Special Feature B

On the Links between Trade Diversification and Economic Development

by Ilian Mihov[1]

Introduction

In 1973, Singapore was a net importer of office machines & automatic data processing equipment, with imports in this category close to 0.3% of total manufacturing imports, while exports accounted for less than 0.02% of total exports. In the same year, the US was a net exporter of such equipment. By 1999, Singapore had become a leading exporter of equipment which now made up 31% of its exports but only 12.9% of its imports, while the US had become a net importer. Over the same period of time, the industrial and trade structure of Singapore changed rapidly. There was a massive relocation of capital and labour across sectors and a parallel process of diversification of both output and exports. Singapore did not just specialise in a few industries but had diversified its production and exports across many different types of goods. Moreover, this process of diversification was accompanied by a four-fold increase in Singapore's income per capita. The case of Singapore is, of course, only an illustration of what happened in other economies in East Asia such as Hong Kong, Japan and Korea.

Both from a theoretical point of view and from a policy perspective, there are several questions that arise from the process of development in these East Asian countries: How do countries diversify their export base? How do they gain and sustain comparative advantage in different industries over time? Why is development associated with diversification rather than specialisation?

What is Diversification?

Export diversification means a broadening of the range of products that a country exports. One standard measure of diversification is the Herfindahl index:

$$HFI_{it} = \sum_{j \in J^{it}} \left(\frac{p_{jt}^{i} q_{jt}^{i}}{\sum_{k \in J^{it}} p_{kt}^{i} q_{kt}^{i}} \right)^{2}$$

The value of this index for country i at time t is the squared sum of export shares, where the summation is across all goods in the set J_{it} of categories in which the country exports.

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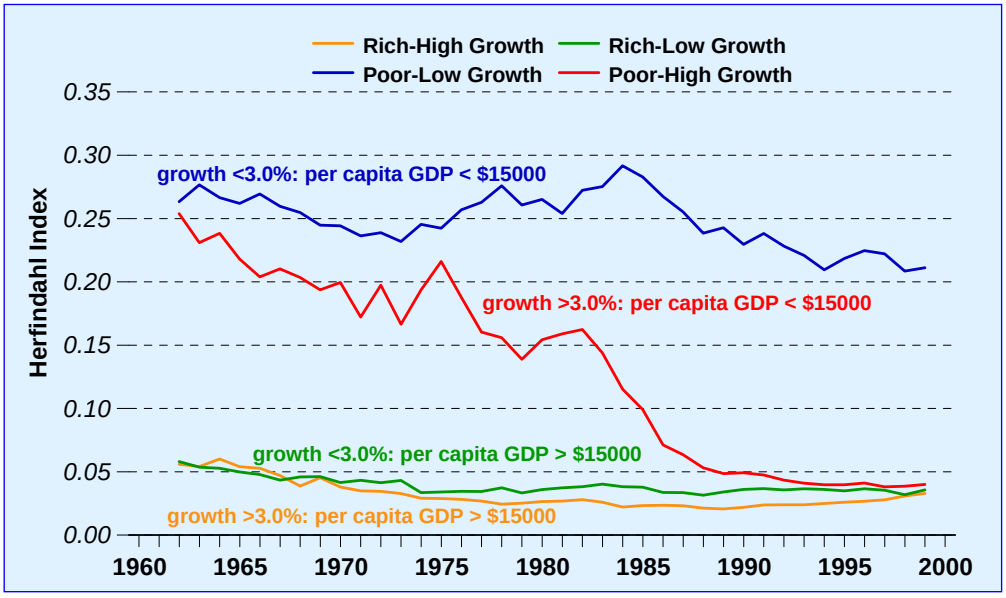
The numerator is the value of exports in country *i* of good *j* at time *t*, while the denominator is the value of total exports from country *i*. Its value ranges from a maximum value of 1 (i.e. no diversification since all exports are in a single category) down to a minimum value of 1/*n*, where *n* is the number of export categories. Full diversification, i.e. export shares equal to 1/*n* in each category, is achieved when the country's export values in each export category are equal.

In order to construct these Herfindahl indices for all countries, we use trade data from the World Trade Flows Database, which contains information on bilateral exports for more than 150 countries over the period 1962-1999. We aggregate bilateral flows across countries to obtain total exports in each country and industry. The data on the value of exports are at the 4-digit Standard International Trade Classification (SITC). As there are 790 categories, this implies that the Herfindahl index will vary from about 0.0013 for a fully diversified country to 1 for countries that export only one product.

Chart 1 presents a striking picture of the relationship between export diversification and economic development. It plots the Herfindahl index of exports over time for four sets of countries: rich countries with low growth rates, rich countries with high growth rates, poor countries with high growth rates, and poor countries with low growth rates. We classify a country as rich if its GDP per capita exceeds $15,000 in the year 2000; and high-growth if its average growth rate between 1960 and 1999 exceeds 3%.[2] Low-growth poor countries did not experience a significant change in their export diversification; they started off less diversified and remained so for the entire time period. However, high-growth poor countries experienced a substantial rise in their diversification of exports (decline in the Herfindahl index from about 0.25 to less than 0.05). Also, notice that rich countries are substantially more diversified than poor countries.

Chart 1
Herfindahl Index of Exports for Different Groups



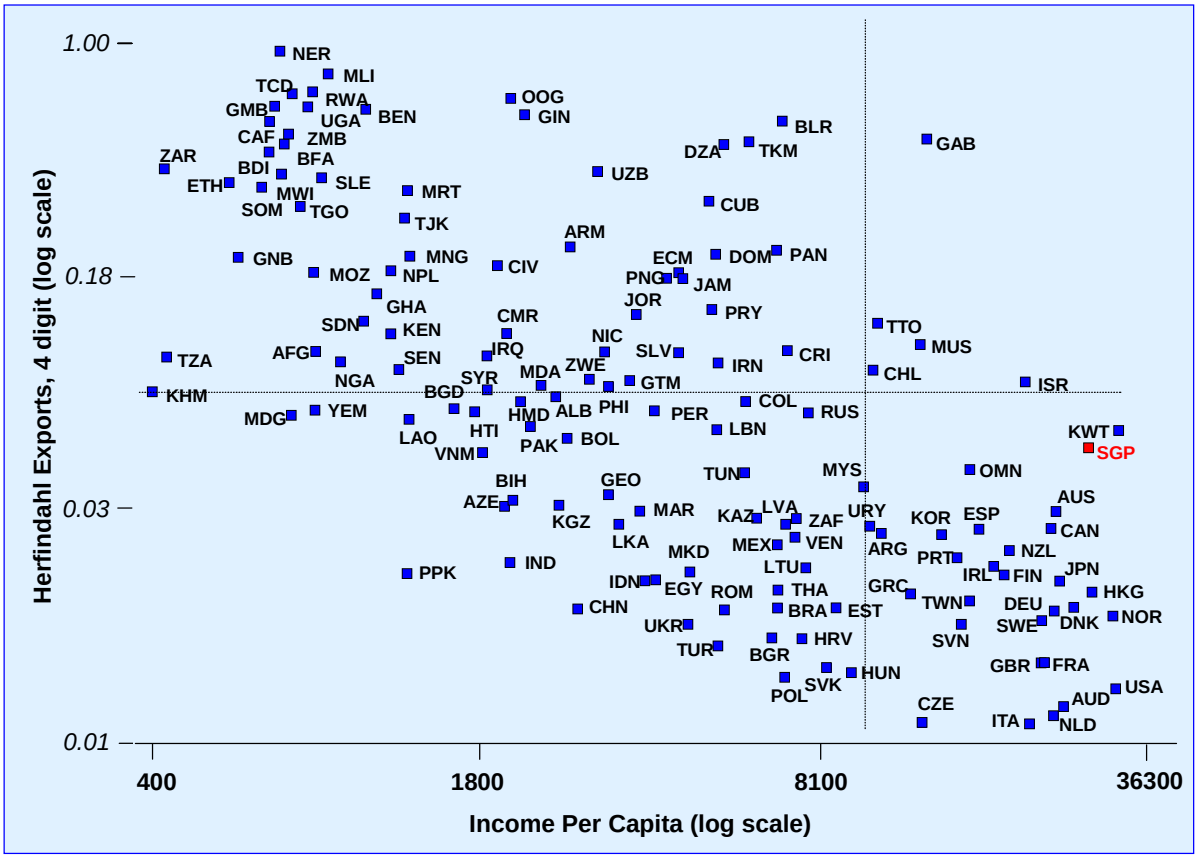
Source: World Trade Flows Database and Penn World Table Version 6.2

[2] In international dollars, according to Penn World Table Version 6.2. See Heston *et al*. (2006).

More evidence on the link between export diversification and income per capita is provided in Chart 2. On the vertical axis, we plot the logarithm of the Herfindahl index while the horizontal axis is the logarithm of real income per capita in 1996 international dollars. The graph, therefore, represents a snapshot for 1996. The correlation is striking. Almost all rich countries (with income per capita above $11,000 in 1996 as denoted by the vertical dotted line) have a diversification index below 0.08 (denoted by the horizontal dotted line), while the majority of poor countries are specialised in exporting only a few categories. It is worth noting also that the countries in the lower left quadrant like China, India, Eastern Europe, and Vietnam (i.e. poor and yet relatively well-diversified) are countries that have grown quite rapidly since 1996.

The key question is whether this link implies a causal effect from diversification to economic development. In other words, is diversification a necessary condition for growth? Alternatively, can a country become rich by specialising in just a few industries? We first turn to theory to get some guidance as to what will determine the number of varieties being exported by a country.

Chart 2
Diversification and Income Per Capita



Source: World Trade Flows Database and Penn World Table Version 6.2

Brief Review of the Theory

The neoclassical Ricardian and the Heckscher-Ohlin models provide no clear role for export diversification. Underlying both models is the idea that countries specialise domestically according to comparative advantage, and exports match such specialisation. In both these models, the Herfindahl index of exports would depend entirely on whether the underlying technological or resource comparative advantage provides a comparative advantage across a small or large number of product categories.

The ''new'' trade models, in comparison, emphasise the extensive margin of trade and are better suited for understanding the determinants of export diversification. Krugman (1979) presents the workhorse model of trade with a monopolistic competitive market structure. The model was originally designed to address the high incidence of trade between countries that have similar technologies and factor endowments. In the Krugman model, the emphasis is on the extensive margin of trade (i.e. the number of categories being traded), with countries in equilibrium producing an endogenous number of varieties. The number of varieties produced in a country is proportional to the size of the economy, with each country (conditional on exporting a particular variety) exporting that variety to all other countries.

Recently, a richer specification of the Krugman (1979) model was proposed by Melitz (2003), in which firms are heterogeneous in terms of productivity. When firms vary in productivity, only the more productive firms find it profitable to export. Melitz shows that the cut-off productivity level depends on trade barriers faced by the exporters and other features of the world market; profitability is higher and the corresponding cut-off productivity level for exporting is lower when exporting to countries with higher demand levels, and when firms in the focal country face lower costs of exporting.

Transport costs that depend on geographic distance, as well as artificial barriers such as tariffs and quotas, are trade costs that vary across country pairs and affect the composition of trade. The role of such costs is incorporated by Eaton and Kortum (2002) into a Ricardian model of trade (one based on differences in technology). Transport costs and market access play a key role in determining the extensive margin of trade.

We can use the insights from these models in order to build a better understanding of what drives product diversification of exports. Market size, transport costs, market access, etc. are good candidates to explain the number of varieties exported by a country.

What Explains Diversification? Some Empirical Analysis

To understand the drivers of diversification, we regress the Herfindahl index on population (in logs), distance (measured by the Rose (2005) remoteness index) and three measures of market access: (1) membership in the GATT/WTO; (2) membership in preferential trade arrangements (PTA); (3) Generalised System of Preferences (GSP). Column (1) in Table 1 reports the pooled OLS results with time fixed effects, while column (2) also includes country fixed effects.[3] For both the pooled estimates and within estimates, the signs are as expected. For example, entering GATT leads to a statistically significant increase in export diversification.

[3] Since most of the literature treats these regressors as reasonably exogenous, we therefore estimate these regressions by OLS.

Table 1
Effects of Trade Costs and Market Access on Export Diversification

Dependent Variable: Herfindahl Index of Exports using 4-digit SITC Classification		
Key Explanatory Variable	**(1)***	**(2)***
GATT/WTO dummy	-0.031 (0.006)	-0.044 (0.007)
PTA access	-0.0002 (0.000)	-0.0002 (0.000)
GSP access	0.004 (0.000)	-0.004 (0.001)
Remoteness index	3,966.7 (297.5)	2,649.4 (462.3)
Population (in logs)	-0.026 (0.001)	0.052 (0.015)
Diagnostics		
R-squared	0.18	0.07
No. of observations	4428	4428
No. of countries	143	143
Time fixed effects	Yes	Yes
Country fixed effects	No	Yes
Joint significance test	44.6	38.7

Robust standard errors are in parentheses.
* All coefficients are statistically significant at the 1% level.

To appreciate the magnitude of the effects, consider the estimated coefficient on the GATT/WTO dummy in column (2). If a country exports evenly in several industries and has a value of the Herfindahl index equal to the overall mean of 0.18, then a coefficient of -0.044 implies that this country will start exporting in slightly fewer than two new industries following accession to GATT/WTO.

Overall, we find that export diversification is well explained by standard variables like trade costs, remoteness, market access, etc.[4] The results are robust to changes in specifications, and changes in the data set. Moreover, if diversification is measured by the extensive margin of trade, and the data set is changed to include more detailed varieties (6-digit level), standard gravity variables explain diversification very well.[5] With these results at hand, we turn now to the link between diversification and development.

[4] Apart from the standard variables used to explain trade patterns, in the research paper we include additional controls to examine the robustness of our results. These are the Herfindahl index capturing production concentration in neighbouring countries, the volume of trade defined as (exports+imports/GDP), and a measure of institutions' "constraints on the executive" from the Polity IV database.

[5] See Dutt *et al.* (2011a).

Diversification of Exports and Economic Development

When examining the links between trade and economic development, research has tended to focus on whether higher ratios of trade volumes to GDP (or lower levels of protectionist policies) are positively correlated with growth, even after controlling for a variety of other growth determinants.[6] Recently, more attention has been directed towards the analysis of the composition of trade, with studies showing that as countries develop, they tend to diversify their production structure, but after a threshold level of income per capita, there is a tendency towards re-concentration.[7]

To analyse the link between diversification of exports and economic development, we start with a simple pooled OLS regression where we regress GDP per capita on the Herfindahl index of exports at the 4-digit level, controlling for trade volumes (exports+imports/GDP), an institutional variable, measured as constraints on the executive, and distance to the equator.

Table 2
Effect of Export Diversification on Economic Development

Dependent Variable: GDP Per Capita (Penn World Tables)					
Key Explanatory Variable	**(1)** Pooled OLS	**(2)** Lagged Herfindahl	**(3)** Initial Herfindahl	**(4)** Fixed effects	**(5)** IV-fixed effects
Herfindahl index of exports (4-digit)	-1.199*** (0.064)	-1.195*** (0.066)	-0.516*** (0.077)	-0.335*** (0.040)	-1.229*** (0.172)
Constraints on the executive	0.150*** (0.005)	0.155*** (0.005)	0.161*** (0.005)	0.007** (0.003)	0.009* (0.005)
Openness	0.003*** (0.000)	0.004*** (0.000)	0.003*** (0.001)	0.002*** (0.000)	0.012*** (0.001)
Distance to equator	0.025*** (0.001)	0.026*** (0.001)	0.028*** (0.001)	-	-
Diagnostics					
R-squared	0.59	0.60	0.56	0.43	0.31
Observations	3780	3419	3782	3780	3674
Number of countries	136	134	113	136	124
Joint significance test	172.87***	190.11***	153.30***	66.92***	46.83***
F-test of excluded instruments:					
Herfindahl index of exports	-	-	-	-	91.14***
Openness	-	-	-	-	46.17***
OID test p-value	-	-	-	-	0.27
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	No	No	No	Yes	Yes

Robust standard errors are in parentheses.
* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

[6] This positive link is suggested by Sachs and Warner (1995), Frankel and Romer (1999), and Wacziarg and Welch (2008) among others. However, in a critical survey of this literature, Rodríguez and Rodrik (2000) question the robustness of these findings, due to problems in measuring openness, the collinearity of protectionist policies with other bad policies, and other econometric difficulties.

[7] Imbs and Wacziarg (2003) were the first to document the relationship between production and employment diversification and income per capita. Klinger and Lederman (2004, 2005) and Cadot, Carrère, and Strauss-Kahn (2007) find a similar result using export data. However, these papers simply present a pattern between development and diversification, leaving aside questions of causality.

Column (1) in Table 2 shows that export diversification is associated with significantly higher levels of GDP per capita. Since this does not establish causality, column (2) uses the Herfindahl index of exports lagged by 5 years, while column (3) uses the initial Herfindahl index from the year 1962. We again find that a country with a diversified export base tends to be richer.[8] The estimates in column (1) imply that a one-standard-deviation decline in the Herfindahl index of exports raises the GDP per capita by about 21%.

Column (4) adds country fixed effects to column (1). Despite the fall in the absolute magnitude of the coefficient on export diversification, it remains statistically significant. In fact, these estimates indicate that the magnitude of the effect is largest for export diversification, as compared to institutions and integration. Since these are within estimates, it implies that there are significant returns for a country if it succeeds in diversifying its export base over time.

To address problems of omitted variables and endogeneity of trade policies in the earlier regressions, we use instrumental variables estimation in column (5), where a Herfindahl index of agricultural exports,[9] the GATT dummy, and the PTA access variable, are used as instruments for the Herfindahl index of exports.[10] We believe the Herfindahl index of agricultural exports to be a valid instrument, since it would logically be related to contemporaneous overall export diversification but unlikely to be directly related to GDP per capita (other than through its effect on overall export diversification). This seems plausible since natural endowments of land, fertility, and weather mainly affect this variable. Similarly, accession to the GATT is not conditional on changing any other policy stance prior to membership. And finally, PTAs tend to be geographically localised with neighbouring countries entering into such preferential trading arrangements. However, since it may be argued that both GATT membership and PTA access affect trade volumes and in turn GDP per capita, we use the same three variables as instruments for openness as well.

Column (5), based on instrumenting export diversification and openness, results in a coefficient on export diversification which is similar to that in column (1) and significantly higher than that in column (4) with fixed effects.

[8] The two regressions reported in columns (2) and (3) produce results where reverse causality is less of a concern.

[9] This is calculated as the Herfindahl index of exports for SITC 1-digit code 0.

[10] There are two potential problems with the results reported in Table 2: omitted variables and endogeneity of trade policies. While the country fixed effects remove all time invariant omitted variables, it may be argued that a move towards diversification may be accompanied by other policy changes (e.g. industrial policies) which also affect GDP per capita.

Sum-up

Overall, our results indicate that there is a tight link between export diversification and development. Further, export diversification in all likelihood has a causal effect on GDP per capita. Whatever the driving force of economic development is, it cannot be the forces of static comparative advantage as conventionally understood: countries that have become rich have diversified their base of exports over time.

Indeed, the economic history of Singapore supports this observation. In the early 1960s, the Herfindahl index of exports for Singapore was about 0.12-0.13. For the following thirty years, the country diversified and the index dropped to 0.03-0.04. During the same period, income per capita has more than quadrupled.

Once we recognise the link between export diversification and development, several policy implications emerge from our findings. First, development is fundamentally about structural change: it involves producing and exporting new goods with new technologies and transferring resources from traditional activities to these new ones. Second, similar to Rose (2004), we find that the intensive margin of exports does not respond to GATT accession, but the extensive margin is affected by accession to WTO. Since preferential trade arrangements are also instrumental in diversifying the export base, welfare implications of PTAs cannot simply be evaluated in terms of trade creation and trade diversion effects. Instead, one must take into account the impact on the extensive margin of trade.[11] Third, and in addition to the results reported in this note, we find in Dutt *et al*. (2011b) that diversification into particular productive sectors delivers gains in terms of output growth. One possible interpretation of this result is that it offers support for targeted industrial policies as adopted by the growth miracle economies like Korea, Taiwan and, prior to that, Japan. Indeed, recently Rodrik (2007) has made a strong case for reinstituting activist industrial policies that have been discarded or fallen into disuse. By showing that some forms of diversification matter more than others, our findings provide empirical support for such a strategy, keeping in mind, however, informational and other constraints.

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[11] See Dutt *et. al* (2011a) for details regarding this result.

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