

TRADE DIVERSIFICATION: DRIVERS AND IMPACTS

7

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7.1 INTRODUCTION

Policy interest in export diversification is not new but, for over two decades, it was mired in an ideologically loaded debate about the role of the State. Old-time industrial policy having died of its own excesses, the debate over what, if anything, the government should do to promote export growth was contained within the fringe of the economics profession. Mainstream economists were happy to believe that whatever market failures were out there, government failures were worse, and that anyway most governments in developing countries lacked the means to do anything. But by an ironic twist of history, years of (Washington-consensus inspired) fiscal and monetary discipline have put a number of developing-country governments back in a position to do something for export promotion, having recovered room to manoeuvre in terms of both external balance and budget position. So the question is back.

With limited guidance from theory, the economics profession’s answer to the return of the industrial-policy debate has been to go back to descriptive statistics (as opposed to the investigation of causal chains). The result is a wealth of new stylized facts. For instance, surprising patterns of export entrepreneurship have emerged from the use of increasingly disaggregated data.

One area where theory has proved useful is in the exploration of the linkages between productivity and trade. So-called “new-new” trade models (featuring firm heterogeneity) have highlighted complex relationships between trade diversification and productivity, with causation running one way at the firm level and the other way around (or both ways) at the aggregate level.

Even at the aggregate level, new issues have appeared. First, Imbs and Wacziarg (2003) uncovered a curious pattern of diversification and re-concentration in production, prompting researchers to explore whether the same was true of trade. Second, a wave of recent empirical work has questioned traditional views on the “natural-re-

source curse”, challenging the notion that diversification out of primary resources was a prerequisite for growth.

Thus, our current understanding of the trade diversification/productivity/growth nexus draws on several theoretical and empirical works, all well developed and growing rapidly. It is easy to get lost in the issues, and the present paper’s objective is to sort them out and take stock of elements of answers to the basic questions.

Among those questions, the first are simply factual ones – “how is export diversification measured?” and “what are the basic stylized facts about trade export diversification, across time and countries?”, which we explore in sections 7.2 and 7.3, respectively. The third question is about diversification’s drivers, among which industrial policy, and is tackled in section 7.7. In section 7.5, we turn to the relationship between trade diversification, growth and employment. Section 7.6 focuses on the import side; we review the evidence on the impact of import diversification on productivity and extend the discussion to labour-market issues. Section 7.7 concludes.

7.2 MEASURING DIVERSIFICATION

7.2.1 *Concentration/diversification indices*

While the focus of this chapter is on diversification, quantitative indices measure concentration rather than diversification. These indices are mainly used in the income-distribution literature where they illustrate income dispersion across individuals. We will review these measures, taking the example of export diversification (which has anyway been the focus of most papers) but keeping in mind that they apply equally well to imports. All concentration indices basically measure inequality between export shares; these shares, in turn, can be defined at any level of aggregation. Of course, the finer the disaggregation, the better the measure.

The most frequently used concentration indices are the ones used in the income-distribution literature: Herfindahl, Gini and Theil. These indices are formalized in technical appendix 7.A.1.1. All three indices can be easily programmed but are also available as packages in Stata. Authors have used one or several of these measures. Across the board, results are not dependent on the index chosen.

The Theil (1972) index has decomposability properties that make it especially useful. It can indeed be calculated for groups of individuals (export lines) and decomposed additively into within-groups and between-groups components (that is, the within- and between-groups components add up to the overall index).¹ It is thus possible to distinguish an increased concentration (diversification) that occurs mainly within groups from one that occurred mainly across groups. We will see in the next section a useful application of this property in our context.

¹ Technical appendix 7.A.1.2 presents the Theil index decomposition.

7.2.2 Trade-expansion margins

Recent research on trade diversification distinguishes evolution at the intensive and extensive margins. In summary, by focusing on the intensive margins one relates to changes in diversification among a set of goods that are commonly traded over the period. In contrast, by looking at the extensive margin one takes account of the effect of newly traded (or disappearing) goods on diversification. More specifically, export concentration measured at the intensive margin reflects inequality between the shares of active export lines.² Conversely, diversification at the intensive margin during a period t_0 to t_1 means convergence in export shares among goods that were exported at t_0 . Concentration at the extensive margin is a subtler concept. At the simplest, it can be taken to mean a small number of active export lines. Then, diversification at the extensive margin means a rising number of active export lines. This is a widely used notion of the extensive margin (in differential form), and the decomposition of Theil's index can be usefully mapped into the intensive and extensive margins thus defined.

Suppose that, for a given country and year, we partition the 5,000 or so lines making up the HS6 nomenclature into two groups: group "one" is made of active export lines for this country and year, and group "zero" is made of inactive export lines (i.e. export lines for which there are no exports). This partition can be used to construct within-groups and between-groups components of the overall Theil index. As shown in the technical appendix 7.A.2, by distinguishing the Theil sub-index for the group of inactive lines from the Theil sub-index for the group of active lines, changes in concentration/diversification within and between groups can be set apart. More importantly, it can be shown that, given this partition, changes in the within-groups Theil index measure changes at the intensive margin, whereas changes in the between-groups Theil index measure changes at the extensive margin. In sum, Theil's decomposition makes it possible to decompose changes in overall concentration into extensive-margin and intensive-margin changes.³ This is a particularly important feature, as changes at the intensive margin or extensive margin reflect very different evolution of a country's productive activities and policies aiming at enhancing diversification in either margin entail distinct recommendations.

The extensive margin defined this way (by simply counting the number of active export lines) leaves out, however, important information. To see why, observe that a country can raise its number of active export lines in many different ways. For instance, it could add "embroidery in the piece, in strips or in motifs" (HS 5810); or it could add "compression-ignition internal combustion piston engines" (HS 8408, i.e. diesel engines). Clearly, these two items are not of the same significance economically, although a mere count of active lines would treat them alike. Hummels

² An active line corresponds to a non-zero export line of the HS6 nomenclature (about 5,000 lines) for a given year.

³ This mapping between the Theil decomposition and the margins was first proposed by Cadot, Carrère and Strauss-Kahn (2011).

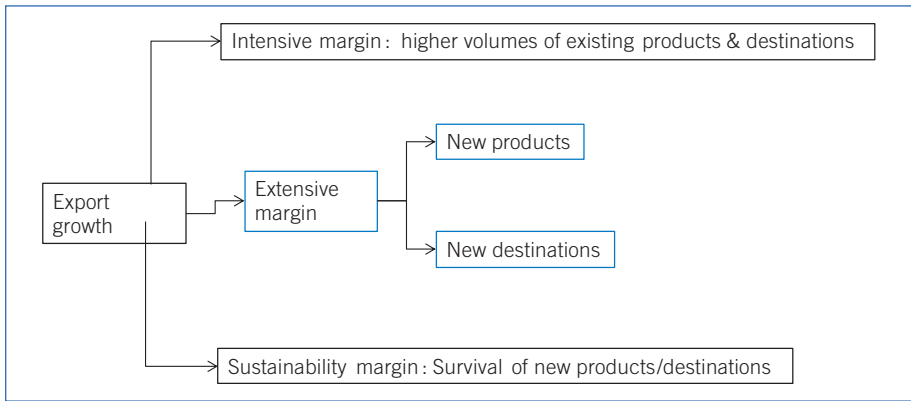
and Klenow (2005) proposed an alternative definition of the intensive and extensive margins that takes this information into account. They define the intensive margin as the share of country i 's exports value of good k in the world's exports of that good. That is, country i 's intensive margin is its market share in what it exports. The extensive margin is defined as the share, in world exports, of those goods that country i exports (irrespective of how much i itself exports of those goods). That is, it indicates how much the goods that i exports count in world trade.⁴

7.2.3 Alternative margins

Although the intensive and extensive product margins as defined above are the most widely studied in the literature on diversification, several other margins bring further understanding on trade and diversification patterns. Brenton and Newfarmer (2007) proposed an alternative definition of the extensive margin based on bilateral flows. The index measures how many of destination country j 's imports are covered (completely or partly, the index does not use information on the value of trade flows) by exports from country i . The numerator of Brenton and Newfarmer's index for country i is the number of products that i exports to j , while its denominator is the number of products that (a) j imports from anywhere and (b) i exports to anywhere (see technical appendix 7.A.3). It is thus the sum of actual and potential bilateral trade flows (for which there is a demand in j and a supply in i), and the fraction indicates how many of those potential trade flows actually take place.

The survival of trade flows (export sustainability), analysed for the first time in the seminal work by Besedes and Prusa (2006), provides another margin of export expansion. The length of time during which bilateral exports of a given good take place without interruption is a dimension along which exports vary and which may

Figure 7.1: Margins of export growth



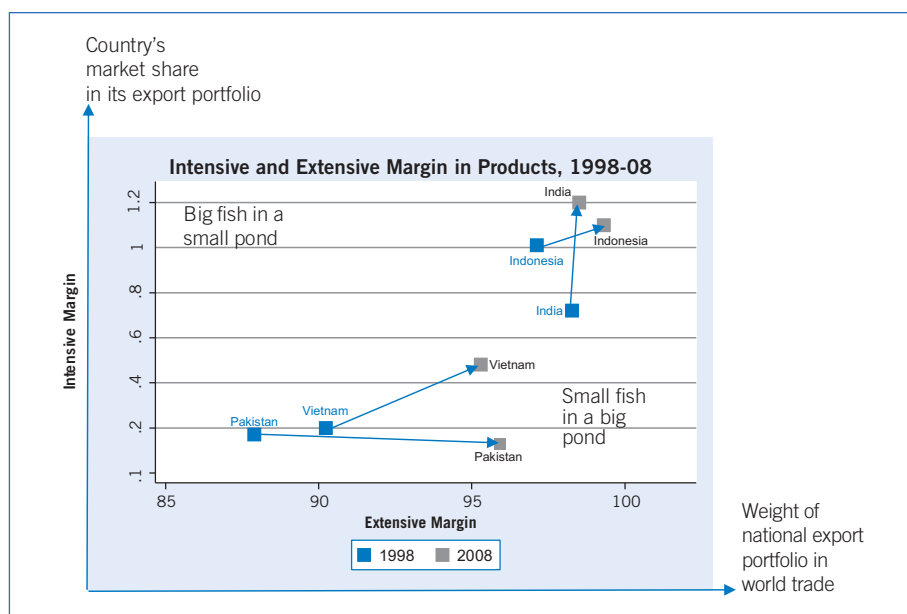
⁴ See technical appendix 7.A.2.2 for a formalization of the Hummels and Klenow index.

also be a margin for export promotion. Figure 7.1 summarizes our decomposition of export growth.

Theil's,⁵ Hummels and Klenow's, and Brenton and Newfarmer's indices provide different pieces of information and should be used accordingly. The former index measures the concentration in products. It thus informs policy-makers on the distribution of economic activity across existing products/sectors (intervention at the intensive margin) and the potential for broadening the country's export portfolio to new sectors (intervention at the extensive margin). Brenton and Newfarmer's index gives information about geographic diversification at the extensive margin. For existing products, it shows how many markets are reached and informs on the potentiality of extending production to new markets. Policies aimed at increasing the scope of exports in terms of products or destination markets are obviously very different. It is therefore important for policy-makers to use the right tool for the right policy question. Finally, Hummels and Klenow's index gives an idea of whether national exporters are "big fish in a small pond" (large intensive margin, small extensive margin) or "small fish in a big pond" (small intensive margin, large extensive margin).

As an illustration of how these concepts can be put to work for policy analysis, figure 7.2 shows the evolution of the intensive and extensive margins defined as in

Figure 7.2: Evolution of the intensive and extensive margins, selected countries, 1998–2008



Source: Comtrade. The authors are grateful to Swarnim Wagle, of the World Bank's Trade Division, for sharing this graph.

⁵ The interpretation for Herfindhal or Gini indices is obviously similar.

Hummels and Klenow for selected countries over the decade preceding the global financial crisis. It can be seen, for instance, that Pakistan's extensive margin has been rising, suggesting active export entrepreneurship. By contrast, its intensive margin has slightly shrunk, suggesting that existing Pakistani exporters are finding it difficult to maintain competitiveness. This type of broad-brush observation is useful to get a first shot at potential constraints on growth – for example, the problem may be declining competitiveness in the textile and clothing sector due to the elimination of Multi-Fibre Arrangement (MFA) quotas. By contrast, India has grown almost only at the intensive margin, which is to be expected given that it is already fully diversified (as the products that belong to its export portfolio account for close to 100 per cent of world trade). Overall, countries can be expected to walk a crescent-shaped trail, first eastward as they broaden their portfolio, then full north as they consolidate positions.

7.3 WHAT DO WE LEARN FROM THESE MEASURES?

7.3.1 *Trends in diversification*

The seminal work by Imbs and Wacziarg (2003) uncovered an unexpected non-monotonic relationship between production diversification and gross domestic product (GDP) per capita. Past a certain level of income (\$9,000 in 1985 purchasing power parity (PPP) dollars), countries re-concentrate their production structure, whether measured by employment or value added. Using different data, Koren and Tenreyro (2007) confirmed the existence of a U-shaped relationship between the concentration of production and the level of development.

Following their work, several papers have looked at whether a similar non-monotone pattern holds for trade. Looking at trade made it possible to reformulate the question at a much higher degree of disaggregation, since trade data is available for the 5,000 or so lines of the six-digit harmonized system (henceforth HS6). In terms of concentration levels, exports are typically much more concentrated than production. This concentration, which was observed initially by Hausmann and Rodrik (2006), is documented in detail for manufacturing exports in Easterly, Reshef and Schwenkenberg (2009). A striking (but not unique) example of this concentration is the case of Egypt, which, “[out] of 2,985 possible manufacturing products in [the] dataset and 217 possible destinations, [...] gets 23 per cent of its total manufacturing exports from exporting one product – “ceramic bathroom kitchen sanitary items not porcelain” – to one destination, Italy, capturing 94 per cent of the Italian import market for that product” (page 3). These “big hits”, as they call them, account for a substantial part of the cross-country variation in export volumes. But they also document that the distribution of values at the export $\times$ destination level (their unit of analysis) closely follows a power law; that is, the probability of a big hit decreases exponentially with its size.

Klinger and Lederman (2006), as well as Cadot, Carrère and Strauss-Kahn (2011), analyse the evolution of trade diversification. The former study uses a panel of 73 countries between 1992 and 2003, while the latter focuses on a larger one, with 156

countries representing all regions and all levels of development between 1988 and 2006. In both cases, concentration measures obtained with trade data turned out to be much higher than those obtained with production and employment data.⁶ But the U-shaped pattern showed up again, albeit with a turning point at much higher income levels (\$22,500 in constant 2000 PPP dollars for Klinger and Lederman, and \$25,000 in constant 2005 PPP dollars for Cadot, Carrère and Strauss-Kahn). Note that, as the turning point occurs quite late, the level of export concentration of the richest countries in the sample is much lower than that of the poorest.

7.3.2 Which margin matters?

The literature so far shows that growth at the intensive margin is the main component of export growth. The early work by Evenett and Venables (2002) used three-digit trade data for 23 exporters over the period 1970–97 and found that about 60 per cent of total export growth is at the intensive margin, i.e. comes from larger exports of products traded since 1970 to long-standing trading partners. Of the rest, most of which was the destination-wise extensive margin, as the product-wise extensive margin accounted for a small fraction (about 10 per cent) of export growth. Brenton and Newfarmer (2007), using Standard International Trade Classification (SITC) data at the five-digit level over 99 countries and 20 years, also found that intensive-margin growth accounts for the biggest part of trade growth (80.4 per cent), and that growth at the extensive margin was essentially destination-wise (18 per cent). Amurgo-Pacheco and Pierola (2008) found that extensive-margin growth accounts for only 14 per cent of export at the HS6 level for a panel of 24 countries over the period 1990–2005.

The observation that the product-wise extensive margin accounts for little of the growth of exports may seem puzzling, as Cadot et al. (2011) found precisely that margin to be very active, especially at low levels of income. Thus, export entrepreneurship is not lacking. Why then does it not generate export growth? There are two answers, one technical and one of substance. The technical answer is that when a new export appears in statistics, it typically appears at a small scale and can only contribute marginally to growth. But the following year, it is already in the intensive margin. Thus, by construction, the extensive margin can only be small. But there is a deeper reason. In work already cited, Besedes and Prusa (2006) showed that the churning rate is very high in all countries' exports, and especially so for developing

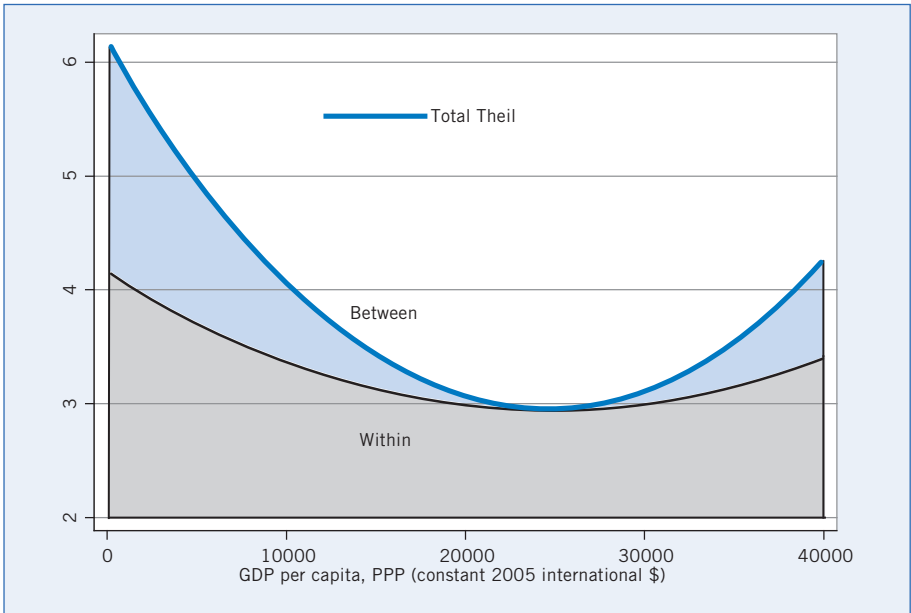
⁶ The reason has to do with the level of disaggregation rather than with any conceptual difference between trade, production and employment shares. Whereas Imbs and Wacziarg calculated their indices at a relatively high degree of aggregation (ILO, one digit; UNIDO, three digits; and OECD, two digits), Cadot, Carrère and Strauss-Kahn (2011) use very disaggregated trade nomenclature. At that level, there is 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 grouped together in "mammoth" lines.

ones. That is, many new export products are tried, but many also fail. Raising the contribution of the extensive margin to export growth requires also improving the “sustainability” margin.

Although not predominant quantitatively as a driver of export growth, the extensive margin can react strongly to changes in trade costs, an issue discussed later in this chapter. For instance, Kehoe and Ruhl (2009) found that the set of least-traded goods, which accounted for only 10 per cent of trade before trade liberalization, may grow to account for 30 per cent of trade or more after liberalization. Activity at the extensive margin also varies greatly along the economic development process. Klinger and Lederman (2006) and Cadot, Carrère and Strauss-Kahn (2011) show that the number of new exports falls rapidly as countries develop, after peaking at the lower-middle income level. The poorest countries, which have the greatest scope for new-product introduction because of their very undiversified trade structures, unsurprisingly have the strongest extensive-margin activity.⁷

Figure 7.3 depicts the contribution of the between-groups and within-groups components to Theil’s overall index, using the formulae derived in the previous section.

Figure 7.3: Contributions of within- and between-groups to overall concentration, all countries



Source: Cadot, Carrère and Strauss-Kahn (2011).

⁷ The average number of active export lines is generally low at a sample average of 2,062 per country per year (using Cadot, Carrère and Strauss-Kahn’s sample), i.e. a little less than half the total, with a minimum of eight for Kiribati in 1993 and a maximum of 4,988 for Germany in 1994 and the United States in 1995.

It can be seen that the within component dominates the index while the between component accounts for most of the evolution. Put differently, most of the concentration in levels occurs at the intensive margin (in goods that are long-standing exports) while changes in concentration are at the extensive margin (for example the decreased concentration for lower-income countries results mainly from a rise in the number of exported goods).

Whereas the extensive margin in figure 7.3 is measured only by the number of exports, using their alternative definition (see Appendix 7.A.2) Hummels and Klenow (2005) performed a cross-sectional analysis of exports for 126 countries decomposing exports into extensive and intensive margins. Interestingly, they found that 62 per cent of the higher trade of larger economies is driven by the extensive margin, while only 38 per cent is driven by the intensive margin. Thus, once the extensive margin is corrected for the importance of the new exports introduced (Hummels-Klenow's version), it dominates the intensive margin in explaining exports growth.

7.4 DRIVERS OF DIVERSIFICATION

7.4.1 *Quantitative insights*

What does the theoretical trade literature have to say on the potential determinants of export diversification? In traditional Ricardian models, productivity affects trade patterns. In the specification proposed by Melitz (2003) – “new-new trade theory” – firms are heterogeneous in productivity levels, and only a subset of them – the most productive – become exporters. Thus, exporting status and productivity are correlated at the firm level, although this comes essentially from a selection effect.

Several papers have studied the impact of productivity/income on diversification by putting export diversification on the left-hand side of the equation and income on the right-hand side. As we already saw, Klinger and Lederman (2006) as well as Cadot, Carrère and Strauss-Kahn (2011) found a U-shaped relationship between export concentration and GDP per capita by regressing the former on the latter, hence providing evidence of a non-linear effect of income on export diversification.

We now consider some of its non-income determinants. In a symmetric (representative-firm) monopolistic-competition model, the volume of trade, the number of exporting firms and the number of varieties marketed are all proportional. In a heterogeneous-firms model, the relationship is more complex, but the ratio of export to domestic varieties is also directly related to the ratio of export to domestic sales. Thus, it is no surprise that gravity determinants of trade volumes also affect the diversity of traded goods. For instance, Amurgo-Pacheco and Pierola (2008) find that the distance and size of destination markets is related to the diversity of bilateral trade.

Parteka and Tamberi (2008) apply a two-step estimation strategy to uncover some of the systematic (permanent) cross-country differences in export diversification. To do so, they break down country effects into a wide range of country-specific characteristics, such as size, geographical conditions, endowments, human capital and institutional setting. Using a panel data set for 60 countries and 20 years (1985–2004),

they show that distance from major markets and country size are the most relevant and robust determinants of export diversity, once GDP per capita is controlled for. These results are consistent with those of Dutt, Mihov and van Zandt (2009), who show that distance to trading centres and market access (proxied by a host of bilateral and multilateral trading arrangements) are key determinants of diversification.

We take account of the main variables used in the above cited empirical studies and propose a quantitative assessment of the main determinants of export diversification. We then go a step further and extend the discussion by assessing whether determinants mainly affect the extensive or intensive margins of diversification.⁸

As theoretical background stays silent on the potential form of the relationship between export diversification and its determinants, we start by showing non-parametric “smoother” regressions.⁹ Such regressions do not impose any functional form and are therefore well suited to a first exploration of data with no ad-hoc pre-defined relationships between variables.

In addition to per capita GDP (specified with a quadratic term to capture the hump-shaped relationship described in section 7.2.2), we introduce the following variables in our analysis:¹⁰

- Size of the economy, proxied by population. We expect larger countries to be more diversified due to larger internal markets and higher degree of product differentiation.
- Market access, proxied by the country membership in preferential trade agreements. Preferential market access should help both export volumes and export of new products.
- Transport costs, proxied by both a remoteness index (as in Rose, 2004) and the quality of infrastructures (captured by the density of railway, paved road and telephone lines). The more remote a country, the lower its exports both in volume and number of products; in contrast, better infrastructures should boost export diversification.
- Human capital, proxied by the number of years of schooling (from Barro and Lee, 2010) and the percentage of GDP invested in research and development (R&D). We expect both variables to have a positive impact on export diversification, in particular through the extensive margin, i.e. through the development and export of new products.
- The quality of institution may also have a positive impact on diversification. This is proxied by two variables, the International Country Risk Guide (ICRG) Indicator of Quality of Government (QoG) and the Revised Combined Polity Score, both provided by the QoG institute.

⁸ As a measure of diversification, we use Theil indices computed at the HS6 level by Cadot, Carrère and Strauss-Kahn (2011) for 1988-2006.

⁹ Non-parametric “smoother” regression (also called “lowess” regression) consists of re-estimating regression for overlapping samples centred on each observation.

¹⁰ A detailed description of these variables is available in technical appendix 7.A.4.

- Finally, we expect foreign direct investment (FDI) to also impact export structure. We thus introduce FDI in the analysis.

Figure 7.4 presents the scatter plots of export diversification measured by the 2006 Theil index versus the variables listed above. Scatter plots show correlations between the variables, whereas curves correspond to “smoother” non-parametric regression. In all scatter plots, a “full diamond” represents a developing country (i.e. low- and middle-income countries) and a “hollow circle” represents a developed country (i.e. high-income OECD and non-OECD countries). The sample includes 129 to 150 countries depending on data availability.

Figure 7.4: Average Theil indices in 2006 on each of the ten explanatory variables in 2005

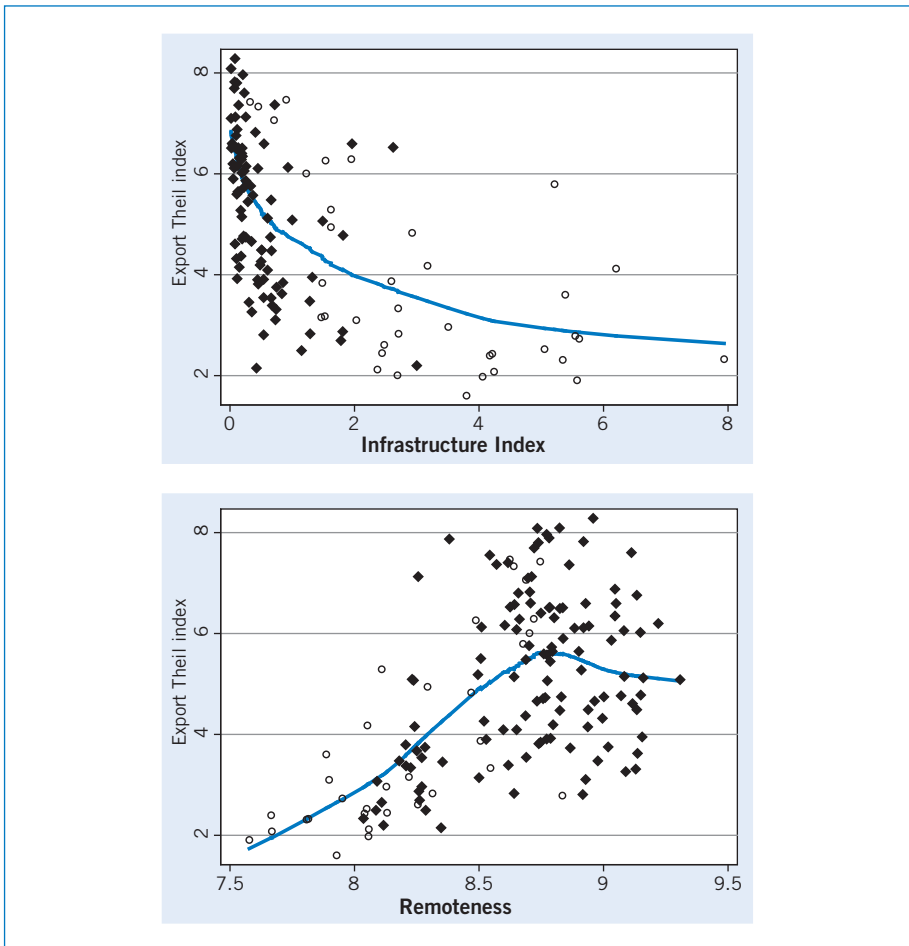


Figure 7.4: Average Theil indices in 2006 on each of the ten explanatory variables in 2005 (Continued)

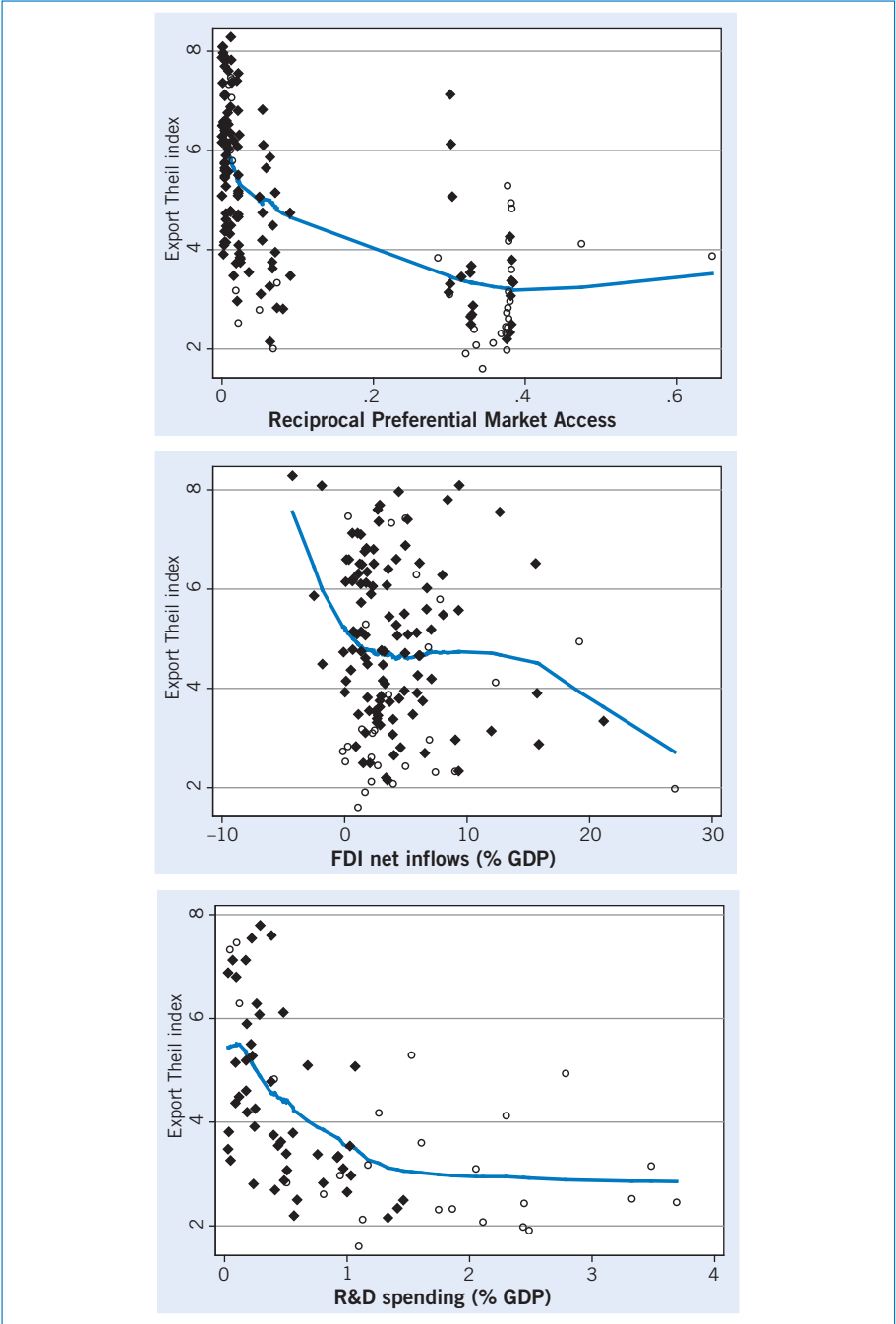


Figure 7.4: Average Theil indices in 2006 on each of the ten explanatory variables in 2005 (*Continued*)

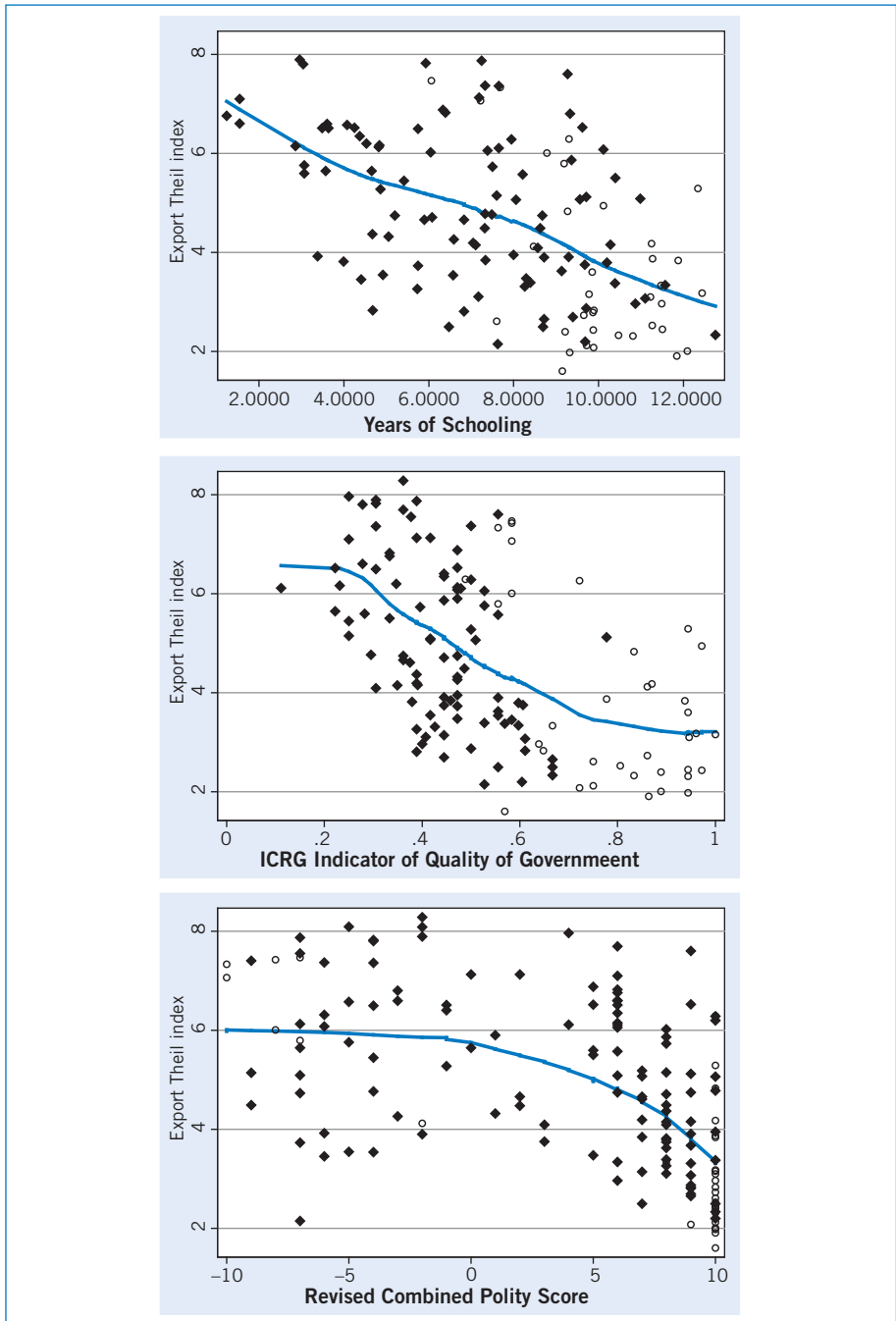
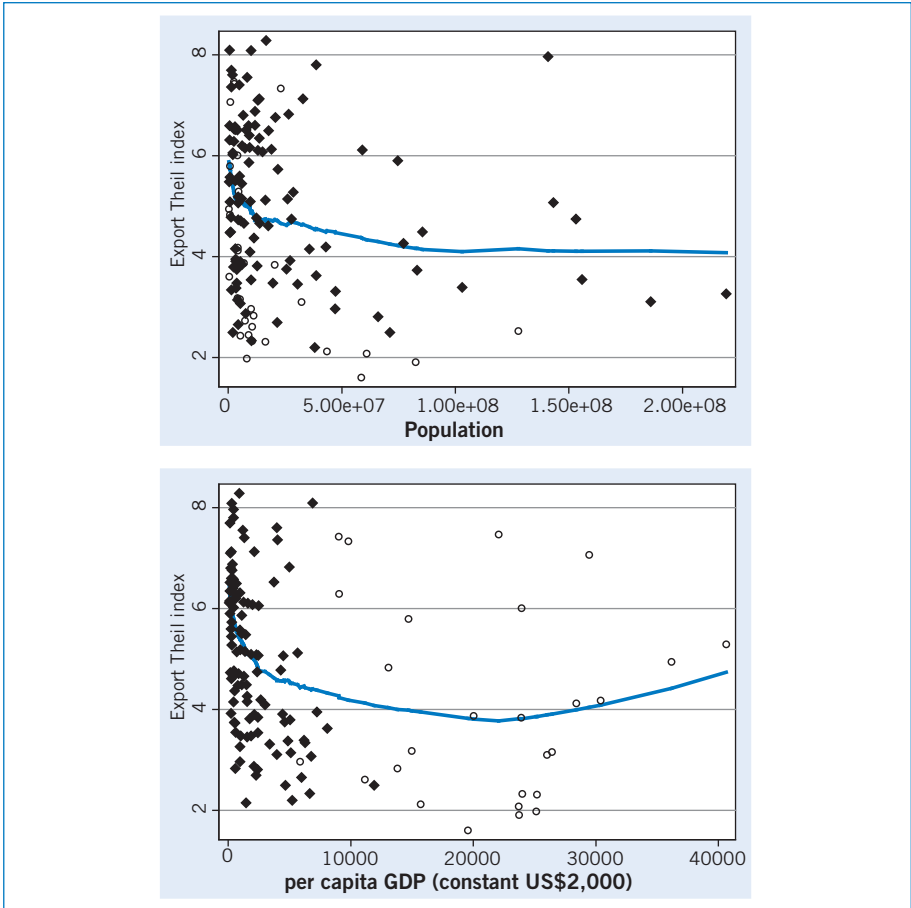


Figure 7.4: Average Theil indices in 2006 on each of the ten explanatory variables in 2005 (*Continued*)



These figures reveal links between export diversification and each of these variables, which, importantly, have the expected signs. A similar test run using the number of exported products instead of the Theil index provides very similar figures, suggesting that our variables influence essentially the extensive margin.¹¹ In order to get further insights on the impact of the set of variables described above on the extensive and intensive margins, we turn to a regression analysis. We regress the overall Theil index, the within-groups Theil, the between-groups Theil and the number of exported products on the ten variables using a panel database, including 87 countries over the

¹¹ These figures are available from the authors upon request.

Table 7.1: Diversification drivers in a panel data set, 1990–2004, 87 countries

	ln (Theil)				ln (Theil_between)		ln (Nber)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
ln (per capita GDP)	-0.505	<i>0.09 ***</i>	-0.193	<i>0.13 *</i>	-1.054	<i>0.32 ***</i>	1.055	<i>0.38 ***</i>
ln (per capita GDP) squared	0.040	<i>0.01 ***</i>	0.009	<i>0.01</i>	0.054	<i>0.02 **</i>	-0.106	<i>0.02 ***</i>
ln (Infrastructure)	-0.072	<i>0.03 ***</i>	-0.122	<i>0.04 ***</i>	-0.303	<i>0.08 ***</i>	0.119	<i>0.07 *</i>
ln (Remoteness)	1.092	<i>0.46 **</i>	-0.439	<i>0.50</i>	3.753	<i>2.14 *</i>	-3.533	<i>1.51 **</i>
Trade liberalization	-0.009	<i>0.01</i>	0.017	<i>0.02</i>	0.031	<i>0.05</i>	0.108	<i>0.06 *</i>
Pref. Market Access	-0.179	<i>0.04 ***</i>	-0.244	<i>0.05 ***</i>	-1.031	<i>0.21 ***</i>	0.316	<i>0.11 ***</i>
FDI (% GDP)	0.001	<i>0.00 **</i>	0.001	<i>0.00 *</i>	0.002	<i>0.00</i>	0.000	<i>0.00</i>
ln (Years of Schooling)	-0.114	<i>0.06 *</i>	0.017	<i>0.07</i>	-0.625	<i>0.26 **</i>	0.619	<i>0.21 ***</i>
ICRG	-0.047	<i>0.04 *</i>	0.086	<i>0.04 **</i>	-0.584	<i>0.14 ***</i>	0.416	<i>0.12 ***</i>
Polity Score	-0.002	<i>0.00 *</i>	0.002	<i>0.00</i>	-0.003	<i>0.00</i>	0.019	<i>0.00 ***</i>
ln (population)	-0.187	<i>0.07 ***</i>	0.041	<i>0.08</i>	-0.642	<i>0.27 **</i>	1.582	<i>0.27 ***</i>
Country fixed effects	yes		yes		yes		yes	
Year fixed effects	yes		yes		yes		yes	
Observations	1195		1257		1257		1257	
Adjusted R-squared	0.97		0.92		0.98		0.95	

Notes: Robust standard errors in italics, with * meaning that the correspondent coefficient is significantly different from zero at 10 per cent; ** significant at 5 per cent; *** significant at 1 per cent.

1990–2004 period.¹² Country and year fixed-effects control for unobservable characteristics in all regressions. The regression analysis, reported in table 7.1, confirms our results from the scatter plots.

Table 7.1 shows a negative significant coefficient on GDP per capita and a positive significant one on GDP per capita squared. We thus retrieve the main result of Cadot, Carrère and Strauss-Kahn (2011) which reveals a quadratic relationship between the Theil index and GDP per capita, mainly driven by the extensive margin (the between component of the Theil index). Once controlled for GDP per capita, infrastructure still appears as an important driver of diversification: a 10 per cent increase in the infrastructure index decreases the Theil's index by about 0.7 per cent.¹³ Better infrastructure increases diversification on both margins. Remoteness also has the expected sign: the more remote the country, the lower its export diversification (i.e. the higher its Theil index), essentially in terms of the extensive margin and number of products. Our analysis thus confirms the result that high distance to importers increases the export fixed cost and, consequently, drastically reduces export diversification. Preferential market access is clearly an important factor of diversification at both margins and this result is consistent with other studies (for example,

¹² As seen in section 7.2.2, the within-groups Theil index corresponds to the intensive margin, whereas the between-groups Theil index corresponds to the extensive margin.

¹³ Note that the log-log specification allows an interpretation of the results in terms of elasticity, which is easily understandable.

Amurgo-Pacheco, 2006; Gamberoni, 2007; Feenstra and Kee, 2007; or Dutt, Mihov and van Zandt, 2009). In contrast, net inflows of FDI (as a percentage of GDP) seem to concentrate exports value on some products and thereby increases concentration at the intensive margin. This result could be expected as multinational corporations specialize in specific products, which they produce in high volumes. We also find a significant impact of education on export diversification. A 10 per cent increase in the years of schooling reduces the Theil index by 1.1 per cent and increases the numbers of exported products by 6.2 per cent. Similarly, the quality of institution appears clearly significant, with a positive impact on diversification. As expected, the larger the population, the more diversified the economy.¹⁴

Note that the above results should be understood with caution. Regressions in table 7.1 are informative of the factors that have a significant impact on diversification and of the sign of this impact once controlled for others factors. It is difficult however to rank these factors and clearly isolate a single impact due to potential multicollinearity issues existing between these variables.

As shown in table 7.1, we also account for a potential factor of diversification largely ignored in empirical literature: the unilateral trade liberalization. We use the dummy variable as defined by Wacziarg and Welch (2008) (see section 7.2.2 for further indications on this variable). This factor appears non-significant except in column (4): import liberalization increases the diversification through a larger number of exported lines. Further investigations reveal that the non-significance of the trade liberalization variable in columns (1)-(3) is mainly due to the “year of schooling” variables. If we drop the latter from the regression, the trade liberalization dummy becomes negative and significant at the 1 per cent level in the three first columns. Strikingly, if we introduce an interactive variable between unilateral trade liberalization and years of schooling, the trade liberalization dummies and the interactive variables are significant, whereas schooling is not. That is: years of schooling matter for export diversification *only in a liberalized regime*. Similar conclusions hold for some other drivers of export diversification of Table 7.1 such as infrastructure. Thus, unilateral trade liberalization appears to be an important underlying driver of export diversification. We now explore this feature in more detail.

7.4.2 Trade liberalization as a driver of diversification

Although preferential trade liberalization has received considerable attention in the empirical literature as a driver of product diversification (for example, Amurgo-Pacheco, 2006; Gamberoni, 2007; Feenstra and Kee, 2007; or Dutt, Mihov and van Zandt, 2009), unilateral trade reforms have not. Yet we will see in section 7.5 that the link between import diversification and total factor productivity (TFP) is strongly

¹⁴ The variable on R&D spending is not included in the regression analysis as it covers only a small number of countries and years, and consequently reduces the sample drastically. The “years of schooling” variable, available every five years in the Barro and Lee database, is considered as constant within the five-year period.

established at the firm level. Thus, import liberalization can be taken as a positive shock on TFP, which should, according to the Melitz (2003) argument, raise the number of industries with an upper tail of firms capable of exporting – and thus raise overall export diversification.¹⁵ Indeed, arguments running roughly along this line can be found in, for example, Bernard, Jensen and Schott (2006) or in Broda, Greenfield and Weinstein (2006). This section presents a brief statistical analysis of this relationship.

To do so, we combine the Theil index of export concentration computed at the HS6 level by Cadot, Carrère and Strauss-Kahn (2011) for the period 1988–2006 with the trade liberalization date of Wacziarg and Welch (2008). The sample used includes 100 countries, 62 middle-income and 38 low-income countries over the period 1988–2006, with respectively 68 per cent and 49 per cent of country-year observations occurring in liberalized regimes (see technical appendix table 4.A.1). We exclude from the sample 34 high-income countries, as 95 per cent of the observations of this group occurs in liberalized regimes throughout the period (Estonia and Iceland are the only countries considered as non-liberalized and they do not change regime over the period – see technical appendix table 7.A.1).

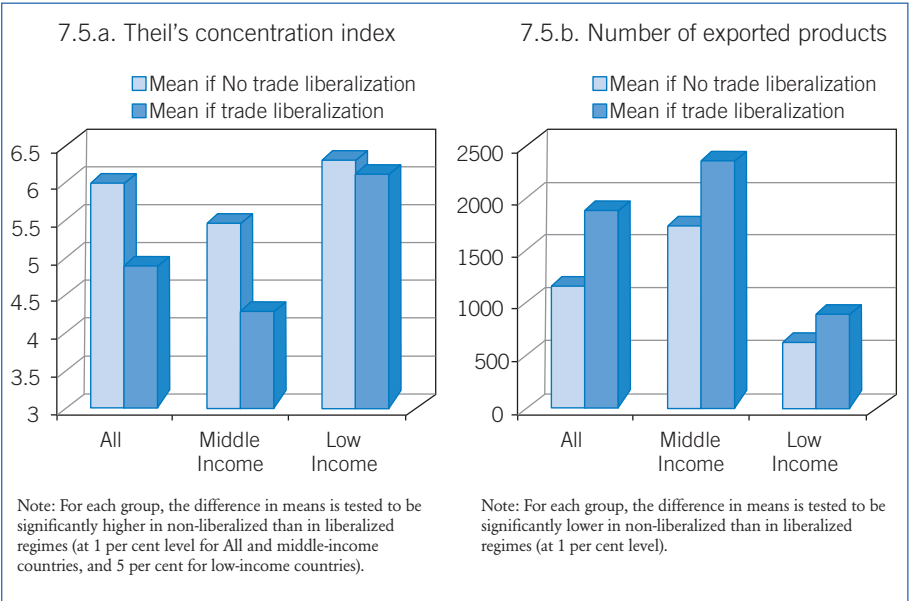
Wacziarg and Welch (2008) propose an update covering the late 1990s of Sachs and Warner (1995)'s trade liberalization dates. Such data were first collected from a comprehensive survey of broad country-specific case studies. More precisely, Sachs and Warner determined trade liberalization dates based on primary-source data on annual tariffs, non-tariff barriers and black market premium. A variety of secondary sources was also used, particularly to identify when export marketing boards were abolished and multi-party governance systems replaced Communist Party rule.¹⁶

As shown in figure 7.5, the conditional mean of Theil's concentration index is 4.8 in a liberalized regime versus 5.9 in a non-liberalized one, while the number of exported products is clearly higher when the trade regime is liberalized (1,893 products versus 1,178 in a non-liberalized trade regime). The difference in Theil indices means is higher for middle-income than for low-income countries, although it is still statistically significant for low-income countries. This suggests a stronger dynamic between trade liberalization and diversification of exports in developing countries with better infrastructure and higher skill levels.

¹⁵ This mechanism is further described in section 7.5.1.

¹⁶ Rodriguez and Rodrik (2000) criticized the Sachs-Warner (1995) openness variable, showing that its explanatory power on growth was driven by only two of its five components: the black market premium on foreign exchange (a measure of overvalued exchange rates rather than trade openness) and the presence of export marketing boards. By contrast, tariffs and non-tariff barriers correlated poorly with growth. As export marketing boards essentially characterized sub-Saharan Africa and overvalued exchange rate Latin America, the Sachs-Warner measure was indistinguishable from African and Latin American "dummy variables". Wacziarg and Welch (2008) improved the methodology by better identifying export marketing boards and trade liberalization dates. Using their improved openness definition and panel data over a long period, they confirmed that openness correlates with faster growth, delivering on average 2 percentage points of additional growth (largely driven by additional investment).

Figure 7.5: Differential of means in liberalized versus non-liberalized regimes (100 middle- and low-income countries, 1988–2006)



We then run fixed-effects regressions of the Theil index on a binary liberalization indicator defined by the dates of liberalization (equal to 1 when liberalized) to assess the within-country effect of trade liberalization on the diversification of exports. We use a difference-in-difference specification similar to the one used by Wacziarg and Welch (2008):

$$Theil_{it} = \lambda_i + \delta_t + \phi LIB_{it} + \varepsilon_{it} \quad (1)$$

where $Theil_{it}$ is the Theil index of country i exports in year t ; LIB_{it} a dummy equal to 1 if t is greater than the year of liberalization (defined by Wacziarg and Welch); and 0 otherwise. We introduce both country and year fixed-effects (λ_i and δ_t , respectively). The sample is not restricted to countries that underwent reforms.

The regression for the period 1988–2006 shows a highly significant within-country difference in export diversification between a liberalized and a non-liberalized regime (ϕ reported in table 7.2, column 1), with a coefficient twice higher for middle-income than for low-income countries, confirming the pattern observed in figure 7.5. We also regress equation (1) using the Theil index's decomposition (within-groups versus between-groups, see section 7.2). Results are reported in table 7.2, columns 3–6. Controlling for country and year effects, the results suggest that middle-income countries that undertook trade liberalization reforms have a significantly more diversified structure of exports along the intensive margin. By contrast, low-income countries diversify mostly along the extensive margin. Thus, trade liberalization helps middle-

income countries to consolidate their positions in goods they are already exporting while it helps low-income countries to develop new exports. As the poorest countries are often the most concentrated (see figure 7.3 and section 7.5.2), it is indeed likely that trade liberalization do not increase exports in sectors (often natural resources) in which they already specialize.

Table 7.2: Fixed-effects regressions of diversification index on liberalization status

	Theil		Theil-within		Theil-between	
	(1)	(2)	(3)	(4)	(5)	(6)
Liberalization (LIB)	-0.190*		-0.075		-0.100*	
	(2.0)		(0.8)		(2.8)	
LIB - Middle-Income		-0.241*		-0.271*		0.067
		(2.0)		(2.0)		(0.5)
LIB - Low-Income		-0.138*		0.053		-0.209*
		(1.6)		(0.5)		(2.0)
Number of Obs.	1794		1394		1394	
Number of countries	100		100		100	
Period	1988-2006		1990-2004		1990-2004	
Country fixed effects	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
R ² within	0.39	0.39	0.28	0.29	0.75	0.75

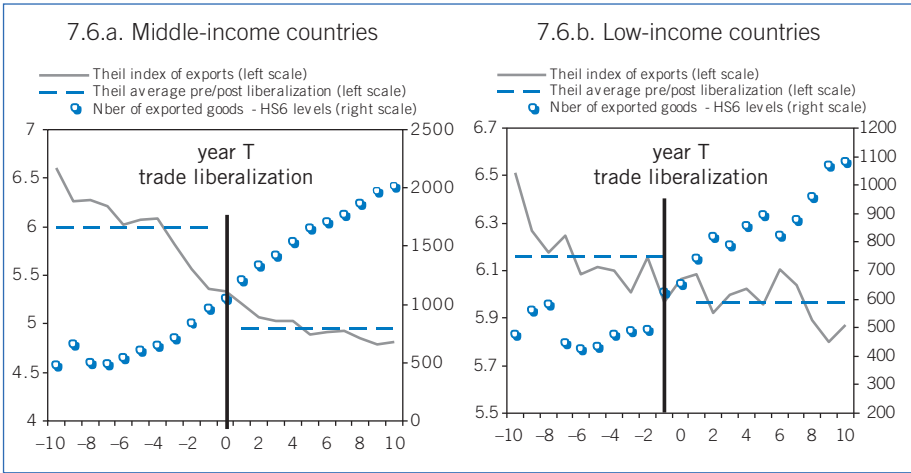
Note: * means a significant coefficient (at 10 per cent level) standard errors in parentheses, heteroscedasticity consistent and adjusted for country clustering.

Figure 7.6 shows the time path of export diversification for an average country before and after liberalization for middle- and low-income countries, respectively. The plain curve shows the Theil index (left-hand scale) and the dotted one shows the number of exported products at the HS6 level (right-hand scale) over a window of ten years before and after liberalization. The sample is made of countries that underwent permanent (non-reversed) liberalizations. For middle-income countries, a strong diversification trend (shrinking Theil index) is apparent over the entire post-liberalization windows, and particularly strong in the five years following liberalization. The figure also suggests an anticipation effect in the three years preceding liberalization. Patterns are less clear in the low-income countries figure.

In order to further examine the timing of export diversification, we follow Wacziarg and Welch (2008) and replace the *LIB* variable with five dummies, each capturing a two-year period immediately before and after the trade-liberalization date *T*. Coefficients on these dummies capture the average difference in the Theil index (and number of exported lines) between the period in question and a baseline period running from sample start to *T*-3.¹⁷ Estimated coefficients (in absolute value) are reported in figure 7.7.

¹⁷ We also run the regression on a larger sample starting at *T*-5, but coefficients on [*T*-5] to [*T*-3] were not significant and did not affect coefficients on other periods.

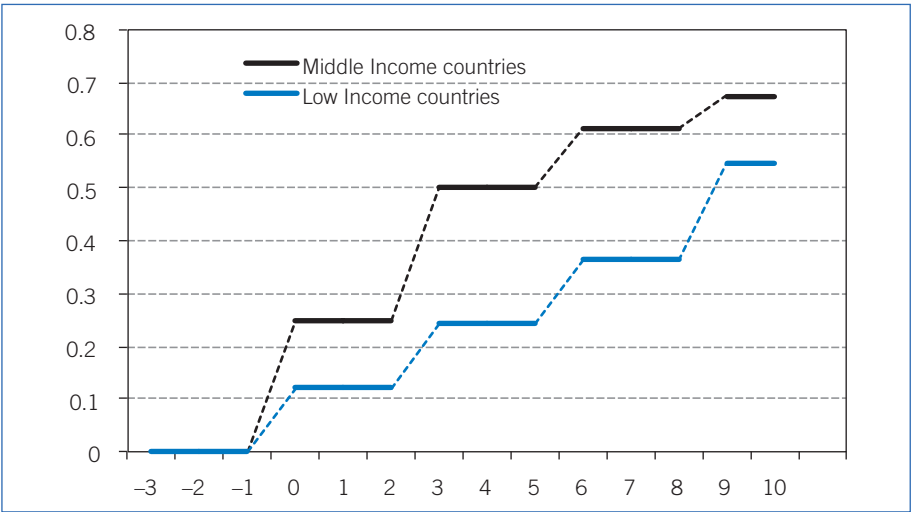
Figure 7.6: Time pattern of export diversification pre- and post-liberalization



Source: Authors' computation. Trade liberalization dates are from Wacziarg and Welch (2008) and Theil index of exports and the number of exported goods from Cadot, Carrère and Strauss-Kahn (2011).

Figure 7.7 shows that the anticipation effect apparent in figure 7.6 disappears in formal tests using the fixed-effects regression, i.e. in the presence of country and year effects. Diversification starts at the date of trade liberalization and proceeds steadily thereafter, as shown by the rising coefficients (in absolute value) on the period dummies.

Figure 7.7: Estimated marginal increase in the export diversification around a trade Liberalization event



7.4.3 *Diversification, spillovers and industrial policy*

The graphs in figure 7.4 highlight a clear statistical association between government supply-side policies, notably the provision of education and infrastructure, and export diversification.

Government provision of infrastructure and education reflects the presence of market failures. As for education, the willingness of employers to provide it is limited, even for vocational training.¹⁸ Reasons include the public-good character of education, the difficulty to retain trained workers, and the footloose nature of many employers in developing countries, which does not encourage social responsibility.

As for road infrastructure, building costs are largely beyond what private-sector users are willing to invest given their public-good nature. Only mining companies are sometimes willing to invest in road infrastructure directly serving their needs, or large plantations in local networks of rural roads. Where governments are unable or unwilling to invest in road infrastructure, transportation costs choke commercial activities, both domestic and international, as Gollin and Rogerson (2010) document in the case of Uganda.¹⁹ As a consequence, only a tiny proportion of crops make it to urban markets and even fewer to international markets, resulting in very concentrated export structures.

Even where roads exist, sometimes transportation services are too expensive for the private sector to provide, in particular in low-density areas. A recent paper by Raballand et al. (2011) reports the results of a randomized experiment in rural Malawi aimed at understanding why rural transportation services are not provided even when rural roads exist. By randomly varying bus fares, they show that bus use is strongly price-sensitive but, most strikingly, that there is no price with positive demand at which costs are covered.²⁰ In the absence of a rural bus service, it is virtually impossible to transport goods (handicrafts, spices and other low-volume items) to the market, reducing the scope of marketable products and income-earning opportunities (in particular for women). Citing other studies that point in the same direction, Raballand et al. (2011) conclude that building roads – a favourite donor activity – does not

¹⁸ As an illustration, the World Bank's Private Sector Competitiveness and Economic Diversification Project in Lesotho has aimed at building workforce skills through the establishment of two worker-training centres in Maseru and Maputsoe. The initiative had both public- and private-sector participation, the management councils in both centres being led by the private sector. But obtaining government funding for the centres has proved a challenge, since only three employers (from Lesotho, South Africa and Malaysia) have expressed interest in participating in their financing.

¹⁹ Gollin and Rogerson (2010) observe that the density of paved roads in Uganda today (16,300 km for a land area of 200,000 km²) is comparable to what the Romans left behind when they evacuated Britain in AD 350 (between 12,000 and 15,000 km of paved roads for a land area of 242,000 km²). As a result, the prices of agricultural products when they reach markets are often more than double the farmgate prices.

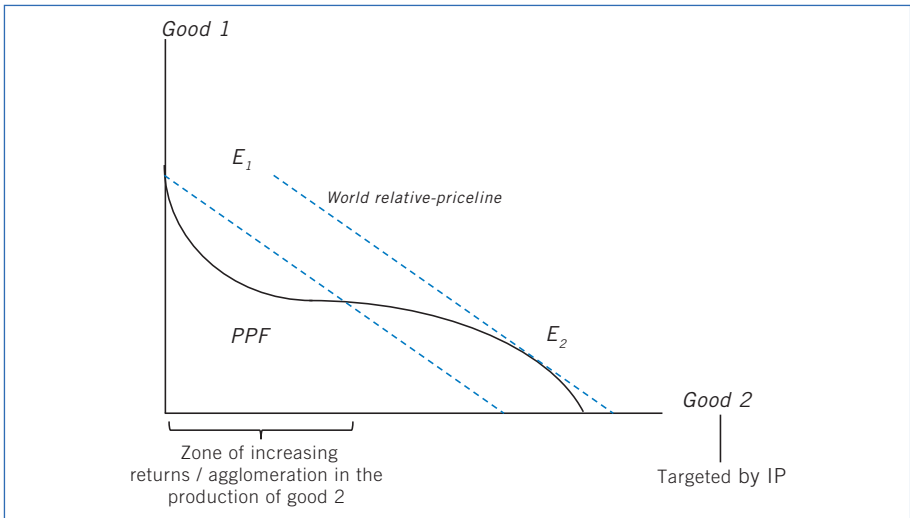
²⁰ Raballand et al. (2011) refrain from estimating a price elasticity of demand, but instead regress the probability that an individual took the bus over the investigation period (July-December 2009) for a fare, which was randomly assigned using a voucher system. When the bus service was free, 47 per cent of the surveyed individuals took the bus at least once. The proportion declined smoothly to reach zero at 500 kwacha (US\$3.57) per ride. Similar results were obtained using the number of rides as the dependent variable.

appear to be enough, by itself, to get farmers to the market. In order to promote diversification at the country and household levels, governments may need to intervene directly in the provision of transportation services, a notion that goes against a philosophy of government retrenchment that has dominated development thinking over the last 30 years.

Other sources of market failure can hamper export diversification. Conceptually, the argument is shown in figure 7.8, where the production-possibility frontier (PPF) between two goods is shown with a convex part, reflecting economies of scale in the production of “good 2” in a certain range (at low levels of production).²¹ This is a classic infant-industry argument. At the relative prices shown by the dotted lines, the economy can find itself stuck at corner equilibrium E_1 where it produces only “good 1” because the curvature of the PPF makes it locally unprofitable to move resources to good 2, even though the economy would be better off at the diversified equilibrium E_2 . In such circumstances, sectorally-targeted industrial policy can have a socially beneficial role to play.

The argument is crucially dependent on the presence of some sort of increasing returns at the industry or cross-industry level. Do these externalities exist outside of development-economics textbooks? Rosenthal and Strange (2004) present a substantial body of evidence in favour of spatial agglomeration externalities. More recently, Alfaro and Chen (2009) show evidence that the location of establishments by multinational companies follows not only “first-nature” determinants (proximity to markets

Figure 7.8: Externalities in a two-good economy

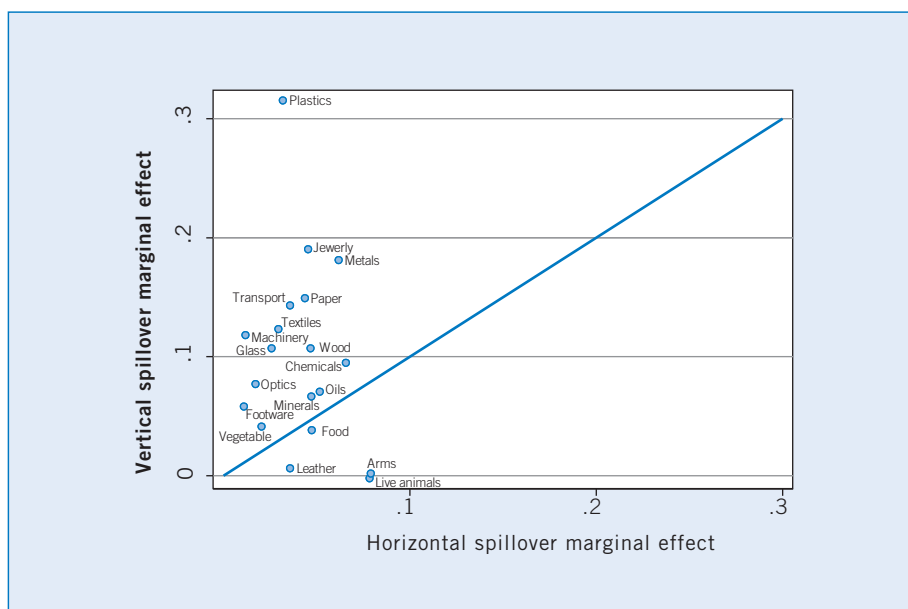


²¹ On this, see Harrison and Rodríguez-Clare (2010), who provide an excellent overview of the literature on industrial policy.

and low production costs) but also “second-nature” ones – pure agglomeration forces.²² Among those, Alfaro and Chen examine the role of labour-market pooling (a larger pool reduces unemployment risk for workers and, therefore, wage premia), capital-equipment linkages (larger pools of capital-intensive industries attract support services), input-output (IO) linkages, and knowledge spillovers between industries measured by cross-citations in patents. They find very strong evidence of capital-equipment linkages and knowledge spillovers in the location of subsidiaries. IO linkages are significant, although weaker. By contrast, evidence of labour-market pooling is weak.

Inter-industry spillovers are also identified empirically by Shakurova (2010), who estimates how the probability of exporting a good depends on previous experience in exporting either similar goods (“horizontal” spillovers) or upstream ones (“vertical” spillovers). Cross-country regressions at the industry level show that the size of those spillovers varies across industries but is, in most cases, statistically significant. Figure 7.9 shows those spillovers in the form of marginal effects for each industry.

Figure 7.9: Vertical and horizontal export spillovers



Source: Adapted from Shakurova (2010).

Note: Marginal effects from a probit regression of export status in product i on export status in product j at $t-1$ on a cross-section of countries. Those shown were significant at 5 per cent or more.

²² Alfaro and Chen (2009) combine geocode software with Dunn and Bradstreet’s worldbase data set, which contains detailed location information on over 41 million establishments, to calculate distances between establishments belonging to different industries (as Alfaro and Chen focus on between-industry agglomeration). Distances are used to estimate actual and counterfactual densities, the difference between the two being the agglomeration index.

Other externalities include information spillovers leading to underinvestment in export entrepreneurship at the extensive margin (Hausmann and Rodrik, 2003). That is, export expansion at the extensive margin reflects a “self-discovery” process whereby export entrepreneurs test the viability of new products on foreign markets. Once they succeed, imitators follow, creating a public-good problem. Spillovers at the extensive margin among exporters of the same country are documented using firm-level data from four African countries by Cadot et al. (2011), who find that the probability of survival of an exporter of good k to country d past the first year rises with the number of exporters of k to d from the same country. Strikingly, the number of exporters of k to d from *other* countries is insignificant, suggesting that the externality is essentially within-country. Interacting this network effect with various measures of dependence on finance suggests that the information spillover may go through domestic credit markets (using competitor performance as a substitute for direct information on export risk) rather than through the direct firm-to-firm imitation effect postulated by Hausmann and Rodrik, although the implications are similar.

If the case for externalities across exporters and industries seems fairly well-established both conceptually and empirically, what governments can do to leverage those externalities is less clear. Harrison and Rodriguez-Clare (2010) give a long list of studies whose gist is that industries supported by government protection in one form or another do not enjoy faster productivity growth. However, all these studies are vulnerable to the endogeneity critique of Rodrik (2007). Namely, if governments support industries to compensate for market failures, slower productivity growth in supported industries may reflect the underlying constraints rather than the effect of (endogenous) industrial policies.

A few case studies identify industries successfully supported by industrial policy. For instance, Hansen, Jensen and Madsen (2003) show how Denmark’s subsidies to wind power (a guaranteed-price scheme for wind power combined with an obligation to buy for power companies that was also adopted in other EU countries, and a favourable tax treatment of investments in wind-turbine manufacturing) have helped create an industry that, by the early 2000s, supplied half the world’s demand for wind turbines. As export sales were not subsidized (although they could possibly be cross-subsidized by Denmark’s four large manufacturers), their growth was suggestive of success. Hansen, Jensen and Madsen indeed show evidence of strong learning economies. They also argue that overall benefits from the industry’s development had, by the early 2000s, outweighed the total cost of the subsidies, although the calculation is complex.

Export promotion has a more uneven record. After reviewing the mixed evidence so far, Lederman, Olarreaga and Payton (2006, 2009) find, on the basis of cross-country evidence, extremely high rates of return on public money invested in export-promotion agencies (EPAs). Some conditions, however, must be fulfilled, including private-sector involvement in agency management. They also find strongly diminishing returns; that is, a little money does a lot of good, but a lot of money does not. A recent impact evaluation of Tunisia’s export-promotion agency by Gourdon et al. (2011) sheds some light on whether export promotion promotes

growth at the intensive or extensive margin. Compared to a control group of firms that did not benefit from export promotion, beneficiary firms expanded at the extensive margin in terms of products and markets. However, overall, their export sales grew faster than those of control-group firms only during the year of the treatment. After one year, they were back to a parallel trajectory. Thus, export promotion seems to foster diversification, but might in the end lead firms to spread themselves too thinly.²³

By and large, it is fair to say that, given the strong empirical evidence in support of the existence of externalities, the case for industrial policy is less easily brushed aside than it was one or two decades ago. But, as Harrison and Rodriguez-Clare (2010) put it, “the key question is whether [industrial policy] has worked in practice”. In this regard, they cite countless studies showing that infant-industry promotion through trade-restricting measures does not pass the classic tests of industrial policy’s worthiness.²⁴ As for trade-promoting measures, such as tax breaks for multinational investors, they are costly to public budgets and raise fairness issues. For instance, the list of concessions offered by Costa Rica to Intel in the late 1990s strikes one as transfers from taxpayers in a poor country to shareholders in a rich one – a proposition of dubious ethical appeal even if it passes the Mill and Bastable tests. Moreover, competition between potential host countries for attracting multinational subsidiaries makes tax breaks a negative-sum game between developing countries, even if those tax breaks are trade-enhancing and pass the Mill and Bastable tests at the national level.

7.5 EXPORT DIVERSIFICATION, GROWTH AND EMPLOYMENT

We now look at export diversification as a potential determinant of growth – diversification measures become explanatory rather than a dependent variable. We first briefly discuss the causality between export diversification and productivity. We then review the existing evidence on the relationship between initial diversification and subsequent growth, starting with the widely discussed “natural resource curse”. We then focus on the link between export diversification and employment.

7.5.1 *Diversification and productivity: An issue of causality*

As seen earlier, Ricardian theory posits that causation runs from productivity to trade patterns and not the other way around. In Melitz (2003) models, causation may run both ways depending on whether we look at the firm or aggregate level. Firms are

²³ Volpe and Carballo (2008) also found benefits to be stronger at the extensive margin in a rigorous impact evaluation of export promotion in Peru.

²⁴ An industrial policy passes the “Mill test” if the beneficiary industry becomes profitable without support after some period of time. It passes the “Bastable test” if the societal benefits of industrial support outweigh its costs (fiscal and other).

heterogeneous in productivity levels, and only the most productive export. At the firm level, causation thus runs only one way, from productivity to export status, like in Ricardian models, as productivity draw is distributed across firms as an i.i.d. random variable and is not affected by the decision to export, be it through learning or any other mechanism.

At the aggregate level, however, causation can run either way in a Melitz model, depending on the nature of the shock. To see this, suppose first that the initial shock is a decrease in trade costs. Melitz's model and recent variants of it (for example, Chaney, 2008; Feenstra and Kee, 2008) show that more firms will export, which will raise export diversification since in a monopolistic-competition model each firm sells a different variety. But low-productivity firms will exit the market altogether, pushing up aggregate industry productivity – albeit, again, by a selection effect. In this case, trade drives aggregate productivity.

Suppose now that the shock is an exogenous – for example, technology-driven – increase in firm productivity across the board, i.e. affecting equally all firms and all sectors. For a given trade cost, only those firms with high productivity draw can bear the cost of exporting. *Ceteris paribus*, the productivity shock will raise the number of firms with high enough productivity, and thus the number of active export lines. In this case, productivity will drive trade.

The pre-Melitz empirical literature on the productivity-export linkage at the firm level was predicated on the idea that firms learn by exporting (see, for example, Haddad, 1993; Aw and Hwang, 1995; Tybout and Westbrook, 1995). However, Clerides, Lach and Tybout (1998) argued theoretically that the productivity differential between exporting and non-exporting firms was a selection effect, not a learning one, and found support for this interpretation using plant-level data in Colombia, Mexico and Morocco. Subsequent studies (Bernard and Jensen, 1999; Eaton, Kortum and Kramarz, 2004, 2007; Helpman, Melitz and Yeaple, 2004; Demidova, Kee and Krishna, 2006) confirmed the importance of selection effects at the firm level. The most recent literature extends the source of heterogeneity to characteristics other than just productivity; for instance, several recent papers consider the ability to deliver quality (Johnson, 2008; Verhoogen, 2008; or Kugler and Verhoogen, 2008). Hallak and Sivadasan (2009) combine the two in a model with multidimensional heterogeneity where firms differ both in their productivity and in their ability to deliver quality. They find, in conformity with their model, that the empirical firm-level determinants of export performance are more complex than just the level of productivity.

At the aggregate level, most of the literature so far (for example, Klinger and Lederman, 2006; or Cadot, Carrère and Strauss-Kahn, 2011) has regressed export diversification (i.e. left-hand side of the equation) on income (i.e. the right-hand side) and found a U-shaped relationship between export concentration and GDP per capita. This can be interpreted as supporting the income-drives-export-diversification conjecture, as the hypothetical reverse mapping, from diversification to income, would, in a certain range, assign two levels of income (a low one and a high one) to the same level of diversification. While multiple equilibria are common in economics, the rationale for this particular one would be difficult to understand. Feenstra and

Kee (2008) were the first to test empirically the importance of the reverse mechanism – from export diversification to productivity. They do so by estimating simultaneously a GDP function derived from a heterogeneous-firm model and a TFP equation where the number of export varieties (i.e. of exporting firms) is correlated with aggregate productivity through the usual selection effect. On a sample of 48 countries, they find that the doubling of product varieties observed over 1980–2000 explains a 3.3 per cent cumulated increase in country-level TFP. Put differently, changes in export variety explain 1 per cent of the variation in TFP across time and countries. The explanatory power of product variety is particularly weak in the between-country dimension (0.3 per cent). Thus, product variety does not seem to explain much of the permanent TFP differences across countries, but an increase in export diversification – for example, due to a decrease in tariffs – seems to trigger non-negligible selection effects. To recall, this selection effect means that the least efficient firms exit the domestic market when trade expands, raising the average productivity of remaining firms. Still, even in the within-country dimension, two-thirds of the variation in productivity is explained by factors other than trade expansion.

While the determinants of diversification have been studied in the previous section, we now turn to the other side of the causality and investigate the effect of export diversification on growth, starting with the well-known “natural resource curse”.

7.5.2 The “natural-resource curse”

The “natural resource curse” hypothesis found support with Sachs and Warner (1997) empirical findings that a large share of natural-resource exports in GDP is statistically associated, *ceteris paribus*, with slow growth. Since then the discussion on the existence of such a curse has been fierce. Building on Sachs and Warner (1997), Auty (2000, 2001) also found a negative correlation between growth and natural-resource exports concentration. Prebisch (1950) provides a set of possible explanations for this phenomenon: deteriorating terms of trade, excess volatility, and low productivity growth. A host of other growth-inhibiting syndromes associated with natural-resource economies are discussed in Gylfason (2008). As we will see, each potential channel has been a subject of controversy; moreover, the very conjecture holds only when looking at natural-resource dependence, which is endogenous to a host of influences. Endowments of natural resources, by contrast, do not seem to correlate negatively with growth. In this section, we thus review the main arguments for and against the conjecture that concentrating on a few natural resources leads to lower growth.

The notion that the relative price of primary products has a downward trend is known as the Prebisch-Singer Hypothesis. Verification of the Prebisch-Singer hypothesis was long hampered by a (surprising) lack of consistent price data for primary commodities, but Grilli and Yang (1988) constructed a reliable price index for 24 internationally traded commodities between 1900 and 1986. The index has later been updated by the IMF to 1998. The relative price of commodities, calculated as the ratio of this index to manufacturing unit-value index, indeed showed a downward log-linear trend of -0.6 per cent per year, confirming the Prebisch-Singer hypothesis.

However, Cuddington, Ludema and Jayasuriya (2007) showed that the relative price of commodities has a unit root, so that the Prebisch-Singer hypothesis would be supported by a negative drift coefficient in a regression in first differences, not in levels (possibly allowing for a structural break in 1921). But when the regression equation is first-differenced, there is no downward drift anymore. Thus, in their words, “[d]espite 50 years of empirical testing of the Prebisch-Singer hypothesis, a long-run downward trend in real commodity prices remains elusive” (page 134).

The second argument in support of the natural resource curse has to do with the second moment of the price distribution. Easterly and Kraay (2000) regressed income volatility on terms-of-trade volatility and dummy variables marking exporters of primary products. The dummy variables were significant contributors to income volatility over and above the volatility of the terms of trade. Jansen (2004) confirms those results with variables defined in a slightly different way. Combining these results with those of Ramey and Ramey (1995), who showed that income volatility is statistically associated with low growth, suggests that the dominance of primary-product exports is a factor of growth-inhibiting volatility. Similarly, Collier and Gunning (1999), Dehn (2000) and Collier and Dehn (2001) found significant effects of commodity price shocks on growth.

However, these results must be nuanced. Using vector autoregressive (VAR) models, Deaton and Miller (1996) and Raddatz (2007) showed that although external shocks have significant effects on the growth of low-income countries, together they can explain only a small part of the overall variance of their real per-capita GDP. For instance, in Raddatz (2007), changes in commodity prices account for a little more than 4 per cent of it, shocks in foreign aid about 3 per cent, and climatic and humanitarian disasters about 1.5 per cent each, leaving an enormous 89 per cent to be explained. Raddatz’s interpretation is that the bulk of the instability is home-grown, through internal conflicts and economic mismanagement. Although this conclusion may be a bit quick (it is nothing more than a conjecture on a residual), together with those of Deaton and Miller, Raddatz’s results suggest that the effect of commodity-price volatility on growth suffers from a missing link: although it is a statistically significant causal factor for GDP volatility and slow growth, it has not been shown yet to be quantitatively important.

A third line of arguments runs as follows. Suppose that goods can be arranged along a spectrum of something that we may loosely think of as technological sophistication, quality or productivity. Hausmann, Hwang and Rodrik (2005) proxy this notion by an index they call PRODY. For each good, this index is the weighted average of the income of countries that export that good where the weight corresponds to a Balassa’s index of revealed comparative advantage for each good-country pair. The central idea is that a good mainly exported by highly developed countries has higher technology or quality content. They show that countries with a higher average initial PRODY (across their export portfolio) have subsequently stronger growth, suggesting, as they put it in the paper’s title, that “what you export matters”. As primary products typically figure in the laggards of the PRODY scale, diversifying out of them may accelerate subsequent growth. In addition, according to the so-called

“Dutch disease” hypothesis (see references in Sachs and Warner, 1997; or Arezki and van der Ploeg, 2007) an expanding primary-product sector may well cannibalize other tradable sectors through cost inflation and exchange-rate appreciation. Thus, natural resources might by themselves prevent the needed diversification out of them. Dutch-disease effects can, in turn, be aggravated by unsustainable policies such as excessive borrowing (Manzano and Rigobon, 2001, in fact argue that excessive borrowing is more of a cause for slow growth than natural resources – more on this below).

However, Hausmann, Hwang and Rodrik’s empirical exercise must be interpreted with caution before jumping to the conclusion that public policy should aim at structural adjustment away from natural resources. Using a panel of 50 countries between 1967 and 1992, Martin and Mitra (2006) found evidence of strong productivity (TFP) growth in agriculture – in fact, higher in many instances than that of manufacturing. For low-income countries, for instance, average TFP growth per year was 1.44 per cent to 1.80 per cent per year (depending on the production function’s functional form) against 0.22 per cent to 0.93 per cent per year in manufacturing. Results were similar for other country groupings. Thus, a high share of agricultural products in GDP and exports is not necessarily by itself (i.e. through a composition effect) a drag on growth.

Other conjectures for why heavy dependence on primary products can inhibit growth emphasize bad governance and conflict. Tornell and Lane (1999), among many others, argued that deficient protection of property rights would lead, through a common-pool problem, to over-depletion of natural resources. Many others, referenced in Arezki and van der Ploeg (2007) and Gylfason (2008) put forward various political-economy mechanisms through which natural resources would interact with institutional deficiencies to hamper growth. In a series of papers, Collier and Hoeffler (2004; 2005) argued that natural resources can also provide a motive for armed rebellions and found, indeed, a statistical association between the importance of natural resources and the probability of internal conflicts.

However, recent research has questioned not just the relevance of the channels through which natural-resource dependence is supposed to inhibit growth, but the very existence of a resource curse. The first blow came from Manzano and Rigobon (2001) who showed that, once excess borrowing during booms is accounted for, the negative correlation between natural-resource dependence and growth disappears. However, this could simply mean that natural-resource dependence breeds bad policies, which is not inconsistent with the natural-resource curse hypothesis.

More recently, Brunnschweiler and Bulte (2007) argued that measuring natural-resource dependence by either the share of primary products in total exports or that of primary-product exports in GDP makes it endogenous to bad policies and institutional breakdowns, and thus unsuitable as a regressor in a growth equation. To see why, assume that mining is an “activity of last resort”; that is, when institutions break down, manufacturing collapses but well-protected mining enclaves remain relatively sheltered. Then, institutional breakdowns will mechanically result in a higher ratio of natural resources in exports (or natural-resource exports in GDP), while being also associated with lower subsequent growth. The correlation between natural-resource

dependence and lower subsequent growth will then be spurious and certainly not reflect causation. In order to avoid endogeneity bias, growth should be regressed on (exogenous) natural-resource abundance. The stock of subsoil resources, on which the World Bank collected data for two years (1994 and 2000), provides just one such measure. But then instrumental-variable techniques yield no evidence of a resource curse; on the contrary, natural-resource abundance seems to bear a positive correlation with growth. Similarly, Brunnschweiler and Bulte (2009) find no evidence of a correlation between natural-resource abundance and the probability of civil war.²⁵ Thus, it is fair to say that at this stage the evidence in favour of a resource curse is far from clear-cut.

7.5.3 A “concentration curse”?

Notwithstanding the role of natural resources, it is possible that export concentration per se has a negative effect on subsequent growth. Lederman and Maloney (2007) found a robust negative association between the initial level of a Herfindahl index of export concentration and subsequent growth. Dutt, Mihov and van Zandt (2009) also found that export diversification correlates with subsequent GDP growth, especially if the initial pattern of export specialization is close to that of the United States.

The idea that all countries should strive to imitate the US export pattern as a recipe for growth sounds slightly far-fetched and would probably not be well received as policy advice in developing countries. But there are additional difficulties with the notion of a “curse of concentration”. First, if there is one, we still do not know why, as many of the arguments that could support it were questioned in the debate on the natural-resource curse (for example, the transmission of terms-of-trade volatility to income volatility). Second, we already saw in our discussion of Easterly, Reshef and Schwenkenberg (2009) in section 7.3 that export concentration is a fact of life. More than that: as they argued, concentration may well be the result of success, when export growth is achieved by what they call a “big hit”. Costa Rica is an example. Thanks to a generally favourable investment climate (in addition to the specific tax breaks it extended), it was able to attract Intel in the late 1990s and became one of the world’s major exporters of micro-processors. But, as a result, microprocessors now dwarf all the rest – including bananas – in Costa Rica’s exports, and concentration has gone up, not down.

7.5.4 Export processing zones (EPZs), export diversification and employment

Notwithstanding the caveats above, export diversification is widely seen by governments not just as insurance against the risks associated with excessive concentration,

²⁵ However, Arezki and van der Ploeg (2007) still found evidence of a resource curse for relatively closed economies when instrumenting for trade à la Frankel and Romer (1999) and for institutions à la Acemoglu, Johnson and Robinson (2001). The debate is thus not quite closed.

but also as a way of fostering manufacturing employment growth. One of the main policy tools used for this objective is the creation of export processing zones (EPZs).²⁶

EPZs have spread rapidly over the last two decades. The ILO's EPZ database counted 176 of them in 47 countries in 1986; by 2006, there were 3,500 in 130 countries. Overall, they account for 68 million jobs worldwide, a sizeable figure which, however, represents only a very small share of global employment.

Table 7.3 shows that the share of national workforces employed in EPZs is above 1 per cent only in the Asia and the Pacific region (which accounts for 61 million of the 68 million worldwide in EPZ employment), in the Americas, and in the Middle East and North Africa (MENA) region.

Table 7.3: Direct employment in EPZs, 2007

	Direct employment (millions)	% of nat. employment
Global	68.441	0.21
Asia & Pacific	61.089	2.30
Americas	3.084	1.15
Western Europe	0.179	0.00
CEECs & Central Asia	1.590	0.00
MENA	1.458	1.59
Sub-Saharan Africa	1.040	0.20

Source: World Bank (2008), table 15.

Outliers include Mauritius, whose EPZ accounts for 24 per cent of its workforce, the United Arab Emirates (UAE) (25 per cent) and Tunisia (8 per cent). In addition to generating relatively modest increases in employment, EPZs have sometimes been criticized for relying on anti-union regulations and lax labour standards to attract investors (see, for example, ILO, 2003; or ICFTU, 2003). For instance, collective bargaining and freedom of association are restricted in EPZs in the Dominican Republic (a highly successful one in terms of employment), as well as Bangladesh, Egypt, Nigeria, Pakistan, Panama and Sri Lanka. Strikes are banned in the EPZs of Bangladesh, Namibia, Nigeria, Panama, Turkey and Zimbabwe (World Bank, 2008). Other EPZs, however, show a less labour-hostile set up; for instance, those of the Philippines, Singapore, and Trinidad and Tobago have labour representatives on their boards. In terms of wages, fragmentary evidence suggests that they tend to be higher inside EPZs than outside (Kusago and Tzannatos, 1998).

²⁶ Export processing zones (EPZs) are also known under various other names, such as "free zones", "special economic zones", etc. For simplicity, this chapter uses "EPZ" throughout to designate all such zones, irrespective of their precise legal form.

Beyond their record on employment creation and labour relations, Farole (2010) notes that EPZs have a highly uneven record as tools of industrial policy. Few of them have led to substantial skill development, the most notable exception being Malaysia's Penang Skills Development Centre. In Africa, in particular, EPZs do not seem to have played the role of catalyst for foreign investment that authorities hoped for them. In essence, EPZs were viewed by governments – and sometimes donors – as ways of cutting through “impossible reforms”. When reforms aimed at the elimination of red tape, high tariff or non-tariff barriers on intermediate products, or predatory taxes seemed impossible, it was hoped that fencing exporters in a sort of good-governance enclave could offer an attractive alternative. But, as Farole notes, EPZs have tended to flourish in countries that were otherwise improving governance and moving forward with reforms. In countries plagued by bad governance and political instability – in particular, in sub-Saharan Africa – EPZs failed to shelter investors and consequently never really took off.

Farole's cross-country regression of EPZ export performance on EPZ characteristics showed little correlation with labour costs (suggesting that “social dumping” was a poor way of luring investors) and even with the size of fiscal incentives; instead, performance seemed to correlate with the EPZs' infrastructure and logistics quality.

The main lesson from Farole's study (whether from the econometrics or from the narrative based on case studies) is that EPZs are no substitute for domestic reforms. Far from being sheltered enclaves, they reflect the general quality of the host country's business environment. Thus, countries whose export portfolios are dominated by a few primary products can hardly count on EPZs alone to generate export diversification. Ironically, the failure of Africa's EPZs to generate sizeable employment in the garment sector prompts Farole to recommend targeting natural-resource based sectors for EPZ development in Africa, thus eliminating the possibility of export diversification.

7.6 IMPORT DIVERSIFICATION, EMPLOYMENT AND INDUSTRIAL POLICIES

Trade diversification concerns imports at least as much as exports. With trade liberalization, countries increase their imports at the intensive margin (i.e., an increase in the size of already existing imports) but they also import new goods/varieties. This leads to a higher import diversification, which has important implications for aggregate welfare, productivity, employment and inequality. The next sections focus on these areas.

7.6.1 *Gains from diversity and “import competition”*

Following Krugman's (1979) seminal paper, several theoretical papers include a “love-for-variety” element capturing the gains from trade resulting from the imports of new varieties (i.e. an increase in import diversification). Empirical work assessing these gains remains scarce, however. Broda and Weinstein (2006) do just this, showing that,

over the 1972–2001 period, the number of varieties (products $\times$ origin countries) imported by the United States has more than trebled. Half of the increase is caused by an increase in the number of products, the other half resulting from an increase in origin countries. The authors find that although consumers have a low elasticity of substitution across similar goods produced in different countries, the welfare gains due to increased product diversity is small. They show that consumers are willing to spend only 2.6 per cent of their income to have access to these extra varieties; put differently, US welfare is 2.6 per cent higher than otherwise due to the import of new varieties. Using Indian data over the 1989–2003 period, Goldberg et al. (2010) also find that lowering input tariffs increases welfare through a rise in the number of imported varieties. Thanks to the new varieties, the price index is on average 4.7 per cent lower per year than it would be otherwise.

A rise in diversification of imports may also lead to productivity gains through “import competition”. As a country imports new products from abroad, local producers of close substitute have to improve in order to stay competitive. Productivity increases through this competitive effect but also through rationalization as less productive firms are forced to exit. For example, using Chilean data for 1979–86, Pavcnik (2002) shows that following trade liberalization productivity of plants in the import competing sector increased by 3 to 10 per cent more than in other sectors of the economy. Pavcnik finds evidence of both an increase in productivity within plants and a reallocation of resources from the less to the most efficient producers. Other studies on developing countries include Levinsohn (1993) for Turkey; Harrison (1994) for the Ivory Coast; Tybout and Westbrook (1995) for Mexico; Krishna and Mitra (1998) for India; and Fernandes (2007) for Colombia. All these papers find a positive effect of increased import competition on domestic productivity. Trefler (2004) shows that Canadian plants’ labour productivity increased by 14 per cent following the Canada-US free trade agreement. It also provides industry level evidence for those industries that experience the biggest decline in tariffs. Productivity increases by 15 per cent (half of this coming from rationalization) while employment decreases by 12 per cent (5 per cent for manufacturing as a whole). Trefler’s paper is one of the few to consider both the impact on productivity and on employment of lower tariffs through more diversified imports. The paper points out the issue of adjustment costs, which encompasses unemployment and displaced workers in the short run.²⁷ It is worth mentioning that Trefler finds a rise in aggregate welfare.

Another strand of literature focuses on productivity gains from increasing varieties of imported inputs. In such cases, most gain is measured in terms of productivity growth realized through lower input prices, access to higher quality of inputs and access to new technologies embodied in the imported varieties. Early models from Ethier (1982), Markusen (1989) or Grossman and Helpman (1991) provide such evidence. Increased import of input may also impact the labour market as varieties produced abroad may substitute for local labour and/or may require specific labour

²⁷ See the discussion in chapter 6 of this volume.

skills in order to be processed. The next sections provide empirical findings on these features, studying in turn the effect of increased import diversification on productivity, employment and inequalities.

7.6.2 Impacts of imported inputs on productivity and employment

As evidenced in Hummels, Ishii and Yi (2001), Yi (2003) or Strauss-Kahn (2004) the share of imported inputs in production has increased drastically over the past 30 years (e.g. Hummels Ishii and Yi find an increase of 40 per cent between 1970 and 1995). Amador and Cabral (2009) show that this phenomenon is not specific to developed countries but also concerns developing countries such as Malaysia, Singapore or China. This recent pattern of trade reflects the increased ability of firms to “slice the value chain” and locate different stages of production in different countries thanks to reduced transportation and communication costs. Micro-level studies, such as the one listed below, also provide evidence of such an increase in the use of imported intermediate goods and therefore of an increased diversification in imported inputs. For example, Goldberg et al. (2008) find that imported inputs increased by 227 per cent from 1987 to 2000 in India while imported final goods rose by 90 per cent over the period. How does this increased diversification impact the domestic economy? Does it entail technological transfer and productivity growth? What is its impact on employment and exports? These are the questions we now address.

Halpern, Koren and Szeidl (2009) suggest two mechanisms by which intermediate goods affect productivity: access to higher quality and better complementarity of inputs. The complementarity channel encompasses elements of gains from variety and of learning spillovers between foreign and domestic goods. Variety gains come from imperfect substitution across goods, as in the love-of-variety setting of Krugman (1979) and Ethier (1982) and as evidenced by Broda and Weinstein (2006). Keller (2004) states that technological spillovers occur as producers of final goods learn from the technology embodied in the intermediate goods through careful study of the imported product (the blueprint).

Empirical studies analysing the effect of an increase in imported inputs on productivity started in the early 1990s and are still ongoing with new econometric techniques and firm-level data. The early works of Coe and Helpman (1995) and Coe, Helpman and Hoffmaister (1997) find that foreign knowledge embodied in imported inputs from countries with larger R&D stocks has a positive effect on aggregate total factor productivity. Keller (2002) shows that trade in differentiated intermediate goods is a significant channel of technology diffusion. He finds that about 20 per cent of the productivity of a domestic industry can be attributed to foreign R&D, accessed through imports of intermediate goods. Using plant-level data for Indonesia for 1991 to 2001, Amiti and Konings (2007) disentangle the impact of a fall in tariff on output from a fall in tariff on input. They find that a decrease in input tariffs of 10 percentage points increases productivity by 12 per cent in importing firms, whereas non-importing firms benefit by only 3 per cent, suggesting productivity gains through technology effects embodied in the imported inputs rather than through import price

effects.²⁸ Kasahara, and Rodrigue (2008) use Chilean manufacturing plant data from 1979 to 1996 and find a positive and immediate impact of increased use of imported inputs on importers' productivity. They also provide some evidence of learning by importing (i.e. past imports positively impacting current productivity). Muendler (2004), however, does not find a substantial impact of increased use of imported inputs on productivity for Brazil in the early 1990s. Loof and Anderson (2008) use a database of Swedish manufacturing firms over an eight-year period (1997-2004) and find that the distribution of imports across different origin countries matters (i.e. productivity is increasing in the G7-fraction of total import). Bas and Strauss-Kahn (2011) distinguish varieties imported from developed and developing countries and find a similar result. By and large, empirical studies thus evidence that diversification of imported inputs increases the productivity of domestic firms.

Although productivity gains may occur through different channels: increased quality and/or complementarity, very few papers to date analyse the relative contribution of these mechanisms. Halpern, Koren and Szeidl (2009) stands as an exception. The authors use a panel of Hungarian firms from 1992 to 2003 to examine the quality and variety channel (imported inputs are assumed to be imperfect substitutes for domestic inputs), through which imports can affect firm productivity.²⁹ They find that imports lead to significant productivity gains, of which two-thirds are attributed to the complementarity argument and the remainder to the quality argument. Obviously, these two mechanisms have different implications on the economy. When quality is important, an increase in imported inputs entails large import substitution, hurting domestic intermediate goods producers and thereby employment. By contrast, when complementarities matter, an increase in imported inputs affects the demand for domestic goods much less, because they must be combined with foreign goods to maximize output. Thus, employment is barely impacted.

Diversification in imports of intermediate goods may also affect the number of goods produced domestically (diversification in production) and exported (diversification in exports). Kasahara and Lapham (2006) extend the Melitz model to incorporate imported intermediate goods. In their model, productivity gains from importing intermediates (through the increasing returns to variety in production) may allow some importers to start exporting. Importantly, because imports and exports are complementary, import protection acts as export destruction. Goldberg et al. (2010) show that imports of new varieties of inputs lead to a substantial increase in the number of domestic varieties produced. The paper provides evidence that the growth in product scope results from the access to new varieties of imported inputs rather than the decrease in the import price index for intermediate products. Finally, Bas and Strauss-Kahn (2011) provide robust evidence of the role of an increase in

²⁸ Interestingly, the effect of a decrease in input tariffs is much larger (more than twice as large) than the one found with a decrease in output tariffs.

²⁹ Their model includes a term related to the number of intermediate imported goods in the production function, which reflects the complementarity channel.

imported intermediate inputs on the number of varieties exported. The effect occurs through an increase in firms' TFP.

Empirical works to date thus confirm that an increase in imported input diversification raises productivity. The increase in productivity results from better complementarity of imported inputs with domestic varieties and learning effects of foreign technology. The increased diversification in imported inputs also entails an increase in the number of domestic varieties produced and exported. It therefore impacts greatly the economic activity. Concerning the effect of increased diversification on employment, the evidence is scarce. As far as we know, no study analyses the impact of imported input diversification on the labour market. Productivity in most studies is measured as total factor productivity and is therefore X-neutral (no impact on employment through variation of the input mix).

More generally, one may wonder how productivity gains affect employment. Unfortunately, and as is common in the literature, there is no clear-cut answer to this question. The seminal work by Gali (1999) finds that productivity gains resulting from positive technology shocks reduced hours worked for the United States and several other G7 countries, except for Japan. While these findings were reinforced by consecutive studies (for example, Gali, 2004; Basu, Fernald and Kimball, 2006; or Francis and Ramey, 2005), other studies have challenged these views, primarily on methodological grounds, finding positive correlations of hours worked with technology shocks. These studies include Christiano, Eichenbaum and Vigfusson (2003), Uhlig (2004) and Chang and Hong (2006). In a nutshell, and apart from the different specifications used in the papers, the impact on employment seems to depend on whether labour productivity or TFP is considered, and on the time lag (i.e. short-run and long-run effects differ). It also varies widely across industries (see Chang and Hong, 2006). In the long run the positive effect of productivity gains on employment seems predominant (for example, this result is also found in the pro-contractionary paper of Basu, Fernald and Kimball, 2006). Concerning the measure of productivity, a negative correlation between increased labour productivity and hours worked is common to most studies. As explained in Chang and Hong (2006), labour productivity reflects change in input mix as well as improved efficiency. Thus, changes in input prices affecting the material-labour ratio increase labour productivity, whereas TFP is unchanged. How can we use this information in our context? As seen above, the increased diversification of imports affects productivity mostly through the channels of better complementarity and learning spillovers. The channel of decreased intermediate input prices leading to increased labour productivity, and consequently decreased employment, is far less important.

7.6.3 Productivity gains and absorptive capacities

The effect of an increase in imported input diversity on productivity is likely to depend on the level of the absorptive capacities of the importing country. Human capital and spending in R&D stand out as the main absorptive capacities in term of adoption and integration of foreign technologies into domestic production process

(see Keller, 2004; or Eaton and Kortum, 1996, for early work on the topic). Using a database of 22 manufacturing industries in 17 countries for the 1973–2002 period, Acharya and Keller (2007) find that imports are a major channel of international technology transfer. They show that some countries benefit more from foreign technology than others and assert that this suggests an important difference in absorptive capacity. Similarly, Serti and Tomasi (2008) find that importers sourcing from developed countries are more capital-intensive and skill-intensive than firms buying only from developing countries. This may reflect the importance of absorptive capacities, or may be a consequence of “learning by importing”.

One important paper on the topic is Augier, Cadot and Dosis (2009). The paper not only evaluates the impact of increased imports on firms’ productivity, but it also explores the importance of firms’ absorptive capacity in terms of their ability to capture technologies embodied in foreign imports. Importantly, the paper considers imported inputs but also imports in capital equipment, which represents another channel through which technology may spill. Augier, Cadot and Dosis (2009) use a panel of Spanish firms from 1991 to 2002, which includes information on the proportion of skilled labour per firm. As mentioned above, such variables may proxy for absorptive capacities. Firms with a share of skilled labour that is 10 per cent above the average experience a productivity gain of 9 percentage points in the first two years after they start importing and of 7 percentage points in the following year. As these results are much higher than those found with lower-skilled labour-intensive firms, firms’ heterogeneity in absorptive capacity seems to affect greatly the contribution of imported input and equipment in increasing productivity.

Further research exploring the role of absorptive capacity in capturing technology embodied in new imported varieties is needed (looking, for example, at the role of R&D spending, the quality of infrastructures or institutions). The evidence so far, however, points out the importance of country/industry absorptive capacities in capturing the positive impact of imported input diversification on productivity.

7.6.4 Offshoring and wages

Rising intermediate imports may impact income inequality between skilled and unskilled workers if it reflects a substitution of domestic labour by foreign labour for cost purposes. A first wave of studies considering this issue focused on manufacturing firms. It included: Feenstra and Hanson (1996, 1999) for the United States; Egger and Egger (2003) for Austria; Hijzen, Görg and Hine (2005) for the United Kingdom; or Strauss-Kahn (2004) for France. These papers investigate the impact of rising intermediate imports on the relative demand for skilled versus unskilled workers, and the skill premium. All evidenced that international sourcing had a large and significant impact on relative wages and/or employment, the growth in imported inputs accounting for 11 per cent to 30 per cent of the observed increase in the skill premium.

More recent literature has looked at service offshoring, a new feature of international trade. Amiti and Wei (2006) show that imported service inputs from United States manufacturing firms have grown at an annual rate of 6 per cent over the period

1992–2000, but they find little impact on employment. This might be because: (i) their measure of employment is too broad, as sourcing in services may affect the less-skilled workers among the skilled; and (ii) in countries with relatively flexible labour markets, such as the United States or United Kingdom, the bulk of the adjustment is on wages rather than employment. Indeed, using household-level panel data combined with industry-level data on imported services inputs over 1992–2004, Geishecker and Gorg (2008) found a positive impact of service outsourcing on the skill premium.

How does the increase in imported inputs by developed countries affect inequalities in the developing world? Traditional Heckscher-Ohlin trade theory and its corollary (the Stolper-Samuelson theorem) posits that developed countries import goods that are relatively intensive in factors they do not have abundantly (i.e. imports are relatively unskilled-labour intensive). This should benefit unskilled workers in the exporting developing country relative to skilled workers. Thus, inequalities in developing countries should decrease. However, most of the empirical evidence goes the other way (see, for example, Arbache, Dickerson and Green, 2004, for Brazil; Attanasio, Goldberg and Pavcnik, 2004, for Colombia; Berman and Machin, 2000, for 14 low- and middle-income countries; Gorg and Strobl, 2002, for Ghana; Hanson and Harrison, 1999, for Mexico; or Robbins and Gindling, 1999, for Costa Rica). Several channels have been proposed to explain the increased wage gap in developing countries. Feenstra and Hanson (1996; 1997), as well as Zhu and Trefler (2005), explain that products characterized as unskilled-labour intensive by developed countries may appear skilled-labour intensive from a developing country's perspective, hence increasing the relative demand for skilled labour. Similarly, Xu (2003) shows that, by expanding a developing country's export set, trade can raise wage inequality. Other studies (for example, Yeaple, 2005; or Verhoogen, 2008) argue that exporting to developed countries entails quality upgrading and adoption of new technologies that could explain the increased demand in skilled labour and increased wage inequality in developing countries. Thus, by and large, the increased diversification in imported inputs by developed countries entails an increase in inequality between skilled and unskilled workers in the developing world. One comment and a policy recommendation still have to be made. First, the increased inequality in developing countries can also be widely attributed to skill-biased technological change (for example, personal computers, automated assembly lines, and so on) that touches developed as well as developing countries (although mainly through international transfer of technology for the latter) and allows important productivity gains. In terms of policy, investment in education seems primordial in order to supply sufficient skilled labour and thereby reduce the wage gap between skilled and unskilled workers.

7.7 CONCLUSIONS

To sum up: poor countries have, on average, undiversified exports. As they grow, they diversify, then re-concentrate at higher income levels. The extensive margin (new products) dominates the action in terms of diversification, but the intensive margin

(higher volumes) dominates the action in terms of export growth. Thus, if governments are ultimately interested in export (and employment) growth, the intensive margin appears to be a better bet. The reason for this is that there is enormous churning, so that many of today's new products are tomorrow's failed products.

The direction of causation between income and diversification is unclear, perhaps because of the observation just outlined – namely, that diversification is driven by the extensive margin, whereas growth is driven by the intensive margin. Even seemingly well-established “stylized facts” linking concentration to growth, such as the natural-resource curse (a negative correlation between the importance of natural resources in a country's wealth and its subsequent growth), do not appear very robust. Thus, diversification and growth are not equivalent objectives.

In spite of the many open questions, a few remarks emerge from the literature as it stands today. First, we find that trade liberalization, which might have been expected to lead to concentration on a country's comparative-advantage sectors, statistically correlates with export diversification at both the intensive and extensive margins.

As for targeted industrial policy, as Easterly, Resheff and Schwenkenberg (2009) show, the probability of a big hit decreases exponentially with its size, making “picking winners” a lottery. What industrial planner would have dreamt of advising the Egyptian Government to target the Italian market for “ceramic bathroom kitchen sanitary items, not porcelain”? We know very little about the channels by which producers of that product became informed of the market opportunities.

Who is best positioned, of the market or government, to identify potential “big hits”? One traditional argument in favour of industrial policy is that the government is better placed than the market to overcome market failures (for example, in the search for information). But the market compensates for this by its ability to generate an endless stream of gamblers, each trying his or her luck in a particular niche. Besedes and Prusa's work (see, for example, Besedes and Prusa (forthcoming) and references therein) shows the importance of this trial-and-error process by the very low survival rate of “export spells” (by which they mean periods of uninterrupted exports in one product between two countries).

Recent work on African exports using firm-level data (Cadot et al. 2011) provides empirical support to the idea that there are agglomeration externalities in export. This suggests that export promotion by the government may be useful to overcome collective-action problems. Indeed, Volpe and Carballo (2008; 2010) find that export promotion has a statistically traceable effect on the export performance of targeted firms. Thus, the new firm-level evidence seems rather supportive of the idea that government intervention can help – although with three caveats. First, the evidence suggests that export promotion works better at the intensive margin than at the extensive one. That is, the rate of growth of the exports of “assisted” firms is higher than that of non-assisted firms (although by a small margin), but the rate at which new products are introduced is unaffected. This does not square well with the conjecture that government intervention can mitigate market failures in “export entrepreneurship”. Second, the intervention studied by Volpe and Carballo is more

like a “little push” than a big one and the idea that, in export promotion, small is beautiful is also supported by the cross-country evidence in Lederman, Olarreaga and Payton (2010).

Third, the export-diversification literature has focused largely on what is produced rather than on how it is produced. Yet Acemoglu and Zilibotti (2000) developed a model highlighting differences in production methods, themselves driven by differences in the availability of skilled labour. Their work highlights that technologies developed in the North are typically tailored to the needs of a skilled workforce and therefore inappropriate for skill-scarce countries. If countries do not have the capabilities to master the tacit knowledge needed to produce sophisticated goods, no industrial policy will make them successful exporters. The most sensible policies are then supply-side ones, in particular in education (think, for instance, of India’s gradual build-up of a world-class network of technology institutes).

As a last remark, although one aim of the export-diversification literature is, ultimately, to generate useful policy advice for developing countries, it sweeps under the carpet an important historical regularity. Practically all latecomers in the industrial revolution, in particular the big ones – France in the early nineteenth century, Japan during the Meiji era, Germany at the turn of the twentieth century, China today, to name but a few – have been aggressive imitators of the technology of more advanced economic powers. All those countries expanded their basket of exports by plundering technology, sometimes (often) with government assistance and with little regard for intellectual property. This process was badly received in advanced countries, but it was a major driver of the diffusion of the Industrial Revolution. We do not know much about the policies that were put in place in the catching-up countries, and the literature has been largely silent on this. No wonder: intellectual-property enforcement is now widely taken as one of the basic good-governance prerequisites for development, and encroachments on the intellectual property of advanced countries are now fought more vigorously than ever before. But for countries that were yesterday’s imitators, this might well be a modern version of Friedrich List’s famous expression, “kicking away the ladder”.

REFERENCES

- Acemoglu, D.; Zilibotti, F. 2000. "Technology differences", mimeo.
- Acharya, R.; Keller, W. 2007. "Technology transfer through imports", *NBER Working Paper* No. 13086.
- Alfaro, L.; Chen, M. 2009. "The global agglomeration of multinational firms", *NBER Working Paper* No. 15576.
- Amador, J.; Cabral, S. 2009. "Vertical specialization across the world: A relative measure", in *North American Journal of Economics and Finance*, Vol. 20, No. 3, pp. 267-280, Dec.
- Amiti, M.; Konings, J. 2007. "Trade liberalization, intermediate inputs and productivity: Evidence from Indonesia", in *American Economic Review*, Vol. 97, No. 5, pp. 1611-1638.
- Amiti, M.; Wei, S.J. 2006. "Service offshoring, productivity and employment: Evidence from the US", *CEPR Discussion Papers* No. 5475.
- Amurgo-Pacheco, A. 2006. "Preferential trade liberalization and the range of exported products: The case of the Euro-Mediterranean FTA", *HEI Working Paper* No. 18/2006.
- Amurgo-Pacheco, A.; Pierola, M.D. 2008. "Patterns of export diversification in developing countries: Intensive and extensive margins", *World Bank Policy Research Working Paper* No. 4473.
- Arbache, J.; Dickerson, A.; Green, F. 2004. "Trade liberalization and wages in developing countries", in *The Economic Journal*, Vol. 114, pp. 93-96.
- Arezki, R.; van der Ploeg, F. 2007. "Can the natural resource curse be turned into a blessing? The role of trade policies and institutions", *IMF Working Paper* No. 07/55.
- Attanasio, O.; Goldberg, P.K.; Pavcnik, N. 2004. "Trade reforms and wage inequality in Colombia", in *Journal of Development Economics*, Vol. 74, pp. 331-366.
- Augier, P.; Cadot, O.; Dosis, M. 2009. "Imports and TFP at the firm level: The role of absorptive capacity", *CEPR Working Paper* No. 7218.
- Auty, R. 2000. "How natural resources affect economic development", in *Development Policy Review*, Vol. 18, No. 4, pp. 347-364.
- Auty, R. 2001. "The political economy of resource-driven growth", in *European Economic Review*, Vol. 45, No. 4-6, pp. 839-846.
- Aw, B.Y.; Hwang, A.R. 1995. "Productivity and the export market: A firm-level analysis", in *Journal of Development Economics*, No. 47, pp. 313-332.
- Barro, R.; Lee, J.W. 2010. "A new data set of educational attainment in the world, 1950-2010", *NBER Working Paper* No. 15902.
- Bas, M.; Strauss-Kahn, V. 2011. "Does importing more inputs raise exports? Firm-level evidence from France", *CEPII Working Paper*, No. 2011-15, June.
- Basu, S.; Fernald, J.; Kimball, M. 2006. "Are technology improvements contractionary?", in *American Economic Review*, Vol. 96, No. 5, pp. 1418-1448, Dec.
- Berman, E.; Machin, S. 2000. "Skill-biased technological transfer around the world", in *Oxford Review of Economic Policy*, Vol. 16, No. 3, pp. 12-22.
- Bernard, A.B.; Jensen, J.B. 1999. "Exceptional exporter performance: cause, effect, or both?", in *Journal of International Economics*, Vol. 47, No. 1, pp. 1-25.
- Bernard, A.B.; Jensen, J.B.; Schott, P.K. 2006. "Survival of the best fit: Exposure to low-wage countries and the (uneven) growth of U.S. manufacturing plants", in *Journal of International Economics*, Vol. 68, No. 1, pp. 219-237.

Trade and Employment: From Myths to Facts

- Bernard, A.B.; Redding, S.J.; Schott, P.K. 2007. "Comparative advantage and heterogeneous firms", in *Review of Economic Studies*, Vol. 74, No. 1, pp. 31-66, Jan.
- Besedes, T.; Prusa, T.J. 2006. "Ins, outs, and the duration of trade", in *Canadian Journal of Economics*, Vol. 39, No. 1, pp. 266-295, Feb.
- Besedes, T.; Prusa, T.J. Forthcoming. "The role of extensive and intensive margins and export growth", in *Journal of Development Economics*.
- Brenton, P.; Newfarmer, R. 2007. "Watching more than the Discovery channel: Export cycles and diversification in development", *World Bank Policy Research Working Paper* No. 4302 (World Bank).
- Broda, C.; Greenfield, J.; Weinstein, D.E. 2006. "From groundnuts to globalization: A structural estimate of trade and growth", *NBER Working Paper* No. 12512.
- Broda, C.; Weinstein, D.E. 2006. "Globalization and the gains from variety", in *Quarterly Journal of Economics*, Vol. 121, No. 2, pp. 541-585, May.
- Brunnschweiler, C.N.; Bulte, E.H. 2007. "The resource curse revisited and revised: A tale of paradoxes and red herrings", in *Journal of Environmental Economics and Management*, Vol. 55, No. 3, pp. 248-264, May.
- Brunnschweiler, C.N.; Bulte, E.H. 2009. "Natural resources and violent conflict: Resource abundance, dependence and the onset of civil wars", in *Oxford Economic Papers*, Vol. 61, No. 4, pp. 651-674, Oct.
- Cadot, O.; Carrère, C.; Strauss-Kahn, V. 2011. "Export diversification: What's behind the hump?", in *The Review of Economics and Statistics*, Vol. 93, No. 2, pp. 590-605, May.
- Cadot, O.; Carrère, C.; Kukuzeva, M.; Strauss-Kahn, V. 2010. "OECD imports: Diversification and quality search", *World Bank Policy Research Working Paper* No. 5285.
- Cadot, O.; Iacovone, L.; Pierola, M.D.; Rauch, F. 2011. "Success and failure of African exporters", mimeo (World Bank).
- Canning, D.; 1998. "A database of world stocks of infrastructure: 1950-1995", in *World Bank Economic Review*, Vol. 12, pp. 529-548.
- Carrère, C.; de Melo, J.; Wilson, J. 2011. "The distance effect and the regionalization of the trade of low-income countries", *Etudes et Documents* No 2009-8 (Université d'Auvergne).
- Chaney, T. 2008. "Distorted Gravity: The intensive and extensive margins of international trade", in *American Economic Review*, Vol. 98, No. 4, pp. 1707-1721.
- Chang, Y.; Hong, J.H. 2006. "Do technological improvements in the manufacturing sector raise or lower employment?", in *American Economic Review*, Vol. 96, No. 1, pp. 352-368.
- Cimoli, M.; Dosi, G.; Stiglitz, J.E. 2009. *Industrial policy and development: The political economy of capabilities accumulation* (Oxford University Press).
- Clerides, S.K.; Lach, S.; Tybout, J.R. 1998. "Is learning by exporting important? Micro-dynamic evidence from Colombia, Mexico, And Morocco", in *The Quarterly Journal of Economics*, Vol. 113, No. 3, pp. 903-947.
- Coe, D.; Helpman, E. 1995. "International R&D spillovers", in *European Economic Review*, Vol. 39, No. 5, pp. 859-887.
- Coe, D.; Helpman, E.; Hoffmaister, W. 1997. "North-south R&D spillovers", in *Economic Journal*, Vol. 107, pp. 134-149, Jan.
- Collier, P.; Gunning, J. 1999. "Trade shocks in developing countries", in P. Collier et al. (eds): *Africa, Vol. 1*.

- Collier, P.; Dehn, J. 2001. "Aid, shocks, and growth", *World Bank Policy Research Working Paper* No. 2688.
- Collier, P.; Hoeffler, A. 2004. "Greed and grievance in civil war", in *Oxford Economic Papers*, Vol. 56, No. 4, pp. 563-595.
- Collier, P.; Hoeffler, A. 2005. "Resource rents, governance, and conflict", in *Journal of Conflict Resolution*, Vol. 49, No. 4, pp. 625-633.
- Christiano, L.J.; Eichenbaum, M.; Vigfusson R. 2003. "What happens after a technology shock?", *NBER Working Paper* No. 9819.
- Cuddington, J.T.; Ludema R.; Jayasuriya, S.A. 2007. "Prebisch-Singer redux", in *Natural resources: Neither curse nor destiny*, pp. 103-140 (Stanford University Press and World Bank).
- Daron, A.; Johnson, S.; Robinson, J.A. 2001. "The colonial origins of comparative development: An empirical investigation", in *American Economic Review*, Vol. 91, No. 5, pp. 1369-1401, Dec.
- Deaton, A.; Miller, R. 1996. "International commodity prices, macroeconomic performance and politics in Sub-Saharan Africa", in *Journal of African Economies*, Vol. 5, No. 3, pp. 99-191.
- Dehn, J. 2000. "The effects on growth of commodity price uncertainty and shocks", *World Bank Policy Research Working Paper* No. 2455.
- Demidova, S.; Kee, H.L.; Krishna, K. 2006. "Do trade policy differences induce sorting? Theory and evidence from Bangladeshi apparel exporters", *NBER Working Paper* No. 12725.
- Dutt, P.; Mihov, I.; Van Zandt, T. 2009. "Trade diversification and economic development", mimeo (INSEAD).
- Easterly, W.; Kraay, A. 2000. "Small states, small problems? Income, growth, and volatility in small states", in *World Development*, Vol. 28, No. 11, pp. 2013-2027.
- Easterly, W.; Resheff, A.; Schwenkenberg, J.M. 2009. "The power of exports", *World Bank Policy Research Working Paper* No. 5081.
- Eaton, J.; Kortum, S. 1996. "Trade in ideas patenting and productivity in the OECD", in *Journal of International Economics*, Vol. 40, No. 3-4, pp. 251-278.
- Eaton, J.; Kortum, S.; Kramarz, F. 2004. "Dissecting trade: Firms, industries, and export destinations", in *American Economic Review*, Vol. 94, pp. 150-154, May.
- Eaton, J.; Kortum, S.; Kramarz, F. 2007. "An anatomy of international trade: Evidence from French firms", *NBER Working Paper* No. 14610.
- Egger, H., Egger, P. 2003. "Outsourcing and skill-specific employment in a small country: Austria after the fall of the iron curtain", in *Oxford Economic Papers*, Vol. 55, No. 4, pp. 625-643.
- Ethier, W. 1982. "National and international returns to scale in the modern theory of international trade", in *American Economic Review*, Vol. 72, No. 3, pp. 389-405.
- Evenett, S.J.; Venables, A.J. 2002. "Export growth in developing countries: Market entry and bilateral trade flows", mimeo (University of Bern).
- Farole, T. 2010. Special economic zones in Africa: Comparing performance and learning from global experience (World Bank).
- Feenstra, R.C.; Hanson, G.H. 1996. "Globalization, outsourcing, and wage inequality", in *American Economic Review*, Vol. 86, No. 2, pp. 240-245.
- Feenstra, R.C.; Hanson, G.H. 1997. "Foreign direct investment and relative wages: Evidence from Mexico's Maquiladoras", in *Journal of International Economics*, Vol. 42, No. 3-4, pp. 371-394.

- Feenstra, R.C.; Hanson, G.H. 1999. "The impact of outsourcing and high-technology capital on wages: Estimates for the United States, 1979-1990", in *The Quarterly Journal of Economics*, Vol. 114, No. 3, pp. 907-941.
- Feenstra, R.C.; Kee, H.L. 2007. "Trade liberalisation and export variety: A comparison of Mexico and China", in *World Economy*, Vol. 30, No. 1, pp. 5-21.
- Feenstra, R.C.; Kee, H.L. 2008. "Export variety and country productivity: Estimating the monopolistic competition model with endogenous productivity", in *Journal of International Economics*, Vol. 74, No. 2, pp. 500-518.
- Fernandes, A. 2007. "Trade policy, trade volumes and plant-level productivity in Columbian manufacturing industries", in *Journal of International Economics*, Vol. 71, No. 1, pp. 52-71, March.
- Francis, N.; Ramey, V. 2005. "Is the technology-driven real business cycle hypothesis dead? Shocks and aggregate fluctuations revised", in *Journal of Monetary Economics*, Vol. 52, No. 8, pp. 1379-1399, Nov.
- Frankel, J.A.; Romer D.H. 1999. "Does Trade Cause Growth?", in *American Economic Review*, Vol. 89, No. 3, pp. 379-399, June.
- Gali, J. 1999. "Technology, employment and the business cycle: Do technology shocks explain aggregate fluctuations?", in *The American Economic Review*, Vol. 89, No. 1, pp. 249-271.
- Gali, J. 2004. "On the role of technology shocks as a source of business cycles: Some new evidence", in *Journal of the European Economic Association*, Vol. 2, No. 2-3, pp. 372-380.
- Gamberoni, E. 2007. "Do unilateral trade preferences help export diversification? An investigation of the impact of European unilateral trade preferences on the extensive and intensive margin of trade", *IHEID Working Paper No. 17/2007*.
- Geishecker, I.; Gorg, H. 2008. "Services offshoring and wages: Evidence from micro data", *Working Paper No. 1434* (Kiel Institute for the World Economy).
- Goldberg, P.K.; Khandelwal, A.; Pavcnik, N.; Topalova, P. 2010. "Imported intermediate inputs and domestic product growth: Evidence from India", in *Quarterly Journal of Economics*, Vol. 125, No. 4, pp. 1727-1767.
- Gollin, D.; Rogerson, R. 2010. "Agriculture, roads, and economic development in Uganda", *NBER Working Paper No. 15863*.
- Gorg, H.; Strobl, E.A. 2002. "Relative wages, openness and skilled-biased technological change", *IZA Discussion Papers No. 596* (Institute for the Study of Labor).
- Gourdon, J. et al. 2011. "Pushing firms to spread themselves too thin? An evaluation of Tunisia's export promotion program", mimeo (World Bank).
- Grilli, E.R.; Yang, M.C. 1988. "Primary commodity prices, manufactured goods prices, and the terms of trade of developing countries: What the long run shows", in *World Bank Economic Review*, Vol. 2, No. 1, pp. 1-47.
- Grossman, G.M.; Helpman, E. 1991. *Innovation and growth in the global economy* (Cambridge, MIT Press).
- Gylfason, T. 2004. "Natural resources and economic growth: From dependence to diversification", *CEPR Discussion Paper No. 4804*.
- Gylfason, T. 2008. "Development and growth in mineral-rich countries", *CEPR Discussion Paper No. 7031*.
- Haddad, M. 1993. "How trade liberalization affected productivity in Morocco", *World Bank Policy Research Working Paper No. 1096*.

- Hallak, J.C.; Sivadasan, J. 2009. "Firms' exporting behavior under quality constraints", *NBER Working Paper* No. 14928.
- Halpern, L.; Koren, M.; Szeidl A. 2009. "Imported inputs and productivity", *CeFiG Working Paper* (Central European University).
- Hansen, J.; Jensen, D.; Madsen, E. 2003. "The establishment of the Danish windmill industry – Was it worthwhile?", in *Review of World Economics*, Vol. 139, No. 2, pp. 324-347, June.
- Hanson, G.; Harisson, A.V.E. 1999. "Trade and wage inequality in Mexico", in *Industrial and Labour Relations Review*, Vol. 52, No. 2, pp. 271-288.
- Harrison, A.E. 1994. "Productivity, imperfect competition and trade reform: Theory and evidence", in *Journal of International Economics*, Vol. 36, No. 1-2, pp. 53-73.
- Harrison, A.E.; Rodríguez-Clare, A. 2010. "Trade, foreign investment, and industrial policy for developing countries", in D. Rodrik; M. Rosenzweig (eds): *Handbook of development Economics*, Vol. 5, pp. 4039-4214.
- Hausmann, R.; Rodrik, D. 2003. "Economic development as self-discovery", in *Journal of Development Economics*, Vol. 72, No. 2, pp. 603-633.
- Hausmann, R.; Hwang, J.; Rodrik D. 2005. "What you export matters", *NBER Working Paper* No. 11905.
- Hausmann, R.; Rodrik, D. 2006. "Doomed to choose: Industrial policy as a predicament", mimeo.
- Helpman, E.; Melitz, M.J.; Yeaple, S.R. 2004. "Export versus FDI with heterogeneous firms", in *American Economic Review*, Vol. 94, No. 1, pp. 300-16, Mar.
- Hijzen, A.; Gorg, H.; Hine, R.C. 2005. "International outsourcing and the skill structure of labour demand in the United Kingdom", in *The Economic Journal*, Vol. 115, No. 506, pp. 860-878.
- Hummels, D.; Ishii, J.; Yi, K.M. 2001. "The nature and growth of vertical specialization in world trade", in *Journal of International Economics*, Vol. 54(1), No. 1, pp. 75-96.
- Hummels, D.; Klenow, P.J. 2005. "The variety and quality of a nation's exports", in *American Economic Review*, Vol. 95, No. 3, pp. 704-723, June.
- Imbs, J.; Wacziarg, R. 2003. "Stages of diversification", in *American Economic Review*, Vol. 93, No. 1, pp. 63-86.
- International Confederation of Free Trade Unions (ICFTU). 2003. Export processing zones – Symbols of exploitation and a development dead-end.
- ILO. 2003. ILO database on export processing zones (Geneva).
- Jansen, M. 2004. "Income volatility in small and developing countries: Export concentration matters", *WTO Discussion Paper* No. 3.
- Johnson, R.C. 2008. "Trade and prices with heterogeneous firms", mimeo (UC Berkeley).
- Kasahara, H.; Lapham, B. 2006. "Import protection as export destruction", *Working Papers* No. 1064 (Department of Economics, Queen's University).
- Kasahara, H.; Rodrigue, J. 2008. "Does the use of imported intermediates increase productivity? Plant-level evidence", in *Journal of Development Economics*, Vol. 87, No. 1, pp. 106-118.
- Kehoe, T.J.; Ruhl, K.J. 2009. "How important is the new goods margin in international trade", *Research Department Staff Report* No. 324 (Federal Reserve Bank of Minneapolis).
- Keller, W. 2002. "Geographic localization of international technology diffusion", in *The American Economic Review*, Vol. 92, No. 1, pp. 120-142, Mar.

- Keller, W. 2004. "International technology diffusion", in *Journal of Economic Literature*, Vol. 42, No. 3, pp. 752-782.
- Klinger, B.; Lederman, D. 2006. "Diversification, innovation, and imitation inside the global technology frontier", *World Bank Policy Research Working Paper* No. 3872.
- Koren, M.; Tenreyro, S. 2007. "Volatility and development", in *Quarterly Journal of Economics*, Vol. 122, No. 1, pp. 243-287, Feb.
- Krishna, P.; Mitra, D. 1998. "Trade liberalization, market discipline and productivity growth: New evidence from India", in *Journal of Development Economics*, Vol. 56, No. 2, pp. 447-462, Aug.
- Krugman, P.R. 1979. "Increasing returns, monopolistic competition, and international trade", in *Journal of International Economics*, Vol. 9, No. 4, pp. 469-479, Nov.
- Krugman, P.R. 1980. "Scale economies, product differentiation, and the pattern of trade", in *The American Economic Review*, Vol. 70, No. 5, pp. 950-959, Dec.
- Kugler, M.; Verhoogen, E.A. 2008. "Product quality at the plant level: Plant size, exports, output prices and input prices in Columbia", *Columbia University Discussion Papers* No. 0708-12.
- Kusago, T.; Tzannatos, Z. 1998. "Export processing zones: A review in need of update", *World Bank Social Protection Discussion Papers* No. 9802.
- Lederman, D.; Olarreaga, M.; Payton, L. 2006. "Export promotion agencies: What works and what doesn't", *World Bank Policy Research Working Paper* No. 4044.
- Lederman, D.; Olarreaga, M.; Payton, L. 2009. "Export-promotion agencies revisited", *World Bank Policy Research Working Paper* No. 5125.
- Lederman, D.; Maloney, W.F. 2007. "Trade structure and growth", in D. Lederman; W.F. Maloney (eds): *Natural resources: Neither curse nor destiny* (World Bank).
- Levinsohn, J. 1993. "Testing the imports-as-market-discipline hypothesis", in *Journal of International Economics*, Vol. 35, No. 1-2, pp. 1-22.
- Loof, H.; Anderson, M. 2008. "Imports, productivity and the origin markets – The role of knowledge-intensive economies", *CESIS Electronic Working Paper* No. 146 (Royal Institute of Technology).
- Manzano, O.; Rigobon, R. 2001. "Resource curse or debt overhang?", *NBER Working Paper* No. 8390.
- Markusen, J.R. 1989. "Trade in producer services and in other specialized intermediate inputs", in *The American Economic Review*, Vol. 79, No. 1, pp. 85-95, Mar.
- Marshall, M.G.; Jagers, K. 2002. *Polity IV project: Political regime characteristics and transitions, 1800-2002: Dataset users' manual* (University of Maryland).
- Martin, W.; Mitra, D. 2006. "Productivity growth and convergence in agriculture and manufacturing", mimeo (World Bank).
- Melitz, M.J. 2003. "The impact of trade on intra-industry reallocations and aggregate industry productivity", in *Econometrica*, Vol. 71, No. 6, pp. 1695-1725, Nov.
- Muendler, M. 2004. "Trade, technology, and productivity: A study of Brazilian manufactures, 1986-1998", *Economics Working Paper* No. 28149 (University of California at San Diego).
- Parteka, A.; Tamberi, M. 2008. "Determinants of export diversification: An empirical investigation", *Working Paper* No. 327 (Universita Politecnica delle Marche).
- Pavcnik, N. 2002. "Trade liberalization, exit, and productivity improvement: Evidence from Chilean plants", in *Review of Economic Studies*, Vol. 69, No. 1, pp. 245-276, Jan.

- Prebisch, R. 1950. "The economic development of Latin America and its principal problems", reprinted in *Economic Bulletin for Latin America*, Vol. 7, 1962, pp. 11-22.
- Raballand, G.; Thornton, R.; Yang, D.; Goldberg, J.; Keleher, N. 2011. "Are rural road investments alone sufficient to generate transport flows? Lessons from a randomized experiment in rural Malawi and policy implications", *Policy Research Working Paper* No. 5535 (World Bank).
- Raddatz, C. 2007. "Are external shocks responsible for the instability of output in low income countries?", in *Journal of Development Economics*, Vol. 84, No. 1, pp. 155-187, Sep.
- Ramey, G.; Ramey, V.A. 1995. "Cross-country evidence on the link between volatility and growth", in *American Economic Review*, Vol. 85, pp. 1138-1151, Dec.
- Robbins, D.; Gindling, T.H. 1999. "Trade liberalization and the relative wages for more-skilled workers in Costa Rica", in *Review of Development Economics*, Vol. 3, No. 2, pp. 140-154.
- Rodriguez, F.; Rodrik, D. 2000. "Trade policy and economic growth: A skeptic's guide to the cross-national evidence", in B. Bernanke; K.S. Rogoff (eds): *NBER Macroeconomics Annual 2000*, Vol. 15 (MIT Press).
- Rodrik, D. 2007. "Industrial development: some stylized facts and policy directions", in D. O'Connor; M. Kjollerstrom (eds): *Industrial development for the 21st century: Sustainable development perspectives* (UNDESA).
- Rose, A.K. 2004. "Do WTO members have more liberal trade policy?", in *Journal of International Economics*, Vol. 63, No. 2, pp. 209-235, July.
- Rosenthal, S.S.; Strange, W.C. 2004. "Evidence on the nature and sources of agglomeration economies" in J.V. Henderson; J.F. Thisse (eds): *Handbook of regional and urban economics*, Vol. 4, pp. 2119-2171.
- Sachs, J.D.; Warner, A. 1995. "Economic reform and the process of global integration", in *Brookings Papers on Economic Activity*, Vol. 1, pp. 1-118.
- Sachs, J.D.; Warner, A. 1997. "Natural resource abundance and economic growth", *NBER Working Paper* No. 5398.
- Serti, F.; Tomasi, C. 2008. "Firm heterogeneity: Do destinations of exports and origins of imports matter?", *LEM Papers Series* No. 2008/14.
- Shakurova, Y. 2010. "Horizontal and vertical export diversification: Propagation effects in the export decisions", mimeo (University of Lausanne).
- Strauss-Kahn, V. 2004. "The role of globalization in the within-industry shift away from unskilled workers in France", in R. Baldwin; A. Winters (eds): *Challenges to globalization: Analyzing the economics* (University of Chicago Press).
- Teorell, J.; Charron, N.; Samanni, M.; Holmberg, S.; Rothstein, B. 2009. *The quality of government dataset (version 17June09)* (The Quality of Government Institute, University of Gothenburg).
- Tornell, A.; Lane, P. 1999. "Are windfalls a curse? A non-representative agent model of the current account and fiscal policy", *NBER Working Paper* No. 4839.
- Theil, H. 1972. *Statistical decomposition analysis* (North Holland Publishing Company).
- Trefler, D. 2004. "The long and short of the Canada-U.S. free trade agreement", in *American Economic Review*, Vol. 94, No. 4, pp. 870-895, Sep.
- Tybout, J.R.; Westbrook, M.D. 1995. "Trade liberalization and the dimensions of efficiency change in Mexican manufacturing industries", in *Journal of International Economics*, Vol. 39, No. 1-2, pp. 53-78.

Trade and Employment: From Myths to Facts

- Uhlig, H. 2004. "Do technology shocks lead to a fall in total hours worked?", in *Journal of the European Economic Association*, Vol. 2, No. 2/3, pp. 361-371, Apr.-May.
- Verhoogen, E.A. 2008. "Trade, quality upgrading, and wage inequality in the Mexican manufacturing sector", in *The Quarterly Journal of Economics*, Vol. 123, No. 2, pp. 489-530.
- Volpe Martincus, C.; Carballo, J. 2008. "Is export promotion effective in developing countries? Firm-level evidence on the intensive and the extensive margins of exports", in *The Journal of International Economics*, Vol. 76, No. 1, pp. 89-106, Sep.
- Volpe Martincus, C.; Carballo, J. 2010. "Beyond the average effects: The distributional impacts of export promotion programs in developing countries", in *Journal of Development Economics*, Vol. 92, No. 2, pp. 201-214.
- Wacziarg, R.; Welch, K.H. 2008. "Trade liberalization and growth: New evidence", in *World Bank Economic Review*, Vol. 22, No. 2, pp. 187-231, June.
- World Bank. 2008. "Special economic zones: Performance, lessons learned, and implications for zone development", *FLAS Report* No. 45869.
- World Bank. 2009a. "Déterminer la priorité des investissements dans l'infrastructure: Une approche spatiale", mimeo.
- Xu, B. 2003. "Trade liberalization, wage inequality, and endogenously determined nontraded goods", in *Journal of International Economics*, Vol. 60, No. 2, pp. 417-431, Aug.
- Yeaple, S.R. 2005. "A simple model of firm heterogeneity, international trade, and wages", in *Journal of International Economics*, Vol. 65, No. 1, pp. 1-20, Jan.
- Yi, K.M. 2003. "Can vertical specialization explain the growth of world trade?", in *Journal of Political Economy*, Vol. 111, No. 1, pp. 52-102, Feb.
- Zhu, S.C.; Trefler, D. 2005. "Trade and inequality in developing countries: A general equilibrium analysis", in *Journal of International Economics*, Vol. 65, No. 1, pp. 21-24, Jan.

TECHNICAL APPENDIX 7.A

7.A.1 Overall indices

7.A.1.1 Herfindhal, Gini and Theil

For a given country and year (but omitting country and time subscripts), the Herfindahl index of export concentration, normalized to a range between zero and one, is given by the following formula:

$$H = \frac{\sum_{k=1}^n (s_k)^2 - 1/n}{1 - 1/n}$$

where $s_k = x_k / \sum_{k=1}^n x_k$ is the share of export line k (with amount exported x_k) in total exports and n is the number of export lines.

As for the Gini index, several equivalent definitions have been used in the literature, among which one of the simplest can be calculated by first ordering export items (at the appropriate level of aggregation) by increasing size (or share) and calculating cumulative export shares.

$$X_k = \sum_{l=1}^k s_l. \text{ The Gini coefficient is then}$$

$$G = 1 - \sum_{k=1}^n (X_k - X_{k-1}) / n$$

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

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

7.A.1.2 Theil decomposition

Let n be the notional number of export products (the 5,016 lines of the HS6 nomenclature), n_j the number of export lines in group j , μ the average dollar export value, μ_j group j 's average dollar export value, and x_k the dollar value of export line k . The between-groups component is

$$T^B = \sum_{j=0}^1 \frac{n_j}{n} \frac{\mu_j}{\mu} \ln \left(\frac{\mu_j}{\mu} \right) \quad (2)$$

and the within-groups component is

$$\begin{aligned}
 T^W &= \sum_{j=0}^1 \frac{n_j}{n} \frac{\mu_j}{\mu} T^j \\
 &= \sum_{j=0}^1 \frac{n_j}{n} \frac{\mu_j}{\mu} \left[\frac{1}{n_j} \sum_{k \in j} \frac{x_k}{\mu_j} \ln \left(\frac{x_k}{\mu_j} \right) \right]
 \end{aligned} \tag{3}$$

where T^j stands for Theil's sub-index for group $j = 0, 1$. It is easily verified that $T^W + T^B = T$.

7.A.2 The intensive and extensive margins

7.A.2.1 Theil decomposition

Let the n lines of the HS6 nomenclature be partitioned into two groups $i = 0, 1$ where group "one" is made of active export lines for this country and year, and group "zero" is made of inactive export lines. The Theil index is then decomposed as in section 7.A.1.2. Note, however, that the between-groups sub-index is not defined, since $\mu_0 = 0$ and expression (1) contains a logarithm. Thus, we have to take a limit. By L'Hôpital's rule,

$$\lim_{\mu_0 \rightarrow 0} \left[\frac{\mu_0}{\mu} \ln \left(\frac{\mu_0}{\mu} \right) \right] = 0 \tag{4}$$

so, based on our partition

$$\lim_{\mu_0 \rightarrow 0} T^B = \frac{n_1}{n} \frac{\mu_1}{\mu} \ln \left(\frac{\mu_1}{\mu} \right). \tag{5}$$

As $\mu_1 = (1/n_1) \sum_{k \in G_1} x_k$, $\mu = (1/n) \sum_k x_k$ and, by construction,

$\sum_{k \in G_1} x_k = \sum_k x_k$ it follows that

$$\lim_{\mu_0 \rightarrow 0} T^B = \ln \left(\frac{n}{n_1} \right) \tag{6}$$

and, as n is fixed,

$$\lim_{\mu_0 \rightarrow 0} \Delta T^B = \Delta n_1 \quad (7)$$

where Δ denote a period-to-period change. That is, given our partition, the between-groups component measures changes at the extensive margin.

As for the “within-groups” component, it is a weighted average of terms combining group-specific means and group-specific Theil indices T^j . In group G_0 (inactive lines), again $\mu_0 = T^0 = 0$; so, in our case, T^w reduces to T^1 , the group Theil index for active lines. Thus, given our partition, changes in the within-groups Theil index measure changes at the intensive margin.

7.A.2.2 Hummels and Klenow margins

Let x_k^i be the value of country i 's exports of good k , and x_k^w the world's exports of that good; let also G_1^i stand for the group of country i 's active export lines. The intensive margin (IM^i) and extensive margin (EM^i), for country i , are defined as

$$IM^i = \frac{\sum_{k \in G_1^i} x_k^i}{\sum_{k \in G_1^i} x_k^w}; \quad EM^i = \frac{\sum_{k \in G_1^i} x_k^w}{\sum_{k=1}^m x_k^w}.$$

7.A.3 Brenton and Newfarmer margins

Let again G_1^i be the set of goods exported by country i to any destination, G_1^{ij} be the set of goods exported by i to destination country j , and M_1^j the set of goods imported by destination country j from any origin. Based on these groups, define binary variables

$$g_k^{ij} = \begin{cases} 1 & \text{if } k \in G_1^{ij} \\ 0 & \text{otherwise} \end{cases}$$

and

$$m_k^j = \begin{cases} 1 & \text{if } k \in M_1^j \\ 0 & \text{otherwise.} \end{cases}$$

Brenton and Newfarmer's index for country i is then

$$IEMP_i = \frac{\sum_{k \in G_1^i} g_k^{ij}}{\sum_{k \in G_1^i} m_k^j}.$$

7.A.4 Description of the drivers of diversification

Market access:

Countries belonging to free trade areas and customs unions obtain privileged access to each other's markets that do not have to be granted to non-members. To capture this aspect of market access we compute, for each country i , a weighted sum of all the preferential trade agreements (PTAs) it participates in. The weights correspond to partner's market size (as measured by GDP).

$$PTA_{it} = \left[\sum_k \frac{GDP_{kt}}{GDP_{wt}} PTA_{ikt} \right],$$

where i is the exporter country, k the importer one, t the year and w the world. This variable is computed by the authors following Dutt, Mihov and van Zandt (2009). PTAs come from Jeffrey Bergstrand's database, available at: <http://www.nd.edu/~jbergstr/>. For each country pair and year, we define $PTA=1$ if the exporter benefits from a reciprocal preferential access to the importer's market.³⁰

Remoteness:

The remoteness index, also called "multilateral resistance" term, is defined as:

$$R_{it} = \left[\sum_k \frac{GDP_{kt}}{GDP_{wt}} \ln(D_{ik}) \right],$$

where i is the exporter country, k the importer one, t the year and w the world. This variable was computed by Carrère, de Melo and Wilson (2011) on the basis of Rose (2004).

Infrastructure index:

This variable was computed by Carrère, de Melo and Wilson (2011), using data from the telecommunication sector (number of main telephone lines per 1000 workers), the transportation sector (the length of the road and railway network –in km per km² of land area) and an index of quality in the service of transport (the share of paved roads in total roads). These raw data come from Canning (1998) and the World Development Indicators (WDI) database (see Carrère, de Melo and Wilson, 2011, appendix A2 for more details).

Politics variables:

We use two variables reflecting the political regime and quality of government. Both variables come from the QoG database built up by Teorell et al. (2009). This database

³⁰ This database records the economic integration of bilateral country pairings for 195 countries annually from 1960 through 2005. Depending on the level of economic integration, a country pairing was assigned a code varying from 0 to 6. We convert this code into a 0/1 dummy.

regroups several political variables issued by international institutions and researchers' studies.

The Revised Combined Polity Score assesses the degree of democracy of a country (see Marshall and Jaggers, 2002). It ranges from +10 (strongly democratic) to -10 (strongly autocratic).

The ICRG indicator of Quality of Government is part of the International Country Risk Guide provided by the PRS Group.³¹ The ICRG indicator of Quality of Government is a mean value of the ICRG variables "Corruption", "Law and Order" and "Bureaucracy Quality".³² It scales from 0 to 1 with higher values indicating a higher quality of government.

Other variables:

Population, R&D spending and FDI come from the WDI database provided by the World Bank.

³¹ Available at: <http://www.prsgroup.com/ICRG.aspx>.

³² These component variables can be purchased at: <http://www.countrydata.com>.

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Table 7.A.1: Countries in the sample

Countries (134)	Date of trade Liberalization (1950-2001)	Export Theil index (1988-2006)	Countries (134)	Date of trade Liberalization (1950-2001)	Export Theil index (1988-2006)
Albania	1992	4.60	Dominican Republic	1992	4.65
Algeria	closed	6.98	Ecuador	1991	6.02
Angola	closed	8.18	Egypt	1995	4.69
Argentina	1991	3.58	El Salvador	1989	4.72
Armenia	1995	5.43	Estonia	closed	3.24
Australia	1964	3.60	Ethiopia	1996	6.33
Austria	1960	1.88	Finland	1960	3.00
Azerbaijan	1995	6.28	France	1959	1.95
Bangladesh	1996	4.68	Gabon	closed	7.56
Belarus	closed	4.01	Gambia, The	1985	6.26
Belgium	1959	2.20	Georgia	1996	4.74
Benin	1990	6.90	Germany	1959	1.71
Bolivia	1985	5.21	Ghana	1985	5.73
Botswana	1979	7.34	Greece	1959	2.89
Brazil	1991	3.11	Guatemala	1988	4.45
Bulgaria	1991	2.76	Guinea	1986	6.97
Burkina Faso	1998	6.87	Guinea-Bissau	1987	6.98
Burundi	1999	7.36	Guyana	1988	6.10
Cameroon	1993	6.22	Haiti	closed	5.08
Canada	1952	3.15	Honduras	1991	4.84
Cape Verde	1991	5.77	Hong Kong (China)	Always	2.56
Central African Republic	closed	6.66	Hungary	1990	2.55
Chad	closed	7.83	Iceland	closed	5.12
Chile	1976	4.57	India	closed	2.98
China	closed	2.17	Indonesia	1970	3.71
Colombia	1986	4.88	Iran, Islamic Rep.	closed	7.45
Dem. Rep. of Congo	closed	6.43	Ireland	1966	3.63
Congo	closed	7.45	Israel	1985	3.78
Costa Rica	1986	4.97	Italy	1959	1.56
Côte d'Ivoire	1994	5.63	Jamaica	1989	5.92
Croatia	closed	2.74	Japan	1964	2.47
Cyprus	1960	3.71	Jordan	1965	4.85
Czech Republic	1991	2.04	Kazakhstan	closed	5.16
Denmark	1959	2.22			

Chapter 7: Trade diversification: Drivers and impacts

Table 7.A.1: Countries in the sample (continued)

Countries (134)	Date of trade Liberalization (1950-2001)	Export Theil index (1988-2006)	Countries (134)	Date of trade Liberalization (1950-2001)	Export Theil index (1988-2006)
Kenya	1993	4.73	Russian Federation	closed	4.34
Korea, Rep.	1968	2.71	Rwanda	closed	7.26
Kyrgyzstan	1994	4.81	Senegal	closed	5.07
Latvia	1993	3.99	Sierra Leone	2001	5.98
Lesotho	closed	6.10	Singapore	1965	3.66
Liberia	closed	6.72	Slovakia	1991	2.67
Lituania	1993	3.37	Slovenia	1991	2.39
Luxembourg	1959	3.20	South Africa	1991	3.41
Macedonia, FYR	1994	3.43	Spain	1959	2.13
Madagascar	1996	5.11	Sri Lanka	1991	3.58
Malawi	closed	6.68	Swaziland	closed	4.64
Malaysia	1963	3.64	Sweden	1960	2.39
Mali	1988	7.22	Switzerland	Always	2.32
Mauritania	1995	6.73	Syrian Arab Republic	closed	6.57
Mauritius	1968	4.93	Tajikistan	1996	6.29
Mexico	1986	3.51	United Rep. of Tanzania	1995	5.09
Republic of Moldova	1994	4.08	Thailand	Always	2.91
Morocco	1984	3.82	Togo	closed	6.00
Mozambique	1995	5.74	Trinidad and Tobago	1992	5.72
Nepal	1991	5.27	Tunisia	1989	3.83
Netherlands	1959	2.00	Turkey	1989	2.73
New Zealand	1986	3.26	Turkmenistan	closed	7.23
Nicaragua	1991	5.20	Uganda	1988	6.74
Niger	1994	6.64	Ukraine	closed	3.16
Nigeria	closed	7.99	United Kingdom	Always	2.15
Norway	Always	4.60	United States	Always	1.97
Pakistan	2001	3.81	Uruguay	1990	3.73
Panama	1996	4.25	Uzbekistan	closed	5.98
Papua New Guinea	closed	6.33	Bolivarian Rep. of Venezuela	1996	6.27
Paraguay	1989	5.70	Yemen	Always	7.91
Peru	1991	4.60	Zambia	1993	6.58
Philippines	1988	4.06	Zimbabwe	closed	4.80
Poland	1990	2.36			
Portugal	Always	2.73			
Romania	1992	2.93			