90 percent level or γ_{2i} was statistically insignificant, but γ_{1i} was positive and statistically significant.

[12] In a similar vein, Bekaert et al. (2007) proposes an exogenous measure of industry-specific growth opportunities by using global average price to earnings ("PE") ratios in stock markets. They argue that global PE ratios contain information about (global) growth opportunities. Thus, for each country, it permits the construction of an exogenous growth opportunities measure that does not use local price information and is less prone to endogeneity issues.

[13] A list of all products included in our analysis is available upon request.

Table 1: Descriptive Statistics

Code	Name	Number	Share	Maturity Mean	Maturity Stand. Devi.	Maturity 25 percentile	Maturity 50 percentile	Maturity 75 percentile
0	Food	78	0.087	0.017	0.103	-0.031	0.011	0.065
1	Beverages and tobacco	9	0.014	0.043	0.076	-0.009	0.038	0.084
2	Crude materials	73	0.045	-0.060	0.164	-0.132	-0.041	0.023
3	Mineral fuels, lubricants	13	0.086	-0.117	0.513	-0.097	-0.015	0.050
4	Animal and vegetable oils	9	0.005	-0.006	0.171	-0.090	-0.016	0.060
5	Chemicals	32	0.070	0.026	0.086	-0.015	0.026	0.073
6	Manufacture	99	0.156	-0.011	0.107	-0.043	-0.002	0.034
7	Machinery and transport	55	0.321	0.002	0.090	-0.036	0.008	0.051
8	Miscellaneous manufactures	57	0.152	0.039	0.105	-0.006	0.034	0.076
9	Unclassified manufactures	2	0.032	0.007	0.065	-0.006	0.014	0.038

Note: Number denotes the number of four-digit products included in our analysis. Share denotes the percentage of export in the global total export at year 2005.

A first "test" of our maturity measure is to simply look at which products actually get classified as mature and young. Ranking products based on their maturity in the global market yields Tables A.1 and A.2, which show the maturity and ranking of the 50 products with the lowest and highest maturity values at the end of our sample period (i.e., 2005), respectively. The corresponding rank number at the start of the period (i.e., 1988) is also given. The pairwise correlation between maturity 2005 and maturity 1988 is -0.021, which is not significant at any conventional level. The negative correlation may imply that products classified as mature in 1988 are classified as newer in 2005 and the other way around. The reason is that most products apparently have a (very) negative γ_2, such that they start with a very high M_{it} (low maturity) and end with a very low value (high maturity), whereas the products with a positive γ_2 tend to start from a very low γ_1. This is consistent with a more or less random distribution over the life cycle stages as early stage products would be expected to have low average growth (captured by a low γ_1) but high growth in growth (captured in a positive γ_2), whereas mature products have low average growth and negative growth in growth. The spearman ranking correlation (0.053) shows that the ranking at 1988 and 2005 is independent (p value is 0.254).

The products at the extremes of the ranking, are not perhaps making a very convincing case at first glance. Especially the list of least mature products includes several raw materials, ores, basic metals and food products that cannot be considered very early stage. Our measure is somewhat weakened by the 90s resource boom. Rising demand for many internationally traded raw materials, ores and energy resources may have caused trade volumes for those commodities to increase faster than the global trade volume for which we correct. Consequently, the boom in commodities trade gets interpreted by our measure as a rejuvenation of traded commodities, when of course nothing has happened to the product itself. We will leave these products in for now, exactly because this will bias the estimations against finding the results we are most interested in. [14] The reader should keep in mind what we measure as maturity is a rough proxy and measurement error is an issue.

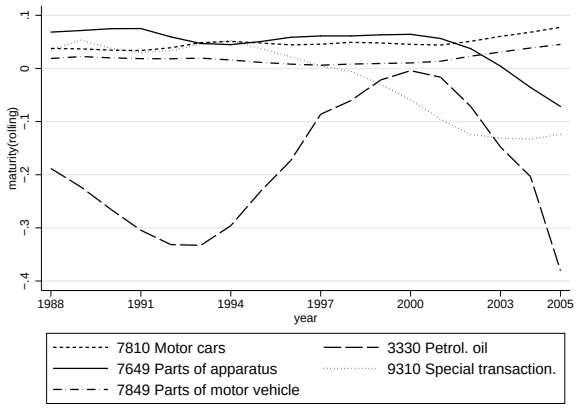
The second "test" of our maturity measure is to explore the trend of major products in the global market. Figure (2) shows the maturity of the most important five products (in terms of their size in the global trade) over time. The figure shows that most manufacturing products are relatively stable and mature. Only petrol oil is moving up and down a lot. Obviously this reflects the peculiarities of global oil markets.

The third "test" of our maturity measure is to explore the volatility of product maturity over time. We want to eliminate those products that exhibit too much volatility over time, e.g. oil. We therefore computed the standard deviation of maturity for each product over the entire sample period. Figure (3) shows the

[14] High degrees of specialization in resources will generally bias the positive effect of new products on economic growth downwards.

Figure 2: Product Maturity

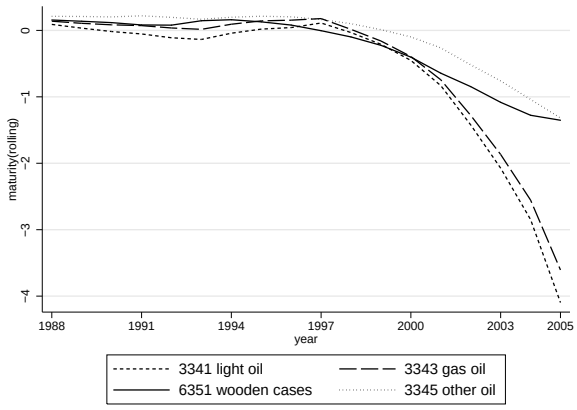
(a) most important products



maturity of four products, for which the standard deviation of maturity was above the 99 percentile of the sample. It too suggests that oil products should be treated with some caution in our analysis. We keep these "products" in our sample for now, however, to avoid selection bias in our empirical analysis below.

Figure 3: Product Maturity

(a) most volatile products



2.2. Measuring the Export Maturity of Countries

The overall maturity associated with country j's export basket, M_{jt}^{All}, in turn can now be defined as

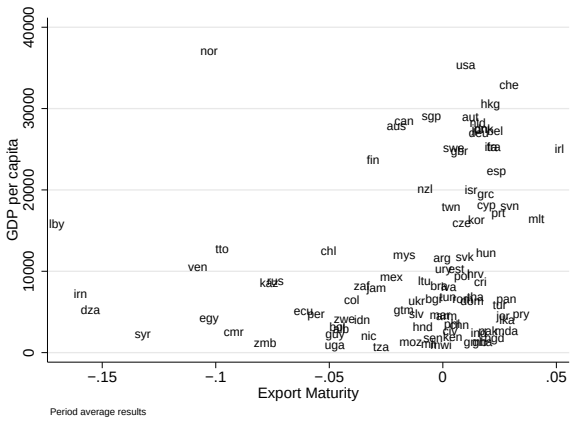
$$M_{jt}^{All} = \sum_i s_{ijt} M_{it} = \sum_i \frac{exp_{ijt}}{exp_{jt}} M_{it} \tag{3}$$

Where M_{jt}^{All} is a weighted average of product maturity M_{it} (at the global level) across all products for country j over time. The weights are the export shares of these products in the country's total exports. We

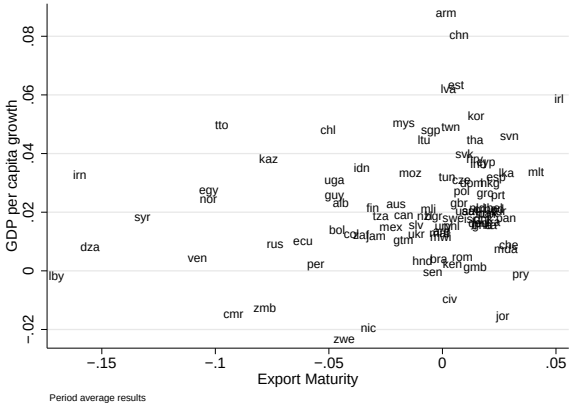
retrieved the product-country level export data for all 430 products identified above in 98 countries during 1988-2005 from COMTRADE to calculate the overall maturity of the countries' export mixes M_{jt}^{All}. Figure 4 plots the weighted maturity measures against GDP per capita and GDP per capita growth to get a first impression of the data. From these scatter plots it seems that a weak positive relation exists between the maturity index (higher values indicate younger products) and the level and growth rate of per capita GDP. The scatter plots also suggests that outliers may be a problem, in particular for the relationship to growth.

Figure 4: GDP Per Capita, Growth and Export Maturity

(a) GDP Per Capita and Export Maturity



(b) Growth and Export Maturity



To check the robustness of our measure M_{jt}^{All}, we therefore computed four other country-level maturity indices by considering sub-samples of products.

First, we compute the measure $M1_{jt}$ by excluding all the oil-related products, i.e. those for which the four digit product code begins with 3. Second, we compute $M2_{jt}$ by only looking at manufacturing products, i.e. those for which the first digit is between 6 and 9. Third, Sutton and Trefler (2010) find that the income difference between the richest and poorest exporters of the same product, i.e product range, is huge, questioning the informativeness of Hausmann et al. (2007)'s product-specific sophistication measure based on the income of the *average* exporter, see Figure (5). They define informative products as those lie in the upper right or bottom left in the figure. In other words, a large share of products that appear in the upper left corner of the graph are considered uninformative.[15] Based on their definition, we identified 191 informative products out of 431 in our sample and calculated $M3_{jt}$ using the maturity and exports of these 191 products. Finally, Rauch (1999) develops a classification of products into differentiated, homogeneous and an intermediate category. Subsequent research has used this classification to explore how trade in homogeneous and differentiated products differ (Besedes and Prusa, 2006). Thus, we remove all differentiated products and calculate $M4_{jt}$ on basis of the other two categories. Table 2 reports pairwise and ranking correlations of all of our five differently constructed measures. We find that these measures are positively and significantly correlated using both pairwise correlation and ranking correlation.

[15] More precisely, the (ln) minimum GDP per capita of the country that produces this good is smaller than 8.26 and the (ln) maximum GDP per capita is 9.99.

Figure 5: Informativeness of Products

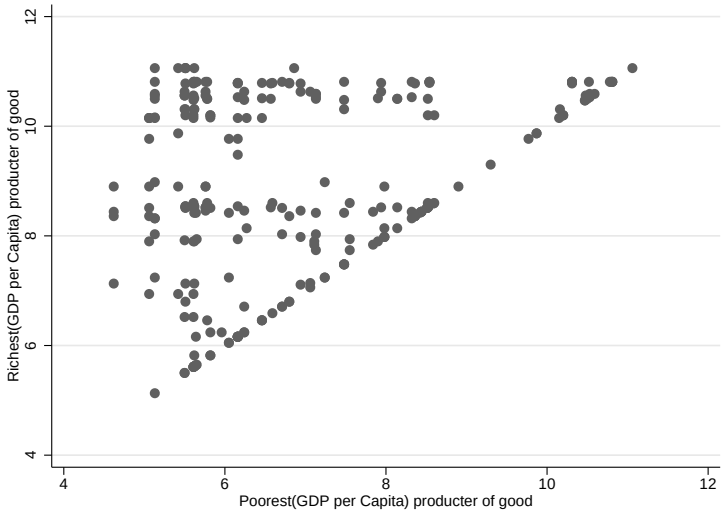


Table 2: Correlation Matrix-Maturity

Pairwise Correlation (N=1696)					
	M_{jt}^{All}	$M1_{jt}$	$M2_{jt}$	$M3_{jt}$	$M4_{jt}$
M_{jt}^{All}	1				
$M1_{jt}$	0.373*	1			
$M2_{jt}$	0.593*	0.539*	1		
$M3_{jt}$	0.497*	0.324*	0.838*	1	
$M4_{jt}$	0.893*	0.241*	0.472*	0.454*	1
Spearman Ranking Correlation (N=1696)					
	M_{jt}^{All}	$M1_{jt}$	$M2_{jt}$	$M3_{jt}$	$M4_{jt}$
M_{jt}^{All}	1				
$M1_{jt}$	0.486*	1			
$M2_{jt}$	0.806*	0.568*	1		
$M3_{jt}$	0.705*	0.378*	0.836*	1	
$M4_{jt}$	0.854*	0.27*	0.608*	0.591*	1

Note: a.*Significant at 1 percent.

We conclude from these results that our time varying, continuous measure of export maturity reflects something that is correlated with the alternative measures suggested in the literature, is easy to compute based on conventional trade data and is founded in well established empirical regularities over the product life cycle. The proof of the pudding, however, is in the eating. Our measure picks up something of substance if we can show it has explanatory power in a panel growth regression, to which we turn below. For our purpose, we use M_{jt}^{All} in the main analysis and the rest four maturity measures in the robustness analysis.

2.3. Empirical Methodology

We start with the following standard growth regression:

$$g_{jt} = \alpha + \beta_1 M_{j0}^{All} + \beta' \mathbf{x}_{jt} + \varepsilon_{jt} \tag{4}$$

where j denotes country and t denotes time; g is per capita GDP growth; M_{j0}^{All} measures the initial maturity of a country j's export basket; β' is a 1 by n parameter vector; $\mathbf{x}$ is an n by 1 vector of control variables that are also important determinants of economic growth. Levine and Renelt (1992) find that most of the independent variables in standard growth regressions are fragile. Since the effect of export maturity on growth, i.e.β_1, is our primary interest, we minimize the data mining biases for the other variables by closely mimicking the regression in Hausmann et al. (2007). We thus include a country's initial level of GDP per capita (gdp_{j0}) to capture beta-convergence, the capital to labour ratio (KL_{jt}), the level of human capital(HC_{jt}) and rule of law index (Law_{jt}), a de jure trade openness index($Trade_{jt}$) and a trade concentration index(HHI_{jt}) in $\mathbf{x}_{jt}$; finally, ε_{jt} is the error term.

One major drawback of equation (4) is that the relationship between the maturity of exports and economic growth is now assumed to be identical across countries. The estimated parameters, e.g., β_1 and β' are common to all countries *by construction*. This masks potentially important parameter heterogeneity across countries. We, therefore, introduce a conditional latent class model, where we model a latent sorting of countries into different growth regimes, each with its own parameter vector β_1, β'. Equation (4) must now be rewritten as follows:

$$g_{jt|k} = \alpha_k + \beta_{1|k} M_{j0}^{All} + \beta_k' \mathbf{x}_{jt} + \varepsilon_{jt|k} \tag{5}$$

where $k = 1, ..., K$ indicates the regime and K refers to the (endogenous) total number of regimes. Our aim is to sort all observed g_{jt} into K discrete regimes. Thus, the (unconditional) likelihood function for each g_{jt} is obtained as a weighted average of its class-specific likelihood, using the prior class membership probability as the weights in equation (6)

$$P_{jt} = \sum_{k=1}^{K} F_{jt,k} P_{jt|k} = \sum_{k=1}^{K} F_{jt,k} f(g_{jt}|\mathbf{y}_{jt}, \beta_k) \tag{6}$$

where P denotes the likelihood; $F_{jt,k}$ is the prior probability attached to the membership of country j at time t in class k; Additionally, $0 \leq F_{jt,k} \leq 1$ and $\sum_{k=1}^{K} F_{jt,k} = 1$; f(.) is the conditional density function; $\mathbf{y}$ is the vector of all independent variables specified in equation (5), including maturity; β_k' is the class-specific parameter vector. Since we do not observe directly which class contains any particular observation it, the class membership probability $F_{jt|k}$ must be estimated. The parametrization of $F_{jt|k}$ is specified with a multinomial logit model:

$$F_{jt,k} = \frac{\exp(\mathbf{z}_{jt}' \theta_k)}{\sum_{k=1}^{K} \exp(\mathbf{z}_{jt}' \theta_k)} \tag{7}$$

where $\mathbf{z}$ denotes a set of observable characteristics which enter the model to determine the class membership probability. In our case, we use the stage of development, proxied by real GDP per capita ($GDPpc$) as the conditioning variable. We rely on two strands of literature to motivate this choice. The first strand has

examined the heterogeneity of growth experience of countries in general and has well established the substantial differences in the determinants of growth across developing and developed countries. A common practice is to adopt a simple classification method based on a certain threshold level of per capita GDP. However, such a partition is somewhat arbitrary and subject to debate since the appropriate cut-off point is not always clear. In contrast, our approach requires no priors with respect to the regime membership and is thus much more flexible. Recent studies (e.g., Durlauf and Johnson, 1995; Canova, 2004; Papageorgiou, 2002) have used initial level of GDP per capita as a regime splitting variable to examine multiple growth regimes, despite using otherwise different methodologies. The second strand has established a non-linear relationship between export structure (specialized vs. diversified) and economic growth (Imbs and Wacziarg, 2003; Aditya and Roy, 2007; Cadot et al., 2007; Hesse, 2008). They find that this relationship depends on the development stage of countries as proxied by GDP per capita. Thus, we use GDP per capita to allow for the model to select into growth regimes that can be characterized *inter alia* by GDP per capita.

The log likelihood for the entire sample is then the sum of the likelihood over all countries N and years T in the sample:

$$logP = \sum_{jt}^{NT} log(P_{jt}) \tag{8}$$

To estimate our model we first need to define the suitable number of classes K. As this is not a parameter to be estimated from equation (8). Greene (2007) suggests a "test-down" strategy to identify the right number of classes. A specification with $K+1$ classes is inferior to one with K classes if the parameters in any two of the $K+1$ classes are equal (statistically indistinguishable). If the true K is known, it is then possible to test down from $K+1$ to K using a log likelihood ratio test.[16]

Following Greene (2007), equation (7) is maximized with respect to the structural parameter vector $\beta = (\beta_1, ...\beta_K)$ and the latent class parameter vector $\theta = (\theta_1, ...\theta_K), \theta_K = 0$ using a conventional maximum likelihood estimator. With the parameter vector β and θ in hand, we can obtain a posterior estimate of the class membership probabilities for each observation it according to Bayes theorem:

$$\hat{F}_{k|jt} = \frac{P_{jt|k} F_{jt,k}}{\sum_{k=1}^{K} P_{jt|k} F_{jt,k}} \tag{9}$$

where each observation is assigned to a particular class with the largest posterior probability $\hat{F}_{k|jt}$. Similarly, the posterior estimate of the parameter vector β for each observation can be estimated as:

$$\hat{\beta}_{jt} = \sum_{k=1}^{K} \hat{F}_{k|jt} \hat{\beta}_k \tag{10}$$

One distinctive feature of our approach is that we also allow countries to switch between regimes over time, following e.g. Bos et al. (2010). We do want to avoid countries close to a switching point, however, to switch back and forth between regimes all the time. We therefore define 4 time periods (the first three periods consists of 5 years, while the last one consists of 3 years): 1988-1992,1993-1997,1998-2002 and 2003-2005 in our modeling framework and allow countries to switch regime only between these four periods. Essentially we pooled together the observations from the time periods and treat observations within 5 year periods as independent draws from the same regime. This implies that one country can be allocated to one particular regime k in period 1 (1988-1992), but a different one in period 2 (1993-1997), but switches are limited by construction.

To summarize, we employ a conditional latent class model to examine for a possible non-linear relationship between export maturity and growth in K endogenously determined classes. The class membership probabilities are conditional on the stage of economic development.

[16] Theoretically, the maximum number of classes is only restricted by the number of cross-sections, i.e. the number of observations in the data. However, empirically the overspecification problem limits the existence of a large number of classes.

2.4. Data

Economic growth (g), measured as the change of the real per capita GDP is taken from the Penn World Table, version 6.3 (PWT 6.3). The vector **x** includes growth determinants that are commonly used in the empirical growth literature. We take the initial level of per capita GDP gdp_0 (2005 international purchasing power parity (PPP) dollars chain index) at the beginning of four different time periods defined above from the same source. The initial level of export maturity M_0 is set in the same way. The capital to labour ratio (KL) is computed as the physical capital stock divided by the total number of workers. We construct the capital stock (K) applying the perpetual inventory method as in Hall and Jones (1999).[17] Human capital (HC), is measured as the average years of schooling of the population that is at least 25 years old and was obtained from the Barro and Lee (2010) database on educational attainment.[18] The rule of law index (Law), ranging from 0.5 (low institutional quality) to 6 (high institutional quality) is retrieved from the International Country Risk Guide (ICRG). *De jure* trade openness measure is taken from Wacziarg and Welch (2008). It takes a value of one when a country's trade regime is liberalized, and zero otherwise. The conditioning variable that we rely on to estimate the latent class model is the stage of economic development for which we proxy by using real GDP per capita (2005 international PPP dollars chain index), retrieved from PWT 6.3. Table 3 summarizes the definitions, sources and descriptive statistics of country-level variables used in our analysis.

Table 3: Descriptive Statistics - Growth Regression

	Description	Unit	Source	Mean	Min	Max	SD	Obs
M^{All}	Initial export maturity, all products	index	COMTRADE	-0.014	-0.443	0.221	0.065	1696
M1	Initial export maturity, non-oil products	index	COMTRADE	0.004	-0.273	0.226	0.046	1696
M2	Initial export maturity, manufacturing products	index	COMTRADE	0.007	-0.220	0.119	0.039	1696
M3	Initial export maturity, Sutton	index	COMTRADE	-0.007	-0.305	0.264	0.055	1696
M4	Initial export maturity, Rauch	index	COMTRADE	-0.042	-0.705	0.194	0.075	1696
g	GDP per capital growth	percentage	PWT 6.3	0.021	-0.323	0.321	0.045	1698
gdp_0	Initial GDP per capita	2005 PPP dollars	PWT 6.3	9766	601	31005	8168	1703
KL	Capital/labour ratio	2005 PPP dollars	PWT 6.3	122.179	0.615	749.560	133.732	1628
HC	Average year of schooling	year	BL2010	7.087	0.642	13.086	2.84	1703
Law	Rule of law index	index	ICRG	3.959	0.5	6	1.468	1652
Jure	De jure openness measure	index	WW2008	0.801	0	1	0.399	1703
HHI	Trade concentration index	index	COMTRADE	0.111	0.001	0.843	0.146	1703
GDPpc	Average GDP per captia	2005 PPP dollars	PWT 6.3	11412	601	42490	9810	1703

BL2005 refers to Barro and Lee (2010); WW2008 refers to Wacziarg and Welch (2008);ICRG refers to International Country Risk Guide.

3. Empirical Results

In this section, we present our results. We examine whether the effect of the maturity of countries' exports is different across development stages by employing a conditional latent class model. Before analyzing differences in the effects, we present a number of specification tests to select our preferred specification. We first must determine the number of regimes in our data following the suggestion provided by Greene (2007). We formally test for the optimal number of regimes using the log likelihood ratio tests. The test results in Table 4 favour a specification with three regimes over the one with two regimes. We identify them as developing, emerging and advanced for the reason we will explain later. Moreover, the second

[17] I estimate the initial stock of capital, K_{t0} as $\frac{I_{t0}}{g+\delta}$, where I is investment, t_0 refers to the year 1988, g is the average geometric growth rate of investment. We use the average growth rate over the first 9 years (the first half of our sample) to determine the country-specific average growth rate. The depreciation rate δ is assumed to be 6 percent. The subsequent value of capital stock is computed following $K_t = (1-\delta)K_{t-1} + I_t$.

[18] Since the data is only available at a five-year interval, we use a linear interpolation to fill in missing annual data.

line states that the unconditional latent class model is rejected in favor of the conditional one. Next, we test whether the parameter estimates differ significantly across regimes by means of Wald tests for joint equality. The results indicate that the equality of all parameters could be rejected at the 1 percent significance level across regimes. Lastly, it is of importance to test whether the effect of export maturity on growth is significantly different across regimes. The Wald tests reveal that the effects are jointly significantly different across the three regimes, with the exception between the developing and advanced regime.

Table 4: Hypothesis Test

Testing	Test	Test Statistic	P-value	Conclusion
Class Fit				
Three-regime conditional	LRT	152.281	0.000	rejected
vs. Two-regime conditional				
Three-regime conditional	LRT	41.263	0.000	rejected
vs. Three regime unconditional				
Equality of All Parameters				
Regime Developing vs. Emerging	Wald	97.405	0.000	rejected
Regime Emerging vs. Advanced	Wald	202.182	0.000	rejected
Regime Developing vs. Advanced	Wald	28.705	0.000	rejected
Regime Developing, Emerging and Advanced	Wald	257.298	0.000	rejected
Equality of Export Maturity				
Regime Developing vs. Emerging	Wald	9.467	0.002	rejected
Regime Emerging vs. Advanced	Wald	47.246	0.000	rejected
Regime Developing vs. Advanced	Wald	0.001	0.975	not rejected
Regime Developing, Emerging and Advanced	Wald	49.895	0.000	rejected

Note: LRT represents the likelihood ratio test.

Then we consider the effect of the maturity of a country's export bundle on economic growth across these regimes by looking at the conditional latent class estimation results in Table 5.
First observe in the lower part of the table that the first regime has a low average GDP per capita, intermediate average maturity and a low GDP per capita growth rate. We therefore labeled this regime "developing". The second "emerging" regime has low but slightly higher average levels of GDP per capita, but a considerably higher average growth rates and the most mature exports. The "advanced" regime has a high average level, moderate growth rates and the lowest average maturity of exports.

More interesting from our perspective, however, is the impact of maturity on the growth rate itself. In emerging countries, a higher maturity index, i.e. a less mature export bundle, *reduces* growth. This strongly contrasts with the advanced country regime, where a less mature export mix *increases* growth. For the developing countries, the relationship is insignificant, implying that the maturity of the export bundle does not have a clear cut impact on the growth performance of these countries. Given what we observed earlier on the impact of resource and commodities trade, this could perhaps be attributed to the fact that developing countries often find themselves exporting in particular these types of products.[19]

[19]The sales volumes of these commodities and resources depend more on the extraction and transport capacity and global demand than production costs. If, as was the case in the 1990s and early 2000s, demand for food, resources and commodities is volatile, then such supply and capacity constraints drive (relative) prices and consequently our measure classifies these non-manufactures products as mature or young as a result of such external market conditions. Possible additional volatility due to speculation in these markets makes this effect even stronger.

Table 5: Main Empirical Results

Regime	Developing	Emerging	Advanced
Initial GDP per capita	-0.019	0.018	-0.002
	(0.007)***	(0.003)***	(0.002)
Capital/labour ratio	-0.010	-0.010	-0.001
	(0.009)	(0.002)***	(0.001)*
Human capital	0.007	0.001	0.001
	(0.002)***	(0.001)	(0.001)
Rule of law	0.013	0.005	0.001
	(0.004)***	(0.002)***	(0.001)
Initial export maturity	0.096	-0.127	0.095
	(0.070)	(0.027)***	(0.018)***
Trade openness	0.019	-0.008	0.006
	(0.009)**	(0.004)**	(0.004)
Trade concentration	0.080	-0.125	0.039
	(0.029)***	(0.016)***	(0.008)***
Constant	-0.012	0.014	0.438
	(0.025)	(0.007)***	(0.283)**
Regime Membership Probability			
Constant	0.438	0.643	Reference
	(0.283)**	(0.280)***	
GDP per capita	-0.011	-0.007	Reference
	(0.002)***	(0.002)***	
Prior Classification Probability	0.191	0.358	0.455
Observations	298	542	740
Mean growth rate of GDP per capita	0.013	0.028	0.02
Mean maturity level	-0.044	-0.014	-0.078
Mean level of GDP per capita	7084	8755	16283

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Our results extend and complement recent literature that examines the linkages between the product characteristics of exports and economic growth(Feenstra and Rose, 2000; Bensidoun et al., 2002; An and Iyigun, 2004; Hausmann et al., 2007; Lee, 2010). We add a new perspective to this literature by proposing a proxy to measure the maturity of countries' export mix. Moreover, we not only show that the export maturity matters for growth, but this effect depends on the stage of economic development and thus, is significantly non-linear across countries. This finding is contrary to the common conclusion that emerges from this literature, which postulates a linear monotonic relationship between specific characteristic of exports and growth in spite of notable differences in measures, specifications and econometric techniques used. Consistent with the notion that what you export matters, our findings suggest that when in your development process you export it matters too.

The usual suspects in the growth regression also show interesting differences over the regimes. The de-

veloping country regime exhibits beta-convergence. The importance of human capital and the rule of law for developing countries are also well established and confirmed in our results. In addition, trade openness and export appears to positively associate with growth. In the emerging regime, countries show strong divergence and a negative impact of a higher capital-labor ratio. This reflects the high returns to capital stock such as infrastructure and reliable power supply in these emerging economies. The accumulation of human capital does not appear significant partially because it is not that important in economies that grow based on exporting mature products. For emerging countries, where inflows of foreign direct investment have been shown to be important, the significance of rule of law is as expected. We also find export concentration carries a growth penalty for emerging countries and suggest that pursuing a more diversified export structure that make countries less vulnerable to adverse terms of trade shocks appear to be growth promoting. For the advanced economies, we do not find strong evidence of the accumulation of physical and human capital as the driver of growth consistent with economies in their steady states, nor improving openness and rule of law have additional impacts as this regime consists of rather homogeneous countries in openness (actually all are open) and rule of law. However, these countries seem to perform better with export concentration, in line with the non-linear effect of export diversification on growth found in the literature (Aditya and Roy, 2007; Cadot et al., 2007; Hesse, 2008).

To check the robustness of our results, we also use four other country-level maturity measures based on sub-samples of products. Table A.4, Table A.6, Table A.8 and Table A.10 in the appendix employ the maturity measure $M1$ by excluding oil-related products, $M2$ by including only manufacturing products, $M3$ for the informative products and $M4$ for the homogeneous products, respectively. The specification tests are shown in Table A.5, Table A.7, A.9 and A.11 in the appendix. We find that the three-regime specification is a very robust feature of our data. Moreover, the non-linear effect between export maturity and economic growth over three development stages is found to be very similar to those reported in Table 5. Overall, our results do not seem to be driven by the choice of a particular export maturity measure.

It is worth noting that the endogeneity of export maturity does not pose a serious problem in our analysis for three reasons. Firstly, since we construct the product-specific maturity measure using the global data, it is less prone to the endogeneity issue than using the country-level data. This approach captures some exogenous product characteristics and does not rely on the product information at the country level. Secondly, we use lagged export maturity, defined as the level at the beginning of each four periods (i.e. 1988, 1993,1998,2003) in our estimations, to alleviate the reverse causality problem. Lastly, the identification of the negative coefficient between export maturity and growth in the emerging regime suggests that the reverse causality is not an issue. As countries enjoying higher growth are less likely to export mature products that are in the declining stage, the causality running from export maturity to growth is more plausible.

There are three reasons why we conclude that our latent class specification does not merely sort country-time observations in such a way that these results endogenously emerge. First the significantly negative coefficient on GDP per capita in the regime membership probability estimation signifies that lower GDP per capita increases the probability of moving from the reference group to the emerging and developing regimes, respectively, where the latter effect is stronger. This implies that countries with high GDP per capita end to be sorted into the advanced regime, whereas countries with medium GDP per capita sort into the emerging regime and low income countries end up in the developing regime.[20]. In an unconditional latent class specification the three regimes might simply emerge because the model fits the data better if one sorts the observations for which a negative, positive and indeterminate effect applies. The fact that GDP per capita has predictive power in the sorting signifies that there is more to these regimes.

Second, in table 6 we present the regime classifications over time for selected countries. It can be verified that most of the G7 countries are in the advanced growth regime, most of the time, with an occasional switch to the emerging regime and back. The newly industrialized countries in South East Asia, South Africa and Brazil are classified in most periods into the emerging regime and occasionally move between the developing and emerging regimes (with the exception of Singapore which moves from the advanced to

[20]Of course we have named these regimes accordingly ex post and based on this outcome. The model endogenously identifies three statistically distinct classes/growth regimes

developing regime. Financial services, re-exports and port logistics may well have driven this outcome).[21] Interestingly, the exports of mature products by e.g. China may constitute an important factor to explain the recent rapid growth and strong convergence of the newly industrialized countries. Our classification is not completely in line with our priors (e.g., Japan classified as emerging in 1988-1992 or Brazil as advanced since 1998), but on the whole the classification looks roughly fine, considering that this classification is in no way based on ex ante assumptions and exogenous thresholds or cut-off points.

Table 6: Classification-Selected Countries

	Country	1988-1992	1993-1997	1998-2002	2003-2005
G7	Canada	Advanced	Advanced	Advanced	Advanced
	Germany	Advanced	Advanced	Advanced	Advanced
	France	Advanced	Advanced	Advanced	Advanced
	Italy	Advanced	Advanced	Advanced	Advanced
	Japan	Emerging	Advanced	Advanced	Advanced
	United Kingdoms	Advanced	Advanced	Advanced	Advanced
	United States	Advanced	Advanced	Advanced	Advanced
Newly Industrialized	Brazil	Emerging	Emerging	Advanced	Advanced
	China	Emerging	Developing	Emerging	Emerging
	Hongkong	Emerging	Advanced	Developing	Emerging
	India	Emerging	Emerging	Emerging	Emerging
	Korea	Developing	Emerging	Developing	Advanced
	Malaysia	Developing	Emerging	Developing	Emerging
	Thailand	Developing	Emerging	Developing	Emerging
	Taiwan	Emerging	Emerging	Advanced	Advanced
	Singapore	Emerging	Emerging	Developing	Emerging
	South Africa	Advanced	Advanced	Advanced	Advanced

Finally, we looked at the stability of this classification by considering regime switches over time. From the transition matrix in table 7 we can see that the diagonal elements carry the largest percentages as would be expected. However, there is quite some transitions from emerging to advanced and back. Transitions between the advanced and the developing regime are more rare, as is to be expected. Transitions from developing to emerging and back are much more frequent than between developing and advanced. The emerging regime thus seems to be the stepping stone towards the advanced country growth regime. The occasional switches from developing to advanced and back can also be due in part to the disrupting effects of resource and commodities trading, as was argued above. This, however, requires much more detailed analysis of the transition dynamics in our data. A useful first step in that direction would be to redo our analysis without products that can be classified as primary sector products. We feel, however, that at this stage it is useful to leave these products in the sample. This has stacked the odds against us finding the results we feel are most important to report in this paper. That is, even in their presence our maturity measure picks up something of significance, both in the statistical and the economic sense. We now turn to our conclusions, to discuss the significance of that result.

4. Conclusions

In this paper we set out to developed a new measure of product maturity using old knowledge about the product life cycle. A typical product will diffuse in global trade (if at all) approximately following an S-shaped diffusion curve, where total market volume increases fast, than slower and eventually goes into

[21] The full classification of countries in growth regimes is presented in Table A.3 in the Appendix.

Table 7: Transition Matrix

		To			
		A-Developing	B-Emerging	C-Advanced	Total
	A-Developing	15	30	10	55
		(27.27)	(54.55)	(18.18)	(100)
From	B-Emerging	16	39	36	91
		(17.58)	(42.86)	(39.56)	(100)
	C-Advanced	34	15	42	117
		(6.84)	(15.38)	(77.78)	(100)
	Total	39	87	131	263
		(41.83)	(33.46)	(24.71)	(100)

Numbers denote the transition cases. The transition probability is in the parentheses.

decline. In global markets a product was thus defined as mature when export growth declines. Using this empirical regularity we developed a continuous maturity measure and showed that our classification of 4-digit products in global trade is positively correlated but certainly not equivalent to other classification methods in the literature. As our empirical analysis went on to show, our measure has something sensible and novel to say about countries' growth performance.

We then showed in a conditional latent class growth estimation that countries can find themselves in three distinct growth regimes. That is, the vector of parameters differs significantly between three endogenously determines groups of country-year observations in our data set. We showed that GDP/capita, as a proxy for the level of development of a country, is a good predictor of class membership and our model distinguishes between low, middle and high income level countries. This too is quite similar to classifications used in the literature, but our classification has the added benefit, that we do not impose group membership or have to rely on inherently arbitrary cut-off points.

Finally, we showed that our maturity measure has a non-linear impact on economic growth over the development stages our countries find themselves in. In the low-income *developing* stage the maturity of exports has no significant impact on growth and such traditional variables as capital-labor ratio's and institutional quality pick up most of the cross-country, within period variation. This implies that for developing countries getting into or out of more or less mature export products is not expected to affect their growth performance in a predictable direction. In part this may be due to the fact that some resources and commodities were classified as early stage products as a result of the late 1990s resource boom. This may have offset the otherwise positive (or negative) impact of manufactured early stage products, but we feel it is more likely we would have found a significant coefficient in either direction if such biases had been strong. Slightly richer *emerging* countries, in contrast have a robust and clearly negative impact of exporting early stage products on growth. They do better exporting mature (manufactured) products and moving into large but globally saturated or declining markets. This gives them the opportunity to grow fast, capturing market share of others. But as in the *advanced* country stage the sign switches and export maturity becomes a drag on growth, the challenge is clearly to grow fast on mature products but at the same time prepare for the final stage in which early stage innovative exports are the engine of growth.

This is clearly a huge policy challenge. As recent theoretical and empirical studies have shown, institutions are of paramount importance in generating sustainable economic growth. And our results once more confirm this. The existence of distinct growth regimes and sign-switches between them imply that institutions that drive growth in one stage may put a drag on growth in the next. The institutions that fit the emerging country stage best (i.e. lax intellectual property standards, autocratic control over e.g. infrastructures and bank credit) may well be less than perfect for the same county when it enters a more advanced stage. And institutions usually resist change. The institutions that bred successes in the past easily become a liability. The advanced industrialized countries are currently still making their transition from an industrial, managed society to an entrepreneurial society (Audretsch, 2007). The challenge for emerging countries is to build institutions that are strong yet flexible enough to take a country to the next stage of development and then keep it at the frontier. What institutions will pass that test is and empirical matter

and left for further research.

5. Reference

Aditya, A., Roy, S. S., 2007. Export diversification and economic growth: Evidence from cross-country analysis. Mimeo, 1–25.

Alfo, M., Trovato, G., Waldmann, R. J., 2008. Testing for country heterogeneity in growth models using a finite mixture approach. Journal of Applied Econometrics 23 (4), 487–514.

Amiti, M., Freund, C., 2010. The anatomy of china's export growth. In: China's Growing Role in World Trade. NBER Chapters. National Bureau of Economic Research, Inc, pp. 35–56.

An, G., Iyigun, M. F., 2004. The export skill content, learning by exporting and economic growth. Economics Letters 84 (1), 29 – 34.

Audretsch, D. B., 1987. An empirical test of the industry life cycle. Review of World Economics (Weltwirtschaftliches Archiv) 123 (2), 297–308.

Audretsch, D. B., 2007. The Entrepreneurial Society. New York: Oxford University Press.

Audretsch, D. B., Sanders, M., 2007. Globalization and the rise of the entrepreneurial economy. CEPR Discussion Papers 6247, 1–48.

Barro, R., Lee, J.-W., 2010. A new data set of educational attainment in the world, 1950-2010. NBER Working Paper 15902, 1–49.

Bekaert, G., Harvey, C. R., Lundblad, C., Siegel, S., 2007. Global growth opportunities and market integration. Journal of Finance 62 (3), 1081–1137.

Bensidoun, I., Gaulier, G., Unal-Kesenci, D., 2002. The nature of specialization matters for growth: An empirical investigation. CEPII Working Paper 13, 1–30.

Besedes, T., Prusa, T. J., 2006. Product differentiation and duration of us import trade. Journal of International Economics 70 (2), 339–358.

Bos, J., Economidou, C., Koetter, M., Kolari, J., 2010. Do all countries grow alike? Journal of Development Economics 91 (1), 113 – 127.

Bos, J., Economidou, C., Sanders, M., 2007. R&D over the life cycle. Tjalling C. Koopmans Research Institute Discussion Paper Series No. 07-18 No. 07-18 (07-18), 1–23.

Cadot, O., Carrére, C., Strauss-Kahn, V., 2007. Export diversification: What's behind the hump? CEPR Discussion Paper 6590, 1–30.

Canova, F., 2004. Testing for convergence clubs in income per capita: A predictive density approach. International Economic Review 45 (1), 49–77.

Cline, W. R., February 1982. Can the east asian model of development be generalized? World Development 10 (2), 81–90.

Cline, W. R., 2010. Exports of manufactures and economic growth: The fallacy of composition revisited. In: Spence, M., Leipziger, D. (Eds.), Globalization and Growth: Implication for a Post-Crisis World.

Connolly, M., 1999. North-south technological diffusion: A new case for dynamic gains from trade. In: Working Paper. No. 99-08. Duke University, Department of Economics.

Dalum, B., Laursen, K., Verspagen, B., 1999. Does specialization matter for growth? Industrial and Corporate Change 8 (2), 267–88.

Dollar, D., 1986. Product cycle in the north-south trade. American Economic Review 76, 177–190.

Durlauf, S. N., Johnson, P., Temple, J., 2005. Growth econometrics. In: Aghion, P., Durlauf, S. (Eds.), Handbook of Economic Growth, 1st Edition. Vol. 1, Part A. Elsevier, Ch. 08, pp. 555–677.

Durlauf, S. N., Johnson, P. A., Oct.-Dec. 1995. Multiple regimes and cross-country growth behaviour. Journal of Applied Econometrics 10 (4), 365–384.

Feenstra, R. C., Rose, A. K., 2000. Putting things in order: Trade dynamics and product cycles. The Review of Economics and Statistics 82 (3), 369–382.

Flam, H., Helpman, E., 1987. Vertical product differentiation and north-south trade. American Economic Review 77, 810–822.

Giles, J. A., Williams, C. L., 2000. Export-led growth: A survey of the empirical literature and some non-causality results. part 2. Journal of International Trade & Economic Development 9 (4), 445–470.

Greene, W., 2007. LIMDEP, Version 9.0: Reference Guide. Econometric Software, Inc.

Grossman, G., Helpman, E., 1991. Quality ladders and product cycles. Quarterly Journal of Economics 109, 557–586.

Gylfason, T., Dec. 2004. Natural resources and economic growth: From dependence to diversification. CEPR Discussion Papers 4804 (4804), 1–34.

Hall, R. E., Jones, C. I., 1999. Why do some countries produce so much more output per worker than others? The Quarterly Journal of Economics 114 (1), 83–116.

Hausmann, R., Hwang, J., Rodrik, D., 2007. What you export matters. Journal of Economic Growth 12 (1), 1–25.

Herzer, D., Nowak-Lehnmann, F., August 2006. What does export diversification do for growth? An econometric analysis. Applied Economics 38 (15), 1825–1838.

Hesse, H., 2008. Export diversification and economic growth. The World Bank Commission on Growth and Development Working Paper 21, 1–25.

Hirsch, S., 1967. Location of Industry and International Competitiveness. Oxford University Press.

Imbs, J., Wacziarg, R., 2003. Stages of diversification. The American Economic Review 93 (1), 63–86.

Jarreau, J., Pocet, S., 2009. Export sophistication and economic performance: Evidence from chinese provinces. CEPII Working Paper 34, 1–36.

Jensen, R., Thursby, M., 1986. A strategic approach to the product cycle. Journal of International Economics 21, 269–284.

Klepper, S., 1996. Entry, exit, growth, and innovation over the product life cycle. American Economic Review 86 (3), 562–83.

Klinger, B., Lederman, D., 2006. Diversification, innovation, and imitation inside the global technological frontier. The World Bank Policy Research Working Paper Series 3872, 1–24.

Krugman, P., 1979. A model of innovation, technology transfer, and the world distribution of income. Journal of Political Economy 87 (2), 253–266.

Lai, E., 1995. The product cycle and the world distribution of income; a reformulation. Journal of International Economics 39, 369–382.
Lee, J., 2010. Export specialization and economic growth around the world. Economic Systems In Press, Corrected Proof, 1–20.
Lee, J.-W., October 1995. Capital goods imports and long-run growth. Journal of Development Economics 48 (1), 91–110.
Levine, R., Renelt, D., September 1992. A sensitivity analysis of cross-country growth regressions. American Economic Review 82 (4), 942–63.
Lewer, J., den Berg, H. V., 2003. Does trade composition influence economic growth? time series evidence for 28 oecd and developing countries. Journal of International Trade & Economic Development 12 (1), 39–96.
Martin, W., 1993. The fallacy of composition and developing country exports of manufactures. The World Economy 16, 159–172.
Mullor-Sebastian, A., 1983. The product life cycle theory: Empirical evidence. Journal of International Business Studies 14, 95–105.
OECD, 2005. Micro-policies for growth and productivity: Final report. Tech. rep., OECD, Paris.
Owen, A., Videras, J., Davis, L., December 2009. Do all countries follow the same growth process? Journal of Economic Growth 14 (4), 265–286.
Paap, R., Franses, P. H., van Dijk, D., 2005. Does Africa grow slower than Asia, Latin America and the Middle East? Evidence from a new data-based classification method. Journal of Development Economics 77 (2), 553–570.
Papageorgiou, C., 2002. Trade as a threshold variable for multiple regimes. Economics Letters 77 (1), 85 – 91.
Ranis, G., 1985. Can the east asian model of development be generalized? A comment. World Development 13 (4), 543–545.
Rauch, J. E., 1999. Networks versus markets in international trade. Journal of International Economics 48 (1), 7 – 35.
Redding, S., 2002. Specialization dynamics. Journal of International Economics 58, 299–334.
Rodriguez, F., Rodrik, D., 2001. Trade policy and economic growth: A skeptic's guide to the cross-national evidence. NBER Macroeconomics Annual 15, 261–338.
Rodrik, D., 2006. What's so special about china's exports? China & World Economy 14 (5), 1–19.
Sachs, J. D., Warner, A., 1995. Economic reform and the process of global integration. Brookings Papers on Economic Activity 26 (1), 1–118.
Schott, P. K., 2008. The relative sophistication of chinese exports. Economic Policy 23 (1), 5–49.
Singh, T., 2010. Does international trade cause economic growth? a survey. The World Economy 33 (11), 1517–1564.
Sutton, J., Trefler, D., 2010. Deductions from the export basket: Capabilities,wealth and trade. Mim, 1–61.
Temple, J., March 1999. The new growth evidence. Journal of Economic Literature 37 (1), 112–156.
Vaio, G. D., Enflo, K., 2010. Did globalization drive convergence? Identifying cross-country growth regimes in the long run. European Economic Review In Press, Corrected Proof.
Vernon, R., 1966. International investment and international trade in the product cycle. The Quarterly Journal of Economics 80 (2), 190–207.
Wacziarg, R., Welch, K. H., 2008. Trade liberalization and growth: New evidence. World Bank Economic Review 22 (2), 187–231.
Wang, Z., Wei, S.-J., 2010. What accounts for the rising sophistication of china's exports? In: China's Growing Role in World Trade. NBER Chapters. National Bureau of Economic Research, Inc, pp. 63–104.
Wörz, J., 2005. Skill intensity in foreign trade and economic growth. Empirica 32 (1), 117–144.
Xu, B., 2010. The sophistication of exports: Is china special? China Economic Review 21 (3), 482–493.

Appendix

Table A.1: Top 50 Least Mature Products

Name	Percentage of World Export	Maturity (year=2005)	Rank (year=2005)	Maturity (year=1988)	Rank (year=1988)
2112-Calf skins,raw (fresh,salted,dried,pickled	0,011	427	72	0,810	-0,139
8841-Lenses,prisms,mirrors,other optical elemen	0,338	426	193	0,749	0,009
8432-Suits & costumes,women's,of textile fabric	0,041	425	305	0,724	0,073
4232-Soya bean oil	0,067	424	88	0,709	-0,114
2234-Linseed	0,005	423	11	0,539	-0,366
0012-Sheep and goats, live	0,016	422	399	0,537	0,154
0616-Natural honey	0,010	421	108	0,512	-0,082
6760-Rails and railway track construction mater	0,029	420	242	0,465	0,037
4239-Other soft fixed vegetable oils	0,029	419	159	0,447	-0,021
0619-Other sugars;sugar syrups;artificial honey	0,035	418	282	0,437	0,059
4313-Fatty acids,acid oils,and residues	0,071	417	166	0,422	-0,015
4111-Fats and oils of fish and marine mammals	0,008	416	165	0,404	-0,016
0411-Durum wheat,unmilled	0,021	415	85	0,402	-0,118
0142-Sausages & the like,of meat,meat offal or	0,032	414	385	0,388	0,140
4249-Fixed vegetable oils,n,e,s	0,273	413	154	0,388	-0,028
0565-Vegetables,prepared or preserved,n,e,s,	0,136	412	260	0,382	0,047
0612-Refined sugars and other prod, of ref, bee	0,107	411	176	0,371	-0,008
3221-Anthracite,whether/not pulverized,not aggl	0,606	410	139	0,361	-0,037
3231-Briquet,ovoids & sim,solid fuels,of coal p	0,003	409	398	0,356	0,153
0730-Chocolate & other food preptns, containing	0,278	408	188	0,348	0,005
5417-Medicaments(including veterinary medicamen	2,668	407	379	0,347	0,133
2481-Railway or tramway sleepers (ties)of wood	0,003	406	161	0,343	-0,019
7188-Engines & motors,n,e,s,such as water turbi	0,109	405	147	0,329	-0,033
2815-Iron ore and concentrates,not agglomerated	0,255	404	190	0,328	0,008
6783-Other tubes and pipes,of iron or steel	0,294	403	130	0,322	-0,049
0611-Sugars,beet and cane,raw,solid	0,069	402	9	0,318	-0,384
3354-Petroleum bitumen,petrol,coke & bitumin,mi	0,134	401	86	0,318	-0,117
6130-Furskins,tanned/dressed,pieces/cuttings of	0,022	400	48	0,316	-0,193
6781-Tubes and pipes,of cast iron	0,013	399	424	0,314	0,248
8928-Printed matter,n,e,s,	0,309	398	270	0,312	0,052
8741-Surveying,hydrographic,compasses etc,	0,140	397	280	0,305	0,057
2320-Natural rubber latex; nat,rubber & sim,nat	0,127	396	18	0,291	-0,319
2332-Reclaimed rubber;waste & scrap of unharden	0,004	395	90	0,290	-0,107
2222-Soya beans	0,202	394	132	0,284	-0,048
7211-Agricultural & horticul,mach, for soil pre	0,047	393	77	0,284	-0,131
2879-Ores & concentrat,of other non-ferrous bas	0,162	392	3	0,281	-0,596
0813-Oil-cake & other residues (except dregs)	0,165	391	138	0,277	-0,037
6973-Domestic-type,non-electric heating,cooking	0,100	390	415	0,277	0,188
6611-Quicklime,slaked lime and hydraulic lime	0,006	389	405	0,276	0,163
5416-Glycosides;glands or other organs & their	0,409	388	400	0,264	0,154
0980-Edible products and preparations n,e,s,	0,391	387	416	0,264	0,192
6359-Manufactured articles of wood,n,e,s,	0,181	386	198	0,262	0,013
0460-Meal and flour of wheat and flour of mesli	0,032	385	269	0,260	0,052
8483-Fur clothing,articles made of furskins	0,030	384	101	0,258	-0,090
0574-Apples,fresh	0,050	383	160	0,257	-0,019
0470-Other cereal meals and flours	0,034	382	127	0,256	-0,055
4113-Animal oils,fats and greases,n,e,s	0,020	381	63	0,253	-0,159
2119-Hides and skins,n,e,s waste and used leath	0,011	380	6	0,253	-0,447
5415-Hormones,natural or reproduced by synthesi	0,096	379	380	0,251	0,135
8459-Other outer garments & clothing,knitted	0,452	378	311	0,249	0,076

Table A.2: Top 50 Most Mature Products

Name	Percentage of World Export	Maturity (year=2005)	Rank (year=2005)	Maturity (year=1988)	Rank (year=1988)
3341-Motor spirit and other light oils	0,001	-4,096	1	0,091	333
3343-Gas oils	0,001	-3,605	2	0,139	384
6351-Wooden packing cases,boxes,crates,drums et	0,007	-1,352	3	0,157	401
3345-Lubricating petrol,oils & other heavy petr	0,067	-1,319	4	0,212	418
6412-Printing paper & writing paper,in rolls or	0,124	-1,101	5	-0,100	95
2235-Castor oil seeds	0,000	-0,668	6	-0,267	32
8710-Optical instruments and apparatus	0,515	-0,643	7	0,069	298
7641-Elect,line telephonic & telegraphic appara	0,572	-0,600	8	-0,007	179
2614-Silk worm cocoons suitabl,for reeling & si	0,001	-0,546	9	-0,059	124
2683-Fine animal hair,not carded or combed	0,010	-0,542	10	-0,240	35
2771-Industrial diamonds,sorted,whether or not	0,007	-0,491	11	0,520	427
2872-Nickel ores and concentrates;nickel mattes	0,069	-0,469	12	-0,290	25
6812-Platinum and other metals of the platinum	0,189	-0,453	13	-0,292	24
0451-Rye,unmilled	0,003	-0,413	14	-0,106	91
3330-Petrol,oils & crude oils obt,from bitumin,	9,535	-0,380	15	-0,188	49
2890-Ores & concentrates of precious metals;was	0,049	-0,372	16	-0,115	87
2440-Cork,natural,raw & waste (includ,in blocks	0,003	-0,369	17	-0,030	151
0483-Macaroni,spaghetti and similar products	0,030	-0,294	18	0,177	411
8452-Dresses,skirts,suits etc,knitted or croche	0,044	-0,285	19	0,057	277
8442-Under garments,excl,shirts,of textile fabr	0,013	-0,284	20	0,238	422
2511-Waste paper,paperboard;only for use paper-	0,066	-0,282	21	-0,417	8
7788-Other elect,machinery and equipment	0,983	-0,279	22	0,048	261
2225-Sesame (sesamum)seeds	0,011	-0,259	23	-0,198	46
2517-Chemical wood pulp,soda or sulphate	0,216	-0,255	24	-0,376	10
2640-Jute & other textile bast fibres,nes,raw/p	0,001	-0,253	25	-0,085	106
7284-Mach,& appliances for spezialized particul	1,404	-0,248	26	0,019	211
6831-Nickel & nickel alloys,unwrought (ingots,p	0,107	-0,245	27	-0,315	20
8813-Photographic & cinematographic apparatus n	0,370	-0,243	28	0,013	197
2232-Palm nuts and palm kernels	0,001	-0,242	29	-0,869	2
6863-Zinc and zinc alloys,worked	0,012	-0,237	30	0,053	271
6415-Paper and paperboard,in rolls or sheets,n,	0,240	-0,235	31	-0,130	78
7281-Mach,tools for specialized particular indu	0,157	-0,231	32	0,001	184
7754-Shavers & hair clippers with motor and par	0,029	-0,225	33	-0,008	175
8811-Photographic,cameras,parts & accessories	0,078	-0,224	34	0,062	284
2512-Mechanical wood pulp	0,025	-0,211	35	-0,236	36
7512-Calculating machines,cash registers,ticket	2,510	-0,211	36	0,020	215
6542-Fabrics,woven,contain,85% of wool/fine ani	0,062	-0,194	37	0,073	304
8939-Miscellaneous art,of materials of div,58	0,760	-0,179	38	0,096	345
2223-Cotton seeds	0,003	-0,176	39	0,298	426
7642-Microphones,loudspeakers,amplifiers	0,153	-0,168	40	0,096	344
6861-Zinc and zinc alloys,unwrought	0,074	-0,166	41	-0,094	97
7442-Lifting,handling,loading mach,conveyors	0,491	-0,164	42	-0,009	173
6573-Coated/impregnated textile fabrics & produ	0,129	-0,155	43	0,081	321
8433-Dresses,women's,of textile fabrics	0,050	-0,148	44	-0,010	172
2516-Chemical wood pulp,dissolving grades	0,017	-0,144	45	-0,277	30
2784-Asbestos	0,004	-0,141	46	-0,101	94
2111-Bovine & equine hides (other than calf),ra	0,041	-0,141	47	-0,223	41
6822-Copper and copper alloys,worked	0,423	-0,137	48	-0,089	102
2472-Sawlogs and veneer logs,of non coniferous	0,063	-0,132	49	-0,068	116
7591-Parts of and accessories suitable for 751,	0,161	-0,127	50	0,052	268

Table A.3: Country Division-main specification

Code	Country	1988-1992	1993-1997	1998-2002	2003-2005
Africa					
civ	cotedivoire	A	A	A	B
cmr	cameroon	A	B	C	C
dza	algeria	A	A	C	C
egy	egypt	B	C	C	A
gha	ghana	C	B	A	C
gmb	gambia	B	B	B	C
ken	kenya	B	B	B	C
lby	libya	C	A	A	A
mar	morocco	B	A	C	C
mli	mali	B	A	B	B
moz	mozambique	A	A	A	A
mwi	malawi	B	A	B	C
sen	senegal	B	B	C	C
tun	tunisia	C	C	C	B
tza	tanzania	A	B	C	C
uga	uganda	C	A	C	C
zaf	southafrica	C	C	C	C
zmb	zambia	B	B	B	C
zwe	zimbabwe	A	B	A	A
Europe					
alb	albania	A	A	A	A
aut	austria	C	C	C	C
bel	belgiumlux	C	C	C	C
che	switzerland	C	C	C	C
cyp	cyprus	B	B	C	C
cze	czechrepublic	C	C	C	C
deu	germany	C	C	C	C
dnk	denmark	C	C	C	C
esp	spain	C	C	B	C
fin	finland	A	B	B	C
fra	france	C	C	C	C
gbr	uk	C	C	C	C
grc	greece	C	C	C	C
hun	hungary	A	C	B	C
irl	ireland	B	B	B	C
ita	italy	C	C	C	C
mlt	malta	B	C	B	C
nld	netherlands	C	C	C	C
nor	norway	C	B	C	C
pol	poland	A	B	C	B
prt	portugal	B	C	C	C
svk	slovakia	B	C	B	C
swe	sweden	C	C	C	C
tur	turkey	B	A	A	B
Former USSR					
arm	armenia			A	A
est	estonia			B	B
kaz	kazakhstan			A	A
ltu	lithuania			B	B
lva	latvia			B	B
hrv	croatia			C	B
svn	slovenia			C	C

Code	Country	1988-1992	1993-1997	1998-2002	2003-2005
Asia					
chn	china	B	A	B	B
bgd	bangladesh	C	B	C	C
hkg	hongkong	B	C	A	B
idn	indonesia	B	B	A	B
ind	india	B	B	B	B
irn	iran	C	A	C	C
isr	israel	B	C	B	C
jor	jordan	A	B	C	C
jpn	japan	B	C	C	C
kor	korearp	A	B	A	C
lka	srilanka	C	C	C	A
mys	malaysia	B	B	A	B
pak	pakistan	C	C	C	B
phl	philippines	B	B	A	B
sgp	singapore	B	B	A	B
syr	syrnarabrp	C	A	B	B
tha	thailand	A	B	A	B
twn	taiwan	B	B	C	C
North America					
can	canada	C	C	C	C
usa	usa	C	C	C	C
Oceania					
aus	australia	C	C	C	C
nzl	newzealand	C	C	C	C
South and Central America					
arg	argentina	A	C	A	B
bol	bolivia	C	C	C	C
bra	brazil	A	C	C	C
chl	chile	B	B	C	C
col	colombia	C	C	C	C
cri	costarica	C	B	C	C
dom	dominicanrp	A	C	A	B
ecu	ecuador	B	C	B	C
gtm	guatemala	C	C	C	C
guy	guyana	A	A	B	B
hnd	honduras	B	B	B	C
jam	jamaica	B	B	B	B
mex	mexico	C	A	C	C
nic	nicaragua	B	B	C	C
pan	panama	A	B	C	B
per	peru	B	A	B	C
pry	paraguay	A	B	B	B
slv	elsalvador	B	C	C	C
tto	trinidadtbg	C	A	B	B
ury	uruguay	A	B	A	B
ven	venezuela	A	B	B	A

A-Developing 2-Emerging 3-Advanced

Table A.4: Empirical Results-Non-oil Products

Regime	Developing	Emerging	Advanced
Initial GDP per capita	-0.023***	0.028***	-0.005***
Capital/labour ratio	-0.004	-0.019***	0.000
Human capital	0.007***	0.000	0.001
Rule of law	0.009**	0.003**	0.002***
Initial export maturity (non-oil)	0.284***	-0.095***	0.089***
Trade openness	0.009	-0.005	0.005
Trade concentration	0.044	-0.106***	0.032***
Constant	0.024	-0.062***	0.022***
Class Membership Probability			
Constant	0.430	0.519	Reference
GDP per capita	-0.010***	-0.007***	Reference
Observations	317	521	742

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table A.5: Hypothesis Test-Non-oil Products

Testing	Test	Test Statistic	P-value	Conclusion
Class Fit				
Three-class conditional	LRT	139.085	0.000	rejected
vs. Two-class conditional				
Three-class conditional	LRT	42.011	0.000	rejected
vs. Three-class unconditional				
Equality of Export Maturity				
Class A vs. B	Wald	16.888	0.002	rejected
Class B vs. C	Wald	23.894	0.000	rejected
Class A vs. C	Wald	5.088	0.024	(not) rejected
Class A, B and C	Wald	30.360	0.000	rejected
Equality of All Parameters				
Class A vs. B	Wald	92.072	0.000	rejected
Class B vs. C	Wald	231.775	0.000	rejected
Class A vs. C	Wald	37.710	0.000	rejected
Class A, B and C	Wald	287.684	0.000	rejected

Note: LRT represents the likelihood ratio test.

Table A.6: Empirical Results-Manufacturing Products

Regime	Developing	Emerging	Advanced
Initial GDP per capita	-0.019***	0.026***	-0.005***
Capital/labour ratio	-0.004	-0.018***	0.001
Human capital	0.007***	0.000	0.000
Rule of law	0.011***	0.003*	0.003***
Initial export maturity (manuf.)	0.266***	-0.086**	0.076***
Trade openness	0.008	-0.003	0.002
Trade concentration	0.045	-0.099***	0.029***
Constant	0.002	-0.058***	0.021***
Regime Membership Probability			
Constant	0.677**	0.655**	Reference
GDP per capita	-0.011***	-0.006***	Reference
Observations	362	537	681

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table A.7: Hypothesis Test-Manufacturing Products

Testing	Test	Test Statistic	P-value	Conclusion
Class Fit				
Three-class conditional	LRT	139.937	0.000	rejected
vs. Two-class conditional				
Three-class conditional	LRT	42.965	0.000	rejected
vs. Three-class unconditional				
Equality of Export Maturity				
Class A vs. B	Wald	23.940	0.000	rejected
Class B vs. C	Wald	13.105	0.000	rejected
Class A vs. C	Wald	8.450	0.004	rejected
Class A, B and C	Wald	26.412	0.000	rejected
Equality of All Parameters				
Class A vs. B	Wald	111.039	0.000	rejected
Class B vs. C	Wald	253.736	0.000	rejected
Class A vs. C	Wald	51.091	0.000	rejected
Class A, B and C	Wald	319.959	0.000	rejected

Note: LRT represents the likelihood ratio test.

Table A.8: Empirical Results-Sutton's Measure

Regime	Developing	Emerging	Advanced
Initial GDP per capita	-0.021***	0.019***	-0.002
Capital/labour aatio	-0.007	-0.009**	-0.002
Human capital	0.007***	0.001	0.001***
Rule of law	0.008**	0.008***	-0.001
Initial export maturity (Sutton)	0.248***	-0.132***	0.122***
Trade openness	0.009	-0.005	0.006**
Trade concentration	0.034	-0.094***	0.033***
Constant	0.031	-0.060***	0.020***
Regime Membership Probability			
Constant	0.338	0.456	Reference
GDP per capita	-0.010	-0.009	Reference
Observations	321	426	833

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table A.9: Hypothesis Test-Sutton's Measure

Testing	Test	Test Statistic	P-value	Conclusion
Class Fit				
Three-class conditional	LRT	134.378	0.000	rejected
vs. Two-class conditional				
Three-class conditional	LRT	40.878	0.000	rejected
vs. Three-class unconditional				
Equality of Export Maturity				
Class A vs. B	Wald	26.122	0.000	rejected
Class B vs. C	Wald	40.938	0.000	rejected
Class A vs. C	Wald	3.645	0.056	(not) rejected
Class A, B and C	Wald	46.948	0.000	rejected
Equality of All Parameters				
Class A vs.B	Wald	78.489	0.000	rejected
Class B vs.C	Wald	185.099	0.000	rejected
Class A vs. C	Wald	31.502	0.000	rejected
Class A, B and C	Wald	232.598	0.000	rejected

Note: LRT represents the likelihood ratio test.

Table A.10: Empirical Results-Rauch's Measure

Regime	Developing	Emerging	Advanced
Initial GDP per capita	-0.017**	0.016***	0.000
Capital/labour aatio	-0.010	-0.009***	-0.003***
Human capital	0.007***	0.001	0.001
Rule of law	0.013***	0.005***	0.001
Initial export maturity (Rauch)	0.054	-0.128***	0.099***
Trade openness	0.022**	-0.010***	0.009***
Trade concentration	0.072**	-0.126***	0.039***
Constant	-0.019	-0.034	0.009
Regime Membership Probability			
Constant	0.397	0.588	Reference
GDP per capita	-0.011	-0.007	Reference
Observations	293	528	759

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table A.11: Hypothesis Test-Rauch's Measure

Testing	Test	Test Statistic	P-value	Conclusion
Class Fit				
Three-class conditional	LRT	158.945	0.000	rejected
vs. Two-class conditional				
Three-class conditional	LRT	40.878	0.000	rejected
vs. Three-class unconditional				
Equality of Export Maturity				
Class A vs. B	Wald	9.674	0.001	rejected
Class B vs. C	Wald	65.453	0.000	rejected
Class A vs. C	Wald	0.659	0.417	not rejected
Class A, B and C	Wald	62.535	0.000	rejected
Equality of All Parameters				
Class A vs. B	Wald	96.874	0.000	rejected
Class B vs. C	Wald	248.152	0.000	rejected
Class A vs. C	Wald	25.148	0.000	rejected
Class A, B and C	Wald	305.133	0.000	rejected

Note: LRT represents the likelihood ratio test.