Export Diversification: What's behind the Hump?*

September 2007

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Abstract

The paper explores the evolution of export diversification patterns along the economic development path. Using a large database with 159 countries over 17 years at the HS6 level of disaggregation (4'998 product lines) we look for action at the "intensive" and "extensive" margins (diversification of export values among active product lines and by addition of new product lines respectively) using various export concentration indices and the number of active export lines. We also look at new product introduction as an indicator of "export-entrepreneurship". We find a hump-shaped pattern of export diversification similar to what Imbs and Wacziarg (2003) found for production and employment. Low and Middle income countries diversify mostly along the extensive margin whereas high income countries diversify along the intensive margin and ultimately re-concentrate their exports towards fewer products. Such hump-shaped pattern is consistent with the conjecture that countries travel across diversification cones as discussed in Schott (2003, 2004) and Xiang (2007).

Keywords: Export diversification, International trade, Latin America

JEL classification codes: F1, O11

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* Research on this paper was supported by a grant from the Interamerican Development Bank and by Switzerland's Fonds National pour la Recherche Scientifique. Without implicating them, the authors would like to thank Antoni Estevadeordal and Christian Volpe for useful comments.
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1. Introduction

Why should we care about export diversification? David Ricardo showed a century and a half ago that countries should *specialize*, not diversify. Monopolistic-competition models suggest that larger countries produce a broader range of products, but that hardly makes diversification a policy objective in itself. Yet as de Ferranti et al. (2002) note, "[a] recurrent preoccupation of [Latin American] policymakers is that their natural riches produces a highly concentrated structure of export revenues, which then leads to economic volatility and lower growth" (p. 38).

The view that concentration is associated with deteriorating terms of trade, income volatility and, ultimately, low growth, goes back to the work of Prebisch (1950) and Singer (1950). Though it has proved difficult to ascertain whether the terms of trade of primary-product exporters do have a deterministic downward trend or not (on this, see Cuddington et al. 2001), evidence in favor of the Prebisch-Singer hypothesis is fairly strong. Regressions on cross-sections of countries (see e.g. Sachs and Warner 1995, or more recently Gylfason 2004) and panels (de Ferranti et al. 2002) suggest that export concentration is indeed statistically associated with slow growth, in particular when export concentration reflects the predominance of primary products, as it usually does. Interestingly, Herzer (2004) also found a long-run statistical association between growth and export diversification on the basis of time-series data from Chile.[1] However evidence in favor of the Prebisch-Singer hypothesis only means that moving away from primary products is desirable; not that diversification is desirable *per se*. Assessing whether or not the quest for export diversification is a meaningful policy objective in itself requires a deeper understanding of how it relates with economic development.

[1] Herzer uses Perron's test for unit roots in the presence of structural breaks, which is of course particularly important given Chile's choppy growth history.

How export diversification evolves, empirically, along the path of economic development is, however, a relatively little-explored question. Imbs and Wacziarg (2003) were the first to uncover a non-monotone path of production and employment as functions of per-capita incomes, with diversification followed by re-concentration. Klinger and Lederman (2004, 2005) shortly followed suit with a similar result on export data. While Imbs and Wacziarg's exercise was a purely empirical one, Klinger and Lederman built on Hausmann and Rodrik (2003) to explore a causal link from market failures to insufficient diversification. Essentially, the story is that opening up new export markets is an entrepreneurial gamble which, if successful, is quickly imitated. The inability of export entrepreneurs to keep private the benefits of their activity leads to a classic public-good problem. Poor institutions, Klinger and Lederman show, appear empirically to compound the problem, lending support to the Hausmann-Rodrik view.

We revisit the issue using a different methodological perspective. We constructed a very large database covering 159 countries (including 121 developing countries) over all years available from the COMTRADE database at the highest disaggregation level (HS6). Using this database, we calculated for all countries and years three variables of interest: an export concentration index (we will use alternatively the Herfindahl, Theil and Gini indices), the number of active lines (lines with nonzero exports), and a measure of "new export products" identified, for each year and country in the sample, as export lines that are active and would remain so for two years but had been inactive during the previous two years.

Using Hummels and Klenow's (2005) terminology, we use these three variables to explore action along the "intensive" and "extensive" margins (diversification of export values among active product lines and by addition of new product lines respectively), as well as structural differences between traditional and new products.

We find a hump-shaped relationship between economic development and export diversification, like Imbs-Wacziarg and Klinger-Lederman, with a turning point around 20'000-22'000 dollars per capita at purchasing-power parity (PPP). At incomes levels below this turning point, there is diversification at both the extensive and intensive margins. Importantly, for the low and middle income countries (i.e., with GDP per capita below 14'000 dollars PPP) diversification occurs mostly along the extensive margin.[2] The intensive margin dominates thereafter. For incomes levels above the turning point, we observe a re-concentration of exports towards fewer products. Such hump-shaped diversification curve is consistent with the conjecture that countries travel across diversification cones as discussed in Schott (2003, 2004) and Xiang (2007).

We also find that if the share of raw materials is a significant contributor to export concentration, its inclusion in regressions does not affect the turning point or the significance of income levels, suggesting that the non-monotone path of diversification is an inherent feature of the economic development process (rather than a reflection of the predominance or not of primary-product exports). Moreover, we evidence that public infrastructure contributes to export diversification but only along the intensive margin.

The paper is organized as follows. Section 2 presents prima-facie (descriptive) evidence on traditional and new export products. Section 3 reports econometric evidence on the stages of export diversification along the economic development process using non-parametric and standard techniques. In order to better understand what is behind the hump-shaped diversification curve evidence in preceding section, Section 4 analyses action along the "intensive" and

[2] PPP $ 14,000 is roughly the World Bank threshold for high income country.

“extensive” margins by (i) comparing changes in export concentration indices and number of active lines and (ii) analyzing the evolution of the “within” and “between” component of the Theil concentration index. We argue that results are consistent with the conjecture that countries travel across diversification cones. Section 5 explores other potential explanations of the diversification process curve. Section 6 concludes.

2. Prima-facie evidence

2.1 Measures of export concentration/diversification

Our dataset comprises data on trade, income per capita, and public capital. The export data is taken from UNCTAD's COMTRADE database at the HS6 level of disaggregation (4'998 lines).[3] The baseline sample covers 159 countries representing all regions and all levels of development between 1988 and 2004 (17 years), including 121 developing countries, i.e. non high-income countries as defined by the World Bank (incomes per capita roughly under 2006 US$10'000). See appendix A.1 for a detailed sample composition. Taking out missing year data the usable sample has 1'574 observations (country-years).

In this section, we compute several measures of export concentration/diversification for each country and year: Herfindahl concentration indices, Theil and Gini indices of inequality in export shares, and the number of active export lines.

The Herfindahl index, normalized to range between zero and one, is

[3] The Harmonized System's classification of goods is defined by the number of digits used, which goes from 1 (sections, numbering 21) to 2 (chapters, numbering 99), 4 (headings, numbering 1'243), and 6 (sub-headings, numbering 4'998 according to the HS 1989-92 nomenclature). Further degrees of disaggregation (HS 8, 10 and beyond) are not harmonized across members of the World Customs Organization and require extremely cautious handling. For instance, Eurostat, the European Union's statistical division, frequently reclassifies goods, shifting them back and forth between different HS8 codes from one year to another. As a result, an HS8 code may correspond to a good at time t, to another good at time t+1, and back to the same good at time t+2. This problem also affects US trade data compiled by Feenstra in the NBERTD (see Feenstra 1997 and Feenstra, Romalis and Schott 2002). Eurostat HS10 data is not publicly available.

$$H^* = \frac{\sum_k (s_k)^2 - 1/n}{1 - 1/n} \quad (1)$$

where $s_k = x_k / x$ is the share of export line k in total exports and n is the number of export lines (omitting country and time subscripts).[4]

Theil's entropy index (Theil 1972) is given by

$$T = \frac{1}{n}\sum_{k=1}^{n} \frac{x_k}{\mu} \ln\left(\frac{x_k}{\mu}\right) \quad where \quad \mu = \frac{\sum_{k=1}^{n} x_k}{n} \quad (2)$$

For Gini indices, we use Brown's formula; that is, for each country and year, we first sort export lines, indexed by k, by increasing order of trade value x so that $x_k < x_{k+1}$. Cumulative export shares are

$$X_k = \sum_{\ell=1}^{k} x_\ell \Big/ \sum_{\ell=1}^{n} x_\ell \quad (3)$$

and cumulative shares in the number of export lines are simply k/n. Brown's formula for the Gini coefficient is then

$$G = \left|1 - \sum_{k=1}^{n} (X_k - X_{k-1})(2k-1)/n\right|. \quad (4)$$

Table 1 shows descriptive statistics for these indices.

Table 1

[4] Note that COMTRADE does not always report inactive export lines as zero lines, as national customs often omit those lines. In a first step, we have thus harmonized sample size for all countries and years by adding the missing lines and assigning them zero trade values. Thus, n = 4'998 (according to the HS 1989-92 nomenclature) for every country and year.

Descriptive statistics – 159 countries over 1988-2004

Observe that Gini coefficients are very high, corresponding to Lorenz curves that are almost right-angle ones. This contrasts with those calculated by Imbs and Wacziarg (2003) on production and employment (typically around 0.5, see their Table 1). The reason has to do with the level of disaggregation rather than with any conceptual difference between trade, production and employment shares. Whereas Imbs and Wacziarg calculated their indices at a relatively high degree of aggregation (ILO 1 digit, UNIDO 3 digits and OECD 2 digits) we use a very disaggregated trade nomenclature. At that level we have a large number of product lines with small trade values, while a relatively limited number of them account for the bulk of all countries' trade (especially so of course for developing countries but even for industrial ones). The reason for this pattern is that the harmonized system used by COMTRADE is derived from nomenclatures originally designed for tariff-collection purposes rather than to generate meaningful economic statistics. Thus, it has a large number of economically irrelevant categories e.g. in the textile-clothing sector while economically important categories in machinery, vehicles, computer equipment etc. are lumped together in "mammoth" lines. High Gini indices are thus to be expected for all countries. Note that we are interested here in the evolution of the Gini index and not in its level.

As for the average number of "positive" export lines –active lines with non-zero trade values– it is relatively low at 2'492 per country per year, i.e. a little less than half the total, with a minimum of 13 for Kiribati in 1993 and a maximum of 4'957 for the United States in 1994. This implies that there is room for a substantial "extensive margin" for developing countries, especially the poorest and least diversified ones.

Note that GDPs per capita are taken from the World Bank's World Development Indicators (WDI) and are expressed in 2000 Purchasing Power Parity (PPP) dollars for comparability. The last line of Table 1 report descriptive statistics for an index of public infrastructure capital which we use in the regression analysis. It is a composite of fixed-line telephone density (number of lines per thousand inhabitant), railroad density (km per inhabitant), road density (km per inhabitant), and the proportion of paved roads. Data is from the WDI and individual components were combined into a single index using principal components analysis.[5]

2.2 Defining "new products"

"New products" (i.e. lines at the HS6 level) for a year and country are defined in our database as those that were not active in the country's export trade in the preceding two years but were exported in each of the following two years (the definition is thus based on a moving 5-year sub-sample). This reduces the sample of "new products" to 1990-2002, two years being taken out at both ends. Our definition differs from that used by Klinger and Lederman (2004) who define "discoveries" (the equivalent of our "new products") as products that represent more than US$1 million of exports per year in the latter part of their sample (1999-2002) and less than $10'000 in the beginning (1992-1993). By their definition, there were a total of 1'710 discoveries at the HS6 level over the whole sample period, whereas we have on average 57 new products per country per year (see table 1), i.e. a total of 51'626 "new products" (new for a country and a year, not in the absolute) for the entire sample period.

Why the difference? Conceptually, our notions of new products are essentially the same, being based on the idea that imperfectly-informed entrepreneurs search for profitable export opportunities. Uncertainty can be about production costs, as in Hausmann and Rodrik (2003), or about foreign demand, as in Vettas (2000); but the point is that starting to export a product is an

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[5] Missing data was completed by linear or geometric interpolation and limited extrapolation. As extrapolation often resulted into overshooting compared to trends, the choice between linear and geometric was based on minimization of extreme values. We are grateful to Claudio Sfreddo for making this data available to us.

entrepreneurial gamble that may fail, leading to short-lived export "spells". The shorter those spells, the more discoveries or new products there should be, as new entrepreneurs try again a few months or years later, incurring the sunk cost of reaching foreign markets anew.[6]

Detailed evidence on the length of export spells and on product turnover in international trade was recently analyzed by Besedes and Prusa (2006a) using the Feenstra, Romalis and Schott (2002) database for the US.[7] Strikingly, they find that over half of all trade relationships (defined as nonzero export lines for a given exporting country, the importing country being always the US) are observed for a single year, while 80% are observed for less than five years. Survival analysis shows a rapidly decreasing hazard rate, suggestive of two regimes: rapid failure vs. long-term success. These numbers indicate very rapid turnover in international trade, a finding that is quite consistent with the entrepreneurial-search view of Vettas or Hausmann and Rodrik.

By aggregation, HS6 data are likely to smooth some of these entries and exits (though Besedes and Prusa's results seem robust to at least some aggregation), so one would want to err on the side of too many new products rather than too few. In addition, they find shorter median spells for Southern exporters (two years) than for Northern ones (six years), so our data is likely to be characterized by high unobserved turnover.[8] Finally, we treat two successive export spells in the same product line for the same country as two new products. The reason is that the product marketed by second-timers after an initial failure may not be –indeed, is unlikely to be– identical to what was tried by the first-

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[6] On this, see Roberts and Tybout (1997), who found that the probability that a firm is active in export markets depends on its status the previous year but not further back, suggesting very rapid decay of incumbency advantages (information, networks etc.).
[7] This database is an extension to 2001 of Feenstra's database on US trade at the HS10 level of aggregation. See Feenstra, Romalis and Schott (2002).
[8] This however must be interpreted cautiously. If some of the apparent failures are simply measurement errors (unrecorded trade), smaller trade volumes are more likely to be censored in a way that cannot be detected. This is likely to affect developing countries whose export volumes are low (see below and the discussion in Besedes and Prusa 2006a).

timers, lest it would be likely to fail again; thus, two spells in the same HS6 line, treated as two new products in our definition, are indeed likely to be two new products, not one.

This said, the number of new products should be interpreted somewhat cautiously, as they do not necessarily represent true entrepreneurial "discoveries". First, as discussed in an earlier footnote, at very high levels of disaggregation such as HS8 or HS10, there is constant reclassification of products across HS codes, giving rise to artificial births and deaths.[9] Second, among the countries with the highest number of "new-product" lines thus defined, one finds transition countries whose trade statistics were gradually put in place during the 1990s, such as Romania (with 1'331 lines in 1991).[10] "New products" in those cases may well be discoveries of their country's statistical office only. Third, one also finds very poor countries whose trade statistics are particularly erratic and report zero trade as a result of mismeasurement, such as Zambia.[11] In that case what looks like two spells may be one with non-recorded trade in the middle. Thus our definition, which requires two zero-trade years instead of one to end a spell, strikes a balance between the very conservative one used by Klinger and Lederman (2004) and the very liberal one used by Besedes and Prusa (2006b).

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[9] In their survival analysis, Besedes and Prusa (2006a) chose to treat reclassifications as censored observations; that is, a spell of, say, five years ending with a reclassification is treated as a spell of *at least* five years, like a spell at the end of the sample.

[10] Romania also figures prominently in Klinger and Lederman's (2004) discoveries (see their Table 2).

[11] Trade statistics are seriously error-prone in poor countries. The data is provided by UNCTAD's member states and is typically compiled by national statistical offices and reviewed by Trade Ministries on the basis of raw data provided by Customs administrations. Under automated systems such as ASYCUDA, data is increasingly entered in computer systems directly by employees of transit companies, sometimes resulting in input errors. Many Least Developed Countries have benefited in recent years from technical-assistance programs designed to raise the awareness of customs administrations to the need to provide government authorities with reliable data and improving their capacity to do so, but progress is slow.

2.3 Are 'new products' any different from others?

Table 2 gives a characterization of export goods using Rauch's index of product differentiation. Rauch (1999) distinguished between products traded on organized exchanges such as the LME, products with reference prices (listed in widely available publications like the *Knight-Ridder CRB Commodity Yearbook*), and differentiated products whose prices are determined by branding.[12] Rauch's classification is likely to be of importance for our analysis as Besedes and Prusa (2006a) found that export spell lengths are significantly lower for homogenous goods than for reference-priced and differentiated ones. This suggests that, in accordance with intuition, search costs are higher for the latter than for the former, leading to more stable trading relationships. One would thus expect entrepreneurs in poor countries to establish the kind of trade networks needed to export differentiated goods only progressively, leading over time to more stable export patterns. This, in turn, would suggest a higher share of differentiated among new products than among traditional ones. Table 2 shows the proportion of each of Rauch's categories in traditional and new export lines.

Table 2
Characterization of products by degree of differentiation

[12] Rauch argued that finding markets for differentiated goods involves a sequential search for trading partners that can be long and costly and will in all likelihood involve networks based on ethnic, linguistic or other factors of proximity. Exporting products listed on organized exchanges, by contrast, (or, to a lesser extent, reference-priced products) involves anonymous markets and hence lower search costs. Evidence from a gravity equation supported this view.

We find a lower share (in terms of export value) of homogenous-product exports among new lines (according to our definition) than among traditional ones (11.4% vs. 22.3% using Rauch's "conservative" classification and 17% vs. 29.3% according to his "liberal" classification). The reverse is true of "reference-priced" goods, the third category (differentiated goods) having similar shares in new and traditional products. Thus, products that appeared in developing countries' exports in the 1990s were no more differentiated than products they had been exporting thus far, suggesting a general failure to establish efficient networks.

3. Stages of diversification: Estimation

3.1 Non-parametric evidence

In order to verify if a non-monotone relationship à la Imbs-Wacziarg holds between export diversification and economic development, we report here the results of a non-parametric "smoother" regression of Herfindahl, Theil, and Gini indices on GDP per capita.

A "smoother" regression is a non-parametric regression technique designed to generate a fitted curve that imposes no a priori functional form (linear, quadratic or other) to the relationship between two variables *X* and *Y*. It is thus a useful exploratory tool to detect highly nonlinear relationships. The so-called LOWESS smoother (for LOcally WEighted Scatterplot Smoothing) proceeds as follows. Suppose we want to ascertain the shape of the relationship between *X* and *Y* on a sample of *n* observations. Order observations by index *i* so that $x_i < x_{i+1}$. For each observation *i*, a Weighted Least Squares regression of *Y* on *X* is run on a sub-sample that goes from observation $i- = \max\{1, i-k\}$ to observation $i+ = \min\{i+k, n\}$, with so-called "tri-cube" weights[13]

[13] This "triangular" weight structure, which gives more weight to observations near *i*, was originally proposed in Cleveland (1979). It is not the only one possible; for instance, Imbs and

$$w_j = \left[1 - \left(\frac{|x_j - x_i|}{\Delta}\right)^3\right]^3,$$
$$\Delta = 1.0001 \max\{x_{i+} - x_i; x_i - x_{i-}\},$$

for all j between i- and i+. Because n such regressions are run, a different slope parameter is obtained for each observation, generating a smooth fitted curve that can have any shape. Observe however from the construction of i- and i+ that the sub-samples become smaller for observations near the sample's bounds, so nonlinearities observed near the extremes should be interpreted cautiously.

In Figures 1a-1c, fitted curves show predicted values of Herfindahl (1a), Theil (1b) and Gini (1c) indices together with the predicted number of active export lines. The latter, which are concave and increasing at the origin, are easy to distinguish from the former, which are convex and decreasing at the origin.

Figures 1a-1c
Predicted concentration indices & number of active products

The curves shown are fitted using smoother and quadratic polynomial regressions. Note that they are quite similar. Given that there is only one turning point in production, the advantage of the non-parametric smoother regressions over quadratic polynomials is nil;[14] so from now on we turn to parametric estimation using the latter, which are much more flexible in terms of estimation methods and use of control variables.

Wacziarg (2003) use a "rectangular" weight structure giving equal weights to each observation in each sub-sample.

[14] Moreover, as the turning point appears late in the sample, the non-parametric estimation are not a relevant method to detect this nonlinearity (as noted above, the LOWESS estimates should be interpreted cautiously near the extremes).

3.2 Parametric evidence

Although Tables 3 to 6 report estimation results for both concentration indices and the number of active export lines, we will first limit the discussion to the former and then turn to the latter and their co-movement.

Table 3 explores the turning point's stability across different definitions of GDP per capita. The first bloc (columns (1)-(4)) uses per capita GDP at PPP from the WDI; the second (columns (5)-(8)) uses per capita GDP at PPP from the Penn World Tables; and the third (columns (9)-(12)) uses GDP per capita in constant US dollars from the WDI. Estimates are from pooled OLS, with White-corrected standard errors. Using WDI definition gives a turning point around $26'000 while other definition of GDP provide turning points between $20'000 and $28'000.[15]

Table 3
Quadratic regression results, pooled OLS

One issue is whether the turning point is driven by microstates and island economies, which could have middle-range per capita GDPs and at the same time be very concentrated –say, in bananas or fish products. The first two columns of Table 4 (using the WDI definition, to which we will stick from now on) show that excluding 24 countries with populations below one million inhabitants shifts the turning point forward to $23'000 at PPP. As microstates are potential outliers, we omit them in the rest of the analysis.

Table 4
Results without microstates

[15] The turning point is much higher when the Gini index is used instead of Theil or HHI indices. Using more sophisticated econometric techniques (i.e., logistic transformation, Generalized Moments Method), which correct for most bias, entails however turning points roughly at the same level of GDP per capita for all measure of concentration. See Table 6 for the logistic transformation and GMM analysis.

Our turning point is substantially higher than the one found by Imbs and Wacziarg for production ($14'600 in 1996 dollars, or about 16'500 in constant 2000 dollars) but quite similar to what Klinger and Lederman (2005) found for exports on a panel of 130 countries over 1992-2003 ($22'500 in constant 2000 dollars).

An addition issue is whether the result is driven by omitted variables. First, spurious correlation could be introduced by fluctuations in the world price of oil and other commodities, as higher commodity prices would raise both per capita incomes and export concentration for primary-product exporters. The first block of Table 5, which reports pooled estimates with time effects, shows that the turning point is unaffected.

Table 5
Pooled, within and between estimates

Second, given the panel structure of our data set, a natural question is which type of estimator –within, between, random-effect or pooled– should be used. Imbs and Wacziarg estimated their production turning point using fixed effects, however their sample was long in the time dimension (1969-1997) whereas ours has only 11 years per country (with a minimum of 2 years and a maximum of 17–see appendix A.1) With such a short time dimension, estimating the turning point on the basis of the within-country dimension only would be of debatable value. Indeed, the second block of Table 5, which reports estimates with time and country fixed effects, shows no turning point at all. By contrast, the third block, which reports between estimates, has the usual turning point.[16]

[16] A natural way of combining the within and the between dimensions of the data would be to use random effects, but a Hausman test rejects the null of no correlation between GDPs and country random effects. The natural fix for such a problem would be to use instrumental-variable techniques such as Hausman-Taylor's (1981), but with only one RHS variable (GDP and its square) instrumentation is not possible.

Table 6 reports a number of robustness checks. One issue has to do with censoring: in order to take account of the fact that Gini coefficients are bounded left and right at zero and one respectively –although neither is binding *stricto sensu*– the first bloc reports estimates from a logistics transformation. The result is to make the turning point appear at the usual level of about $23'000. The second has to do with the potential endogeneity of GDP per capita to export concentration. As we have no valid outside instrument for GDP per capita, the table's last block –columns (4) to (7)– shows system Generalized Moments Method (GMM) estimation results, with a turning point varying between $19'524 (Herfindahl) and $24'500 (Gini).[17]

Table 6
Robustness

Thus, by and large both the existence of a turning point in export concentration and its location around a GDP per capita of about $20'000-23'000 at PPP –a very late point in the development process– are fairly robust.

3.3 Number of active lines and "New" products

A glance at the columns entitled "Nber" in Tables 3-6 shows that there is a clear hump-shaped relation between the number of active export lines and the GDP per capita, the turning point for the number of active export lines being always roughly at the same level of GDP per capita as that of Herfindahl and Theil indices (see also figures 1a-1c). This applies as well to column (3) of Table 6, which reports negative binomial estimation to take into account the fact that the

[17] Blundell and Bond's (1998) system GMM estimator uses lagged differences as instruments for current levels and lagged levels for current differences. As is well-known, a crucial issue when using GMM and especially system GMM is the number of instruments, which should not exceed the number of individuals in the panel (see Roodman 2006). We make the standard choice of using two lags for the instruments of the differenced equation and one lag for the instruments of the level equation. Following Arellano and Bond (1991) we use the Sargan/Hansen test of overidentifying restrictions and a direct test for the absence of second-order serial correlation; both fail to reject the null of no serial correlation.

number of lines is a count variable.[18] The increasing part of the curve corresponds to the introduction of new products as countries develop (see more evidence below) whereas the decreasing part of the curve shows that high income countries tend to "close", once active, export lines.

Figure 2 reports the quadratic estimates for the number of "new" export lines (per country-year, defined as per section 2.2 above) on *ln*(GDPpc). This specification is justified by the non-parametric estimates (see the Lowess of the number of new products on GDP per capita also reported in figure 3). Results are very similar to the ones of Klinger and Lederman (2005) despite a different definition of "new products": the number of new products falls as countries develop, after peaking at the lower-middle income level (PPP $4'150).

Figure 2
Predicted New Exports: non-parametric & quadratic estimates

Figure 3 compares the number of new export lines and their average value (per line) against GDP per capita (non-parametric estimates). It can be seen that, if the number of new products peaks at $4000 per capita, their value per line shoots up very late in the development process, largely after $25'000 per capita, so the increase in value concerns only a few countries.

Figure 3
New products and their average value: nonparametric curves

Thus our analysis, using regressions of concentration indices as well as number of active line on GDP per capita, evidences a hump-shaped relationship between economic development and export diversification. Our next task is to understand what is behind the hump.

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[18] Note that, for active lines, we have one additional reason for using time effects –namely, that their number can be affected by commodity reclassifications (see footnote 1) as those happen even at the HS6 level (e.g. goods that are suddenly reported separately though they were previously lumped together in the 'not elsewhere specified' category). As reclassifications cannot be identified directly, we follow Klinger and Lederman (2005) and control for them simply by year dummies.

4. Stages of diversification: “extensive” *vs.* “intensive” margins

Increase exports diversification with countries development is an expected result as capital accumulation entails production and trade of new products. In contrast and although consistent with Imbs and Wacziarg (2003)‘ s findings for production and employment, the hump-shape pattern is rather puzzling.

In order to better understand what is behind the hump, we now turn to what might be called the “intensive” from “extensive” margins. By these, we mean respectively variations in trade values for existing products and variations in the number of active lines. The decomposition of export concentration indices also provides important results as it tells apart actions along the intensive and extensive margin. We carry out the analysis in terms of Theil indices because of their decomposability properties.

4.1 Number of active export lines *vs.* concentration indices

Using alternatively indices of concentration and the number of active product lines as the dependent variable (the explanatory variable being GDP per capita), four broad patterns are possible: (i) with both concentration indices and the number of active lines rising with GDP per capita, there is diversification along the extensive margin and concentration along the intensive one; (ii) with concentration indices decreasing and the number of active lines rising, there is diversification along the extensive or both margins; (iii) with concentration indices rising and the number of active lines decreasing, there is concentration along the extensive or both margins; (iv) with concentration indices and the number of active lines decreasing, there is concentration along the extensive margin (retrenchment), but diversification among existing products.

According to results in Tables 3-6, only scenari (ii) and (iii) are relevant. At income levels below the turning point, concentration indices decrease and the number of active lines increases suggesting diversification along the extensive *or both* margins. Similarly, at income levels above the turning point, there is concentration along the extensive *or both* margins. In order to determine the type of diversification (extensive *vs*. intensive) that predominates during the development process, we thus need to further analyse the concentration indices through decomposition.

4.2 One step further: Theil decompositions

We decompose the Theil's index into a "within" component

$$\begin{aligned} T^W &= \sum_{j=1}^{J} \frac{n_j}{n} \frac{\mu_j}{\mu} T^j \\ &= \sum_{j=1}^{J} \frac{n_j}{n} \frac{\mu_j}{\mu} \left\{ \frac{1}{n_j} \sum_{k \in j} \frac{x_k}{\mu_j} \ln\left(\frac{x_k}{\mu_j} \right) \right\} \end{aligned} \quad (5)$$

and a "between" component

$$T^B = \sum_{j=1}^{J} \frac{n_j}{n} \frac{\mu_j}{\mu} \ln\left(\frac{\mu_j}{\mu} \right) \quad (6)$$

where $T^W + T^B = T$. The "within" component captures the concentration of exports within groups whereas the "between" component reveals the concentration of exports across groups. The "within" component thus explores the levels and evolution of concentration within traditional products' exports (the "intensive" margin) while the between component provides information on concentration between the group of traditional products, the group of new products and the group of non-traded products (the “extensive” margin). [19] Whereas the within component does not depend on the total potential number of export lines (i.e., 4998 lines), the between component differentiates the actual number of active line from the potential one. This is an important feature as it allows distinguishing the extensive from the intensive margin.

Figure 4
“Within” and “between” components of Theil’s index

Figure 4 depicts the contribution of the between and within component to the Theil. Two main results emerge. First, the “within” component accounts for most part of the Theil. Second, and importantly, the evolution of the Theil depends mostly on the evolution of the between component.

For low income levels, the total Theil decreases at a higher rate than the within Theil. The acceleration in diversification is thus caused by the “between” component. In fact, when the slope of the total Theil is at least twice the slope of the within component, the between component contributes for more than 50% to the decrease of the Theil. That is: diversification occurs mostly at the “extensive” margin. This will be the case for GDP levels below about PPP $ 14,000 (which roughly corresponds to the World Bank high income country threshold). After that point and until the turning point of around PPP $24,000, diversification along the intensive margin predominates. What does explain that the contribution of the “extensive” margin to diversification is decreasing in the level of GDP? When the number of active lines rises, total export value is spread over a higher number of lines, thus decreasing the between component of the Theil. As suggested by Figure 2 the cumulative effect of new exports lines on the number of active lines is decreasing as countries develop after peaking at lower-

[19] Note that the within component is a weighted average of the within Theil for the group of traditional product and of the within Theil for the group of new product. As the group of traditional product accounts for 0.99 of the total value of exports, in the discussion we associate the within component to the within for traditional products.

middle income level (ppp$4'150), entailing a diminishing contribution of the "extensive" margin to diversification.

Moreover, the "between" component is responsible for most of the U-shape of the Theil index. At the turning point of the Theil (i.e., around GDP of PPP $24,000), the within component of the Theil is decreasing. Although there is a continue diversification within the group of traditional products (hence, along the intensive margin), we observe a concentration of exports across groups. What does explain this increase of the between component? At high level of GDP, the number of new export lines is low and the number of active line actually falls. This evolution reflects the death of several traditional export lines with low export values as evidence in Table 7.

Table 7
Cumulated "Closed" lines over 2001-2003 on average for countries with a GDP per capita > 24 000$

Table A.2 in the appendix lists the chapters with the highest number of closed lines. Various industries are represented. Chapters from the Chemicals industry (Chapter 29) as well as from the Raw Hides and Skins, Leather, Furskin industry (Chapter 41) are among the chapters that have closed the highest number of lines. For the former it corresponds to 5.4% of the chapter 2000 number of active lines whereas for the latter it represents 29.5% of 2000 number of active lines. In both case the value of closed lines is low (about 0.03% of 2000 total export value). These features confirm Schott (2004)'s findings that specialization occurs *within* products rather than *across* products, with closure of the less profitable lines in which countries have lost their comparative advantage. Note that, as shown in Figure 5b and although we observe closure of several lines in chapter 29, high income countries are specializing in the Chemical industry. In contrast, Figure 5c reveals that exports for the Raw Hides and Skins, Leather, Furskin industry (section 8) are declining. Thus, in the Chemical industry we may talk of *within* products specialization whereas for the

Raw Hides and Skins, Leather, Furskin industry we encounter a dying sectors slowly closing most of its lines.

Thus at income levels below the turning point, there is diversification along both margins. For income levels below PPP $ 14,000, the between component is predominant. Countries diversify at the extensive margin adding lines to their reduced set of exports. For income levels between $ 14,000 and $24,000, the within component explains most of the diversification. Exports values become more equally distributed across products lines and the number of products exported slightly increases with the level of GDP. At income levels above the turning point there is concentration along the extensive margin only. Whereas the number of active lines declines, the concentration of exports value among existing active line stays still.

Low and Middle income countries diversify mostly along the extensive margin. High to very high income countries diversify at the intensive margin, and ultimately re-concentrate their exports towards fewer products. The extensive/intensive margin analysis helps explain this hump-shaped pattern of the diversification curve. It is in accordance with the theory that countries travel across diversification cones as discussed in Schott (2003, 2004) or Xiang (2007) and developed in the next section.

4.3 Travel across diversification cones

When they accumulate capital, countries travel across diversification cones. As they do so, “old-cone” lines should become inactive while “new-cone” ones should become active. Suppose that “old-cone” lines are slow to die because of incumbency advantages, established ties with customers, or any kind of support they may get. During the transition phase, then, new-cone lines become active while old-cone ones don’t want to die. As a result, exports diversify and the total number of active lines rises. As time passes, however, comparative advantage catches up on old lines and they slowly die, reducing diversification. Viewed this way, high diversification at middle-income levels is essentially a transitory phenomenon between two steady states in terms of industrial specialization.

Besedes and Prusa's finding that the hazard rate decreases rapidly in the first years of an export spell is indeed suggestive of a dual regime with high infant mortality, consistent with Hausman and Rodrik's view of an entrepreneurial trial-and-error process, and persistence among "old" spells, consistent with the conjecture above. It is also consistent with Schott's (2003) finding that "[…] estimated development paths deviate substantially from the theoretical archetypes of Figure 4 [i.e. a systematic pattern of births for "new-cone" industries and deaths for "old-cone" ones]. Many sectors, including Apparel and Footwear, exhibit positive value-added per worker in more than two cones" (pp. 693-6). Apparel and footwear could indeed be slow-dying industries in many countries, not only on the import-competing side but also on the export side (the EU for instance is still today a major exporter of textile and apparel products). If that were the case, the high diversification characterizing the middle part of the economic development process would not be a desirable outcome *per se* but simply an out-of-equilibrium one characterizing the transition from one steady state to another, each characterized by specialization according to comparative advantage.

A comparison of Figures 5c and Figure 5d, which show respectively the shares of textile and apparel products (section 11) and machinery (section 16) in exports as a function of GDP per capita, partly bears out this story, as the former follows a decreasing and only mildly convex trajectory (see the smoother fitted curves) while the latter follows a rising and concave one. The combination of the two generates a decrease in export concentration up to the $10'000 threshold, after which there isn't much action any more as both textiles and machinery stabilize at low (5%) and high (30%) shares respectively.

5. Stages of diversification: alternative explanations

As made clear by the Theil decomposition, explanations of trade diversification should allow for the extensive/intensive margin interpretation and the slow adjustment across diversification cone conjecture.[20] We must however consider alternative explanations which could *artificially* enhance a hump-shape pattern. The diversification curve may indeed result from spurious statistical effects instead of reflecting the economic development process. Alternative explanations include (i) the discrepancy in primary resources exports emphasized by the between-country aspect of the database, (ii) the structure of the HS6 COMTRADE classification and (iii) the uneven levels of countries public infrastructure.

5.1 Primary products

Given that a substantial chunk of the U-shaped pattern of export concentration evidenced in section 3 is generated by the between-country dimension of the data, a likely candidate for the underlying cause is the prevalence of primary resources in exports. Figure 5 shows selected sectoral shares against GDP per capita.

Figures 5a-5e
Selected sectoral shares against GDP per capita

It can be seen that for many sectors the data shows substantial heterogeneity with large outliers. For minerals (HS section 5) there is a fairly distinct pattern

[20] Recall: low to middle income countries diversify mostly along the extensive margin whereas high income countries diversify along the intensive margin and eventually re-concentrate their exports towards fewer products.

whereby large exporters of mineral products (those for which mineral products represent over 20% of exports) are either low/middle income countries (below $12'000) or very high-income ones (above $25'000). This pattern, which is confirmed by the non-parametric regression curve, is of course likely to contribute to the U-shaped pattern of export concentration.

In order to verify the conjecture that primary products contribute to the U-shape of export concentration on our dataset, we ran our usual quadratic-polynomial regressions controlling for the share of raw materials as proxied by the share of HS chapters 26 (ores, slag and ashes) and 27 (mineral fuels, mineral oils and products of their distillation) in exports.[21] Results are shown in Table 8.

Table 8
Estimates with raw-material export shares

Unsurprisingly, the share of raw materials comes out as a positive and significant contributor to export concentration and as a negative one to the number of active lines (columns (4) and (8)). There is thus evidence of concentration and of some degree of Dutch disease. But the striking result is that coefficients on GDP per capita and its square are not affected by much, nor is the turning point. These results confirm that we do not seem to be dealing with a spurious correlation but with a true feature of the economic development process.

As a further exercise, we interact the share of raw materials in exports with GDP per capita (second block of Table 7). We plot in Figure 6 the predicted Theil indices against GDP per capita for various levels of raw-material export shares.

Figure 6
Predicted Theil indices against GDP per capita and the share of raw materials in export

[21] Chapters 26 and 27 belong to section 5.

Except for very high values of the share of raw-materials (over 70%), the U-shaped relationship is maintained with very similar turning points.

5.2 The Harmonized System's classification

The harmonized system classification used by COMTRADE could also potentially explain the hump-shaped relationship between economic development and export diversification. This classification is derived from nomenclatures originally designed for tariff-collection purposes rather than to generate meaningful economics. Consequently, some sections have a large number of economically irrelevant categories (e.g. the textile-clothing sector -- section 11), whereas in other sections (e.g. machinery -- section 16, or transport equipments -- section 17) economically important categories are lumped together in a few lines. Figure 7 which plots for each section of the HS6 classification total export value *versus* number of lines provides evidence of such feature. Sections 16 and 17 are well above the 45° line reflecting a disproportionate high value per export line, while section 11 includes a large number of small lines.

Figure 7
Shares Value/number of lines by section weighted average

Now, assume that products in section 11 are essentially exported by middle income countries whereas products in sections 16 and 17 are essentially exported by high income countries (assumptions confirmed by Figures 5a, 5d and 5e respectively). Then, the observed diversification/re-concentration pattern could be an *illusion* caused by the structure of the HS6 classification.

In order to verify whether the hump-shaped curve of diversification results from the classification of COMTRADE, we includes controls for sections 5, 11, 16 and 17 (introduction of the share of each of these sections in total exports, per country-year) in the regression analysis. The shape of the curve as well as the turning point is robust to the introduction of such controls. The hump-shaped relationship between economic development and export diversification is thus not the consequence of a spurious “composition” effect.[22]

5.3 Public infrastructure capital

Active policies on infrastructures may also have influenced the diversification process. Table 9 shows results from our usual regressions of concentration coefficients on our measure of public infrastructure capital described in section 2. It can be seen that infrastructure capital contributes to reduce export concentration along the intensive margin (concentration coefficients, columns (5)-(7)) but not the extensive (one active lines, column (8)) suggesting some limited scope for supply-side policies as vehicles to encourage export entrepreneurship. The turning point, however, remains, again, unchanged.

Table 9
Effect of public infrastructure capital

Such results are of interest as they provide insights on the role of government on trade diversification and export entrepreneurship. Further research leading to concrete policy advises would be of great value. It is however beyond the scope of the present paper.

6. Concluding remarks

The results presented so far suggest two observations and one caveat. First, there seems to be, across countries and time, a robust hump-shaped relationship between export diversification and the level of income (the mirror image of our U-shaped concentration indices). Moreover, the diversification

[22] Results are available upon request.

occurs mostly at the extensive margins for the low to middle countries. This relationship does not appear to be spurious or driven only by variations in the share of primary products. Given existing evidence on a statistical relationship between export diversification and growth, export diversification appears to be related to both the *level* and the *change* in per capita income. From a policy perspective, it thus appears as a key element of the economic development process and is, if not necessarily an objective *per se*, at least an important policy indicator. From an econometric perspective, our findings justify treating export diversification as endogenous in growth regressions, as de Ferranti et al. do.

The second observation is that diversification at high to very high levels of income may simply reflect a slow adjustment process between two equilibria, with new export sectors being faster to appear than old ones are to die. The hump-shaped relationship between diversification and development may be explained by this slow adjustment and thus corresponds to traveling across diversification cones.

The caveat is that diversification can be the by-product of two policy distortions. First, support for declining industries can be the reason for over-diversification during the transition phase. Second, and perhaps more importantly, trade diversion fostered by preferential agreements like Mercosur or the European Union can result in welfare-reducing export diversification. Sanguinetti et al.'s (2001) findings are definitely suggestive of this, and more work is needed in this direction.

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Tables and figures

Tables

Table 1
Descriptive statistics – 159 countries over 1988-2004

Variable	Obs	Mean	Std. Dev.	Min	Max
Export concentration indices:					
Gini	1'574	.959	.045	.793	.999
Herfindahl	1'574	.131	.183	.003	.987
Theil	1'574	4.392	1.669	1.589	8.461
Nber of active lines	1'574	2'492	1'630.6	13	4'957
Nber of new export lines a/	912	56.61	67.60	0	1'151
GDPpc, const. 2000 US$	1'574	7'324.8	9'501.5	106.09	48'419.3
GDPpc, PPP	1'545	10'247.8	9'488.8	486.47	64'298.64
Share of oil in exports	1'574	.129	.230	0	.996
Public infrastructure capital	790	1.018	.622	.019	2.348

a/ according to the "new" export lines definition (see section 2.2), the sample is reduced to (i) 1990-2002, two years being taken out at both ends and (ii) the 125 countries with available data for at least 5 consecutive years.

Table 2
Characterization of products by degree of differentiation

	All products	New products b/	World trade, 1990 (Rauch) c/
Conservative classification a/			
Homogenous	22.35	11.39	12.60
Reference priced	26.43	38.91	20.30
Differentiated	51.21	49.70	67.10
Liberal classification a/			
Homogenous	29.29	16.96	16.00
Reference priced	21.92	36.60	19.50
Differentiated	48.80	46.44	64.20

Notes

a/ Because the classification of some products cannot be asserted unambiguously, Rauch's conservative classification assigns fewer products to the "homogenous" and "reference-priced" categories than his liberal ones.
b/ According to the definition in the text
c/ From Table 2 of Rauch (1999)

Table 3
Income levels: pooled OLS, 1988-2004

	GDPpc, PPP in constant 2000 intern. $, WDI				GDPpc, PPP in constant 2000 intern. $, PWT				GDPpc, in constant 2000 US$, from W		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Dependant	HHI	Theil	Gini	Nber	HHI	Theil	Gini	Nber	HHI	Theil	Gini
GDPpc	-1.14E-05	-0.000199	-4.40E-06	2.33E-01	-1.55E-05	-0.000228	-4.84E-06	2.58E-01	-9.80E-06	-0.000181	-5.54E-06
	5.68***	12.86***	9.99***	19.41***	7.27***	13.56***	10.53***	19.07***	6.75***	14.51***	13.99***
$GDPpc^2$	2.11E-10	3.71E-09	4.43E-11	-4.27E-06	3.81E-10	5.10E-09	7.04E-11	-5.36E-06	1.71E-10	3.47E-09	9.60E-11
	3.35***	7.10***	2.72***	11.09***	5.44***	8.40***	4.04***	11.00***	3.72***	8.33***	7.31***
Turn. Point ($)	27014	26873	49661	27280	20341	22353	34375	24029	28655	26066	28854
R2	0.17	0.29	0.39	0.42	0.09	0.25	0.32	0.39	0.07	0.24	0.35
obs.	1545	1545	1545	1545	1540	1540	1540	1540	1574	1574	1574
Nber countries	155	155	155	155	154	154	154	154	159	159	159
period	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004
	Countries on the right of the turning point in 2004										
	Australia	Australia	None	Australia	Australia	Australia	Norway	Australia	Denmark	Denmark	Denmark
	Austria	Austria		Austria	Austria	Austria	US	Austria	Iceland	Hong Kong	Iceland
	Belgium	Belgium		Belgium	Belgium	Belgium		Belgium	Japan	Iceland	Japan
	Canada	Canada		Canada	Canada	Canada		Canada	Norway	Ireland	Norway
	Denmark	Denmark		Denmark	Cyprus	Cyprus		Denmark	Sweden	Japan	Sweden
	Finland	Finland		Finland	Denmark	Denmark		Finland	Switzerland	Norway	Switzerland
	Hong Kong	France		Hong Kong	Finland	Finland		France	US	Sweden	US
	Iceland	Hong Kong		Iceland	France	France		Germany		Switzerland	
	Ireland	Iceland		Ireland	Germany	Germany		Hong Kong		UK	
	Netherlands	Ireland		Netherlands	Hong Kong	Hong Kong		Iceland		US	
	Norway	Japan		Norway	Iceland	Iceland		Ireland			
	Sweden	Netherlands		Switzerland	Ireland	Ireland		Japan			
	Switzerland	Norway		UK	Israel	Italy		Netherlands			
	UK	Sweden		US	Italy	Japan		Norway			
	US	Switzerland			Japan	Netherlands		Singapore			
		UK			Netherlands	NZ		Sweden			

US	NZ	Norway	Switzerland	
	Norway	Singapore	UK	
	Singapore	Sweden	US	
	Slovenia	Switzerland		
	Spain	UK		
	Sweden	US		
	Switzerland			
	UK			
	US			

Absolute value of robust t statistics under coefficients (White's correction for heteroskedasticity used)
***, **, * significant at respectively 1%, 5% and 10% level.

Table 4
Results without microstates

	(1)	(2)	(3)	(4)
Dependant	HHI	Theil	Gini	Nber
Method	Pooled	Pooled	Pooled	Pooled
GDPpc	-1.59E-05	-0.000262	-6.16E-06	3.09E-01
	7.72***	17.21***	13.75***	30.11***
GDPpc²	3.43E-10	5.49E-09	9.15E-11	-6.48E-06
	5.29***	10.65***	5.53***	19.85***
Turning Point ($)	23178	23825	33661	23878
R2	0.12	0.39	0.50	0.59
obs.	1359	1359	1359	1359
Nber of countries	131	131	131	131
period	1988-2004	1988-2004	1988-2004	1988-2004
Countries on the right of the turning point in 2004				
	Australia	Australia	Ireland	Australia
	Austria	Austria	Norway	Austria
	Belgium	Belgium	US	Belgium
	Canada	Canada		Canada
	Denmark	Denmark		Denmark
	Finland	Finland		Finland
	France	France		France
	Germany	Germany		Germany
	Hong Kong	Hong Kong		Hong Kong
	Ireland	Ireland		Ireland
	Italy	Italy		Italy
	Japan	Japan		Japan
	Netherlands	Netherlands		Netherlands
	Norway	Norway		Norway
	Singapore	Singapore		Singapore
	Sweden	Sweden		Sweden
	Switzerland	Switzerland		Switzerland
	UK	UK		UK
	US	US		US

Absolute value of robust t statistics under coefficients (White's correction for heteroskedasticity used)
***, **, * significant at respectively 1%, 5% and 10% level.

Table 5
Pooled, within and between estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependant	HHI	Theil	Gini	Nber	HHI	Theil	Gini	Nber	HHI	Theil	Gini	Nber
Method	Pooled	Pooled	Pooled	Pooled	Within	Within	Within	Within	Between	Between	Between	Between
GDPpc	-1.55E-05	-0.000257	-5.96E-06	3.09E-01	6.13E-06	0.000108	1.38E-06	5.29E-02	-1,31E-05	-0,000228	-6,96E-06	2,71E-01
	7.55***	16.69***	13.37***	28.92***	1.6	5.75***	3.17***	3.53***	2.16**	4.32***	4,51***	6.91***
GDPpc²	3.33E-10	5.35E-09	8.48E-11	-6.47E-06	-4.07E-11	-6.83E-10	1.89E-11	-2.02E-06	2,81E-10	4,97E-09	1,36E-10	-5,91E-06
	5.13***	10.20***	5.15***	19.14***	0.52	1.79*	2.15**	6.68***	1.66*	2.81***	2.60***	4,80***
Turning Point ($)	23273	24019	35142	23868	-	-	-	13085	23310	22948	25588	22926
Year effects	yes	yes	yes	yes	yes	yes	yes	yes	-	-	-	-
Country effects	no	no	no	no	yes	yes	yes	yes	-	-	-	-
R2	0.12	0.40	0.50	0.59	0.02	0.14	0.21	0.28	0.06	0.27	0.45	0.44
obs.	1359	1359	1359	1359	1359	1359	1359	1359	131	131	131	131
Nber of countries	131	131	131	131	131	131	131	131	131	131	131	131
period	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004

Absolute value of robust t statistics under coefficients.
***, **, * significant at respectively 1%, 5% and 10% level.
Note: all sample except microstates, GDP per capita PPP in constant 2000 international $, from WDI

Table 6
Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependant	Gini	Nber	Nber	HHI	Theil	Gini	Nber
Method	Logistic transformation		Negative binomial	System GMM			
GDPpc	-2.70E-04	3.34E-04	1.51E-04	-2.87E-05	-3.62 E-04	-7.84E-06	3.75E-01
	20.72***	23.66***	22.97***	5.29***	7.55***	5.78***	10.50***
GDPpc²	5.73E-09	-6.54E-09	-3.57E-09	7.35E-10	8.81E-09	1.60E-10	-8.57E-06
	13.67***	14.19***	18.40***	4.49***	5.65***	3.35***	7.31***
Turning Point ($)	23543	25566	21176	19524	20556	24500	21865
Year effects	yes	yes	yes	yes	yes	yes	yes
obs.	1359	1359	1359	1359	1359	1359	1359
Nber of countries	131	131	131	131	131	131	131
period	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004	1988-2004

Absolute value of robust t statistics under coefficients.
***, **, * significant at respectively 1%, 5% and 10% level.
Note: all sample except microstates, GDP per capita PPP in constant 2000 international $, from WDI

Table 7
Cumulated "Closed" lines over 2001-2003 on average for countries with a GDP per capita > 24 000$

Cumulated Closed lines 2001-2003	Mean	Std. Dev.	Min	Max
Cumulated number of closed lines	140	71.8	73	295
Cumulated number of closed lines in % of total actives lines in 2000	3.16%	1.84%	1.49%	7.81%
Cumulated value of closed lines in % of total exports in 2000	0.60%	0.78%	0.06%	3.29%

"Closed" lines in date t are defined as a line with positive exports in t-2 and t-1 et zero exports in t, t+1 and t+2 for countries with a population higher than 1 million (not a microstate) and a GDP per capita higher than 24 000$ (hence for countries at the right of the turning point). To have a robust picture, we compute the "cumulated" closed lines over 2001-2003.

Table 8
Estimates with raw-material export shares

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependant	HHI	Theil	Gini	Nber	HHI	Theil	Gini	Nber
GDPpc	-1.52E-05	-2.54E-04	-5.92E-06	0.308042	-2.00E-05	-3.02E-04	-6.54E-06	0.3332
	10.32***	22.69***	15.12***	29.85***	11.85***	22.46***	14.16***	28.59***
$GDPpc^2$	3.84E-10	5.71E-09	8.99E-11	-6.58E-06	5.54E-10	7.06E-09	9.4E-11	-7.42E-06
	8.67***	16.34***	6.35***	20.41***	10.99***	16.18***	5.64***	19.68***
Raw materials	0.5039	3.5376	0.0507	-1118.25	0.3890	1.8221	0.0024	-416.99
	22.36***	34.85***	18.11***	9.11***	3.23***	9.35***	9.61***	2.20**
GDPpc*Raw mat.					3.06E-05	3.63E-04	7.54E-06	-0.171182
					4.19***	10.78***	9.61***	3.57***
$GDPpc^2$*Raw mat.					-1.06E-09	-9.39E-09	-7.85E-11	5.41E-06
					6.86***	9.64***	2.67***	4.04***
Turning Point ($)	19792	22277	32925	23407	-	-	-	-
Year effects	yes				yes			
obs.	1359				1359			
Nber of countries	131				131			
period	1988-2004				1988-2004			

Absolute value of robust t statistics under coefficients.
***, **, * significant at respectively 1%, 5% and 10% level.
Note: all sample except microstates, GDP per capita PPP in constant 2000 international $, from WDI

Table 9
Effect of public infrastructure capital

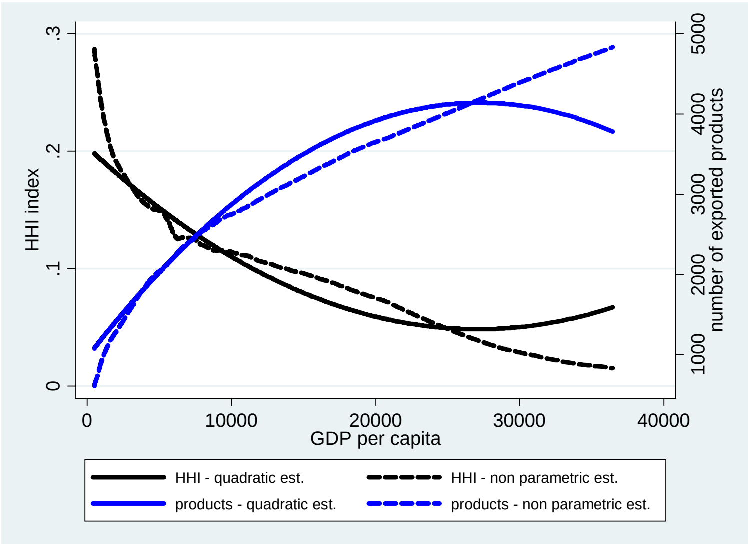
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependant	HHI	Theil	Gini	Nber	HHI	Theil	Gini	Nber
GDPpc	-1.48E-05	-2.27E-04	-5.75E-06	0.2543	-1.02E-05	-1.98E-04	-5.25E-06	0.2578
	5.96***	11.67***	9.53***	17.87***	4.02**	8.74***	7.81***	15.59***
GDPpc²	3.15E-10	4.64E-09	8.77E-11	-5.06E-06	2.09E-10	3.97E-09	7.61E-11	-5.14E-06
	4.23***	7.29***	4.16***	11.89***	2.79***	5.65***	3.37***	10.91***
Public capital					-0.0296	-0.1865	-0.0032	22.2698
					2.71***	2.71***	2.48**	0.47
Turning Point ($)	23492	24494	32782	25129	24402	24987	34494	25074
Year effects	yes				yes			
obs.	727				727			
Nber of countries	92				92			
period	1996-2004				1996-2004			

Absolute value of robust t statistics under coefficients.
***, **, * significant at respectively 1%, 5% and 10% level.
Note: all sample except microstates, GDP per capita PPP in constant 2000 international $, from WDI

Figures

Figure 1a

Herfindahl concentration index & number of active export lines



Notes: HHI: Herfindahl index; products: # of active export lines

Figure 1b

Theil concentration index & number of active export lines

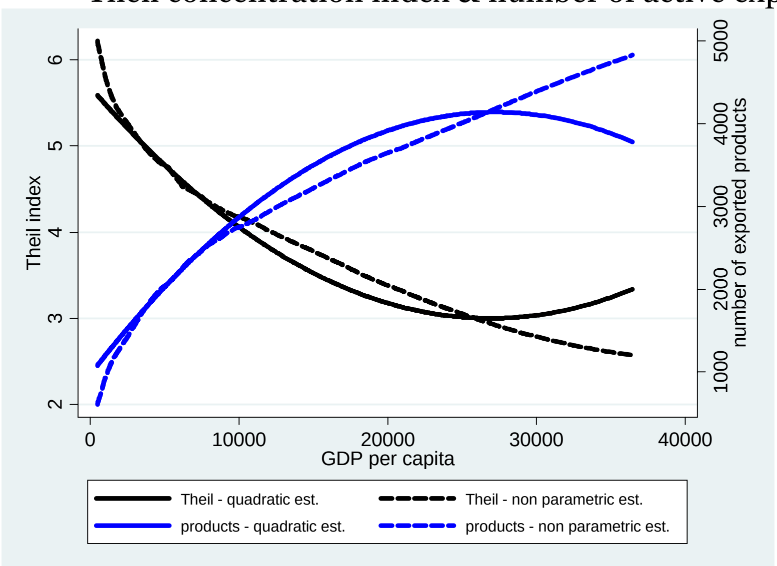
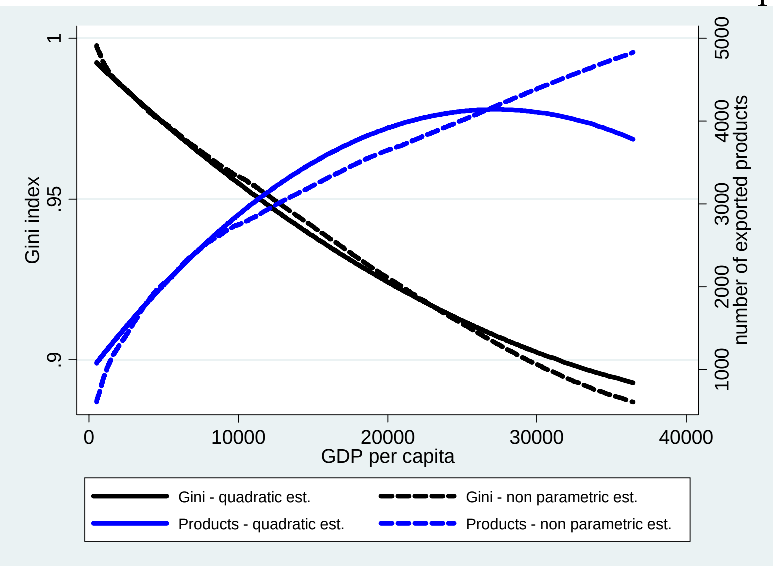


Figure 1c

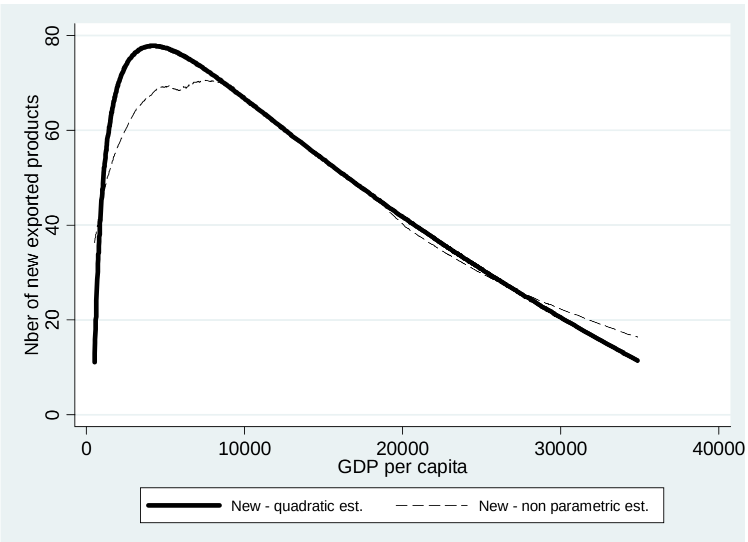
Gini concentration index & number of active export lines



Notes: HHI: Herfindahl index; products: # of active export lines
Source: author calculations using COMTRADE

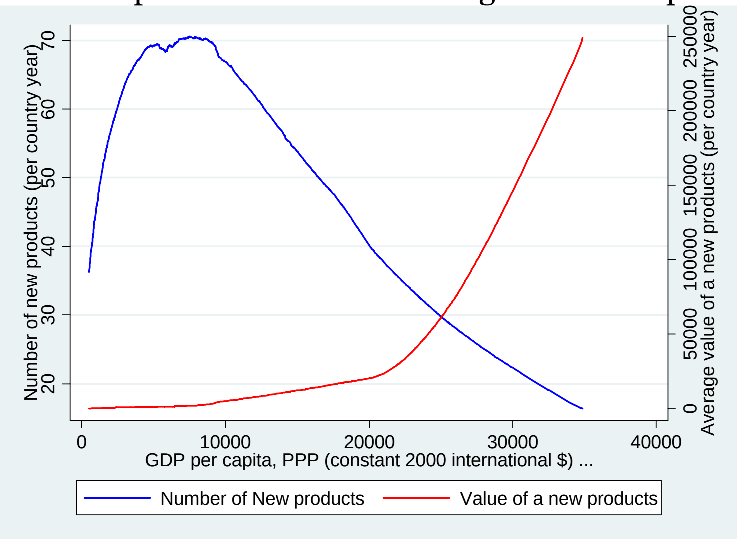
Figure 2

Predicted New export lines: non-parametric & quadratic estimates



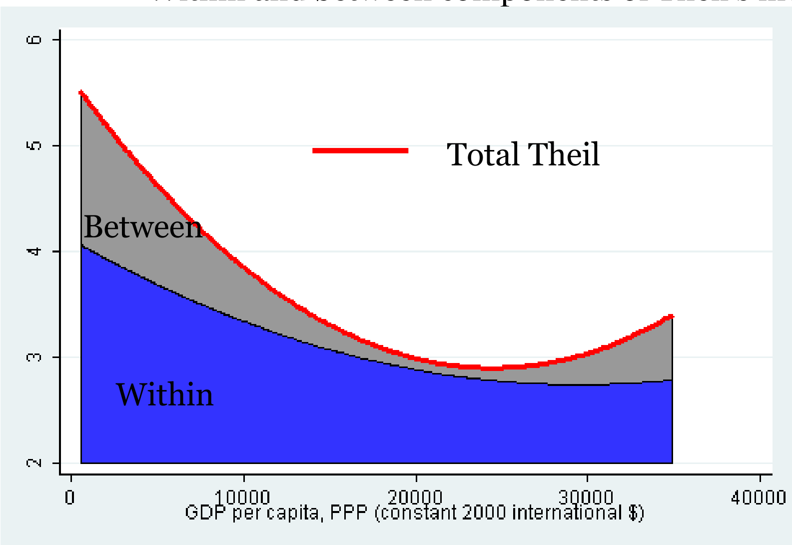
Source: author calculations using COMTRADE

Figure 3
New products and their average value: nonparametric curves



Source: author calculations using COMTRADE

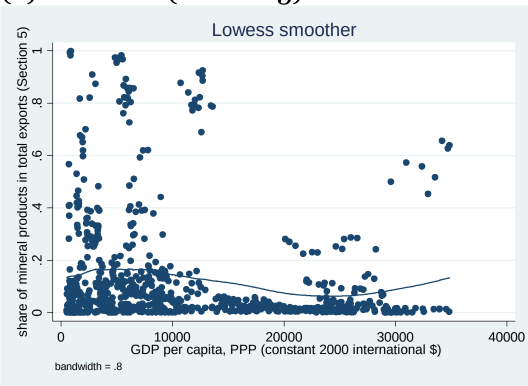
Figure 4
Within and between components of Theil's index



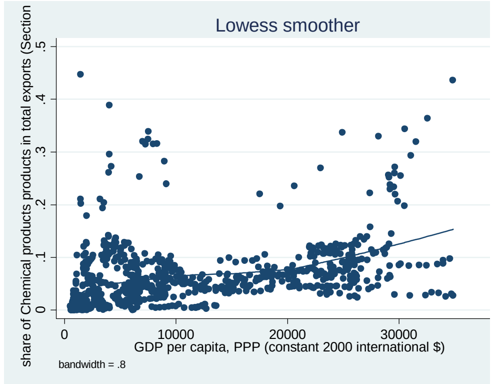
Source: author calculations using COMTRADE (quadratic estimates)

Figure 5
Selected sectoral shares against GDP per capita

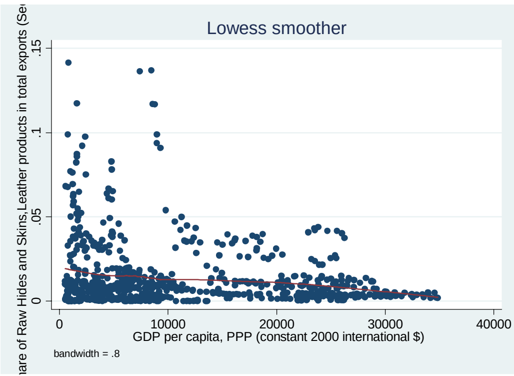
(a) Minerals (section 5)



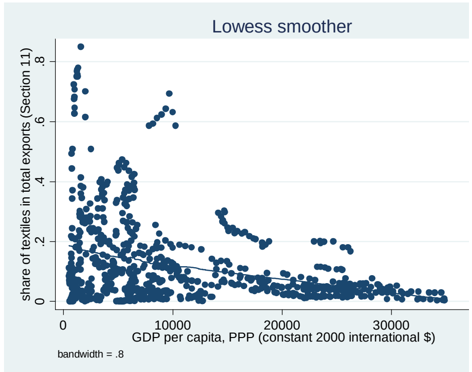
(b) Chemicals (section 6)



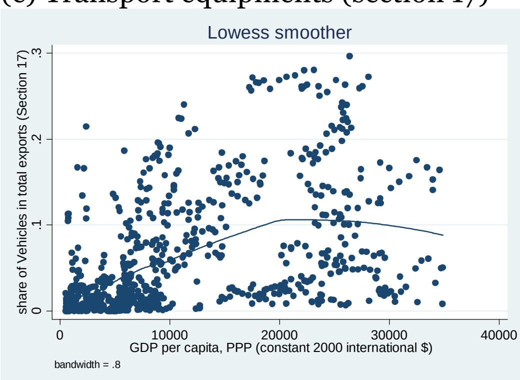
(c) Raw Hides and Skins, Leather (section 8)



(c) Textile & Apparel (section 11)



(e) Transport equipments (section 17)



(d) Machinery (section 16)

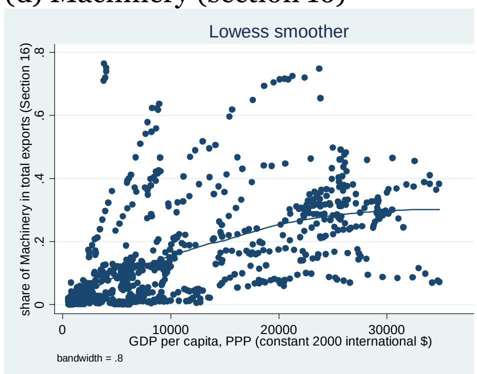


Figure 6
Theil indices against GDP and the share of raw materials

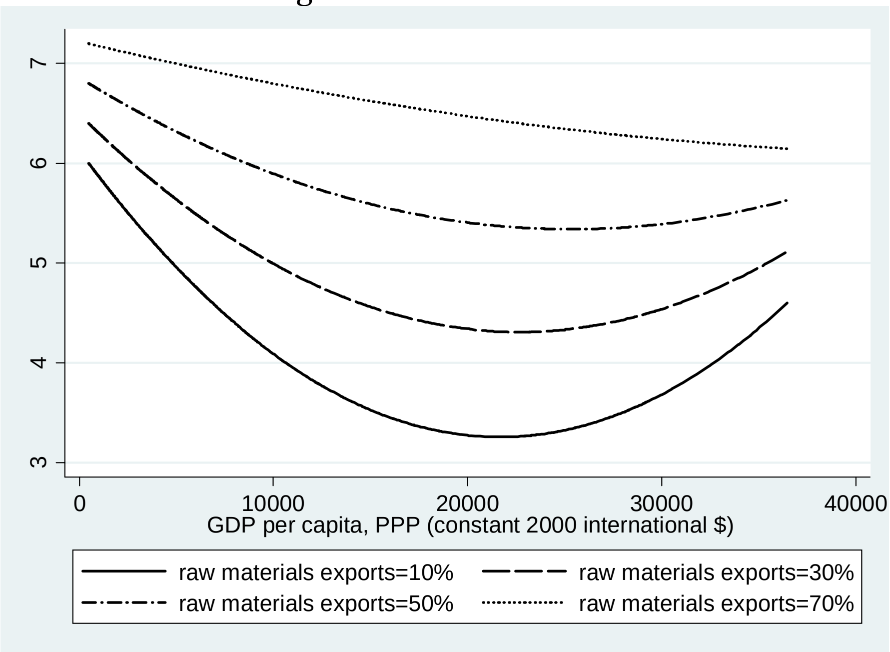


Figure 7 Shares Value/number of lines by sections
Weighted average

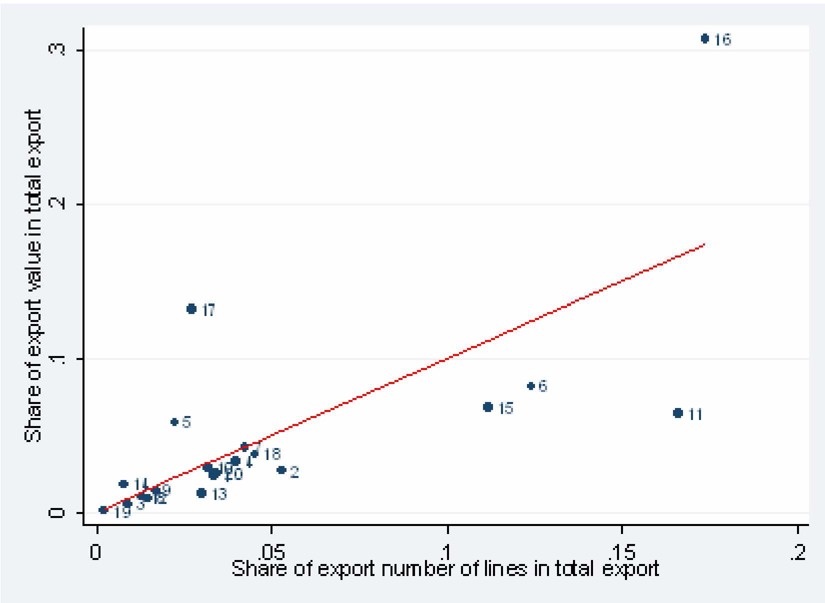


Table A.1 Countries in the sample (available time period in brackets) – 159 countries, including 121 non High Income countries

High income		Low income		Lower middle income		Upper middle income	
Australia	[1988 - 2004]	Bangladesh	[1989 - 2004]	Albania	[2004 - 1996]	Ant. and Barbuda	[1999 - 2000]
Austria	[1994 - 2004]	Benin	[1998 - 2002]	Algeria	[2004 - 1992]	Argentina	[1993 - 2004]
Bahamas, The	[1997 - 2001]	Bhutan	[1993 - 1999]	Armenia	[2004 - 1997]	Belize	[1992 - 2003]
Bahrain	[2000 - 2003]	Burkina Faso	[1995 - 2004]	Azerbaijan	[2004 - 1996]	Botswana	[2000 - 2001]
Belgium	[1999 - 2004]	Burundi	[1993 - 2004]	Belarus	[2004 - 1998]	Chile	[1990 - 2004]
Canada	[1989 - 2004]	Cambodia	[2000 - 2004]	Bolivia	[2004 - 1992]	Costa Rica	[1994 - 2004]
Cyprus	[1989 - 2004]	Central African Rep.	[1993 - 2003]	Brazil	[2004 - 1989]	Croatia	[1992 - 2004]
Denmark	[1989 - 2004]	Comoros	[1995 - 2000]	Bulgaria	[2004 - 1996]	Czech Republic	[1993 - 2004]
Finland	[1988 - 2004]	Congo, Rep.	[1993 - 1995]	Cameroon	[2004 - 1995]	Dominica	[1993 - 2004]
France	[1994 - 2004]	Côte d'Ivoire	[1995 - 2003]	Cape Verde	[2004 - 1997]	Estonia	[1995 - 2004]
French Polynesia	[1996 - 2004]	Eritrea	[- 2003]	China	[2004 - 1992]	Gabon	[1993 - 2004]
Germany	[1988 - 2004]	Ethiopia	[1995 - 2003]	Colombia	[2004 - 1991]	Grenada	[1993 - 2003]
Greece	[1988 - 2004]	Gambia, The	[1995 - 2003]	Dominican Rep.	[2001 - 1997]	Hungary	[1992 - 2004]
Hong Kong, China	[1993 - 2004]	Ghana	[1996 - 2004]	Ecuador	[2004 - 1991]	Latvia	[1994 - 2004]
Iceland	[1988 - 2004]	Guinea	[1995 - 2002]	Egypt	[2004 - 1994]	Lebanon	[1997 - 2003]
Ireland	[1992 - 2004]	Haiti	[1988 - 1997]	El Salvador	[2004 - 1994]	Lithuania	[1994 - 2004]
Israel	[1995 - 2004]	India	[1988 - 2004]	Fiji	[2004 - 2000]	Malaysia	[1989 - 2004]
Italy	[1994 - 200]	Kenya	[1992 - 2004]	Georgia	[200 - 1996]	Mauritius	[1993 - 2004]

	4				4		
Japan	[1988 - 2004]	Kyrgyz Republic	[1995 - 2004]	Guatemala	[2004 - 1993]	Mexico	[1990 - 2004]
Korea, Rep.	[1988 - 2004]	Lesotho	[2000 - 2002]	Guyana	[2004 - 1997]	Oman	[1989 - 2004]
Kuwait	[2000 - 2001]	Madagascar	[1990 - 2004]	Honduras	[2003 - 1994]	Panama	[1995 - 2004]
Luxembourg	[1999 - 2004]	Malawi	[1990 - 2004]	Indonesia	[2004 - 1989]	Poland	[1994 - 2004]
Macao, China	[1991 - 2004]	Mali	[1996 - 2001]	Iran	[2003 - 1997]	Romania	[1989 - 2004]
Malta	[1994 - 2004]	Moldavia	[1994 - 2004]	Jamaica	[2002 - 1991]	Russia	[1996 - 2004]
Netherlands	[1992 - 2004]	Mongolia	[1996 - 2003]	Jordan	[2004 - 1994]	Seychelles	[1994 - 2004]
New Caledonia	[1999 - 2004]	Mozambique	[1994 - 2002]	Kazakhstan	[2004 - 1995]	Slovak Republic	[1994 - 2004]
NZ	[1989 - 2004]	Nepal	[1994 - 2003]	Kiribati	[1999 - 1995]	South Africa	[1992 - 2004]
Norway	[1993 - 2004]	Nicaragua	[1993 - 2004]	Macedonia	[2004 - 1994]	St. Kitts and Nevis	[1993 - 2003]
Portugal	[1988 - 2004]	Niger	[1995 - 2003]	Maldives	[2004 - 1995]	St. Lucia	[1992 - 2004]
Saudi Arabia	[1991 - 2002]	Nigeria	[1996 - 2003]	Morocco	[2004 - 1993]	St. V. and the Grenad.	[1993 - 2004]
Singapore	[1989 - 2004]	Pakistan	[2003 - 2004]	Namibia	[2003 - 2000]	Trinidad and Tobago	[1991 - 2003]
Slovenia	[1994 - 2004]	Papua New Guinea	[1998 - 2003]	Paraguay	[2004 - 1989]	Turkey	[1989 - 2004]
Spain	[1989 - 2004]	Rwanda	[1996 - 2003]	Peru	[2004 - 1992]	Uruguay	[1994 - 2004]
Sweden	[1992 - 2004]	São Tomé and Principe	[1999 - 2003]	Philippines	[2004 - 1996]	Venezuela, RB	[1994 - 2004]
Switzerland	[1988 - 2004]	Senegal	[1996 - 2004]	Samoa	[2004 - 2001]		
United Arab Emirates	[1991 - 2001]	Sierra Leone	[- 2002]	Sri Lanka	[2004 - 1990]		
United Kingdom	[1993 - 2004]	Sudan	[1995 - 2003]	Suriname	[2001 - 1994]		

US	[1991 - 2004]	Tanzania	[1997 - 2004]	Swaziland	[2002 - 2000]
		Togo	[1994 - 2004]	Syria	[2004 - 2001]
		Uganda	[1994 - 2004]	Thailand	[2004 - 1989]
		Yemen, Rep.	[- 2004]	Tunisia	[2004 - 1991]
		Zambia	[1992 - 2004]	Turkmenistan	[2000 - 1997]
		Zimbabwe	[1995 - 2004]	Ukraine	[2004 - 1996]
				Vanuatu	[200 - 1993]

Table A.2 Cumulated "closed" lines over 2001-2003 by main chapters on average for countries with a GDP per capita > 24000$

Chapter		Corresponding Section		Nber	Nber in % of chapter' active lines in 2000	Nber in % of total closed lines	Value in % of total export value in 2000
29	Organic Chemicals	6	Products of the Chemical or Allied Industries	11.9	5.4%	8.2%	2.79E-02
41	Raw Hides and Skins (Other Than Furskins) and Leather	8	Raw Hides and Skins,Leather, Furskins and Articles Thereof; Saddlery and Harness; Travel Goods, Handbags, and Similar Containers;Articles of Animal Gut	8.8	29.5%	7.9%	2.69E-02
28	Inorganic Chemicals; Organic or Inorganic Compounds of Precious Metals, Of Rare-earth Metals, of Radioactive Elements or of Isotopes	6	Products of the Chemical or Allied Industries	8.4	5.9%	6.5%	1.81E-02
48	Paper and Paperboard; Articles of Paper Pulp, of Paper Or of Paperboard	10	Pulp of Wood or of other Fibrous Cellulosic Material; Waste and Scrap of Paper or Paperboard; Paper and Paperboard and Articles Thereof	7.2	6.8%	6.2%	2.22E-01
11	Products of the Milling Industry; Malt; Starches; Inulin; Wheat Gluten	2	Vegetable Products	4.6	16.6%	4.0%	1.28E-03
62	Articles of Apparel and Clothing Accessories, Not Knitted Or Crocheted	11	Textiles and Textile Articles	5.6	1.2%	3.7%	8.99E-03
25	Salt, Sulphur, Earths and Stone; Plastering Materials, Lime and Cement	5	Mineral Products	4.6	7.5%	3.2%	4.73E-04
68	Articles of Stone, Plaster, Cement, Asbestos, Mica or Similar Materials	12	Footwear, Headgear, Umbrellas, Sun Umbrellas, Walking-Sticks, Seat-Sticks, Whips, Riding-Crops and Parts Thereof; Prepared Feathers and Articles Made Therewith; Artificial Flowers; Articles of Human Hair	3.3	6.7%	2.8%	2.57E-04
52	Cotton	11	Textiles and Textile Articles	4.1	4.5%	2.6%	7.12E-05
43	Furskins and Artificial Fur; Manufactures Thereof	8	Raw Hides and Skins,Leather, Furskins and Articles Thereof; Saddlery and Harness; Travel Goods, Handbags, and Similar Containers;Articles of Animal Gut	2.7	17.5%	2.6%	5.95E-04

12	Oil Seeds and Oleaginous Fruits; Misc, Grains, Seeds & Fruit; Industrial or Medicinal Plants; Straw and Fodder	2	Vegetable Products	3.2	10.1%	2.4%	4.48E-04
15	Animal or Vegetable Fats and Oils and their Cleavage Products; Prepared Edible Fats; Animal or Vegetable Waxes	3	Animal or Vegetable Fats and Oils and Their Cleavage Products; Prepared Edible Fats;	3.0	6.8%	2.3%	1.85E-03
3	Fish & Crustaceans, Molluscs & Other Aquatic Invertebrates	1	Live Animals; Animal Products	3.3	6.5%	2.1%	2.17E-04
53	Other Vegetable Textile Fibres; Paper Yarn and Woven Fabrics of Paper Yarn	11	Textiles and Textile Articles	2.8	13.8%	2.1%	2.65E-04
26	Ores, Slag and Ash	5	Mineral Products	3.0	15.4%	2.1%	6.49E-04
72	Iron and Steel	15	Base Metals and Articles of Base Metal	3.7	2.8%	2.0%	3.14E-02

Closed" lines in date t are defined as a line with positive exports in t-2 and t-1 et zero exports in t, t+1 and t+2 for countries with a population higher than 1 million (not a microstate) and a GDP per capita higher than 24 000$ (hence for countries at the right of the turning point). To have a robust picture, we compute the "cumulated" closed lines over 2001-2003.