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Trade Diversification, Income, and Growth: What Do We Know?

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1. Introduction

Policy interest in export diversification derives largely from the notion that poor countries are excessively reliant on primary commodities in their export and output structures and that they should diversify into activities characterized by technology spillovers and high productivity growth. However, this notion largely rests on the early conjecture of Prebisch (1950) and, more recently, on reduced-form econometrics that has become highly controversial.

Academic interest in export diversification is not new, going back at least to Michaely's work (Michaely 1958). It got a new boost under several impulses. 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, so-called "new-new" trade models (featuring firm heterogeneity) suggest 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. Third, a wave of recent empirical work has questioned traditional views on the "natural-resource curse", challenging the notion that diversification out of primary resources is a prerequisite for growth. Finally, yet another strand of literature has uncovered significant productivity gains related to the decision of importing inputs at the firm level, confirming the intuition of "love-of-variety" models. Thus, our current understanding of the trade diversification/ productivity/growth nexus draws on several theoretical and empirical literatures, 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 firsts are simply factual ones—how export diversification is measured and what are the basic stylized facts about trade export diversification, across time and countries, which we explore in Section 2 and 3 respectively. The third one is about diversification's drivers, and is tackled in Section 4. In Section 5, we turn to the relationship between diversification and growth. In Section 6, focuses on the import side; we review the evidence on import diversification and productivity and extend the discussion to labor-market issues. Finally, in Section 7, we consider some policy implications and conclusions.

2. Measuring diversification

2.1 Overall indices

Although much of the talk is about trade *diversification*, quantitative measures, most of them borrowed from the income-distribution literature, are about concentration. We will review these measures taking the example of export diversification (which has anyway been the focus of most papers) 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. All three can be easily programmed but are also available as packages in Stata. For a given country and year (but omitting country and time subscripts), the Herfindahl index of export concentration, normalized to 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 $X_k = \sum_{l=1}^{k} s_l$. The Gini coefficient is then

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

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

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

Theil's index has the property that it can 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). Specifically, 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

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

(1)

and the within-groups component is

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

(2)

where T^j stands for Theil's sub-index for group *j* = 0,1. It is easily verified that $T^W + T^B = T$. We will see in the next section a useful application of this property in our context.

2.2 Intensive and extensive margins

Export concentration measured at the *intensive* margin reflects inequality between the shares of active export lines. 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. We could potentially use this partition to construct group Theil sub-indices, one for each group i = 0,1, and their within and between components. However, note 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,

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

(3)

so, based on our partition

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

(4)

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

$$\lim_{\mu_0 \to 0} T^B = \ln\left(\frac{n}{n_1} \right).$$

(5)

and, as n is fixed,

$$\lim_{\mu_0 \to 0} \Delta T^B = \Delta n_1 \qquad (6)$$

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. In sum, Theil's decomposition makes it possible to decompose changes in overall concentration into extensive-margin and intensive-margin changes. [1]

However, the extensive margin defined this way (by simply counting the number of active export lines) leaves out 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 and Klenow (2005) proposed an alternative definition of the intensive and extensive margins that takes this information into account. Formally, 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. Hummels and Klenow defined the intensive margin, for country *i*, as

$$IM^i = \frac{\sum_{k \in G_1^i} x_k^i}{\sum_{k \in G_1^i} x_k^W}; \tag{7}$$

that is, country *i*'s intensive margin is its market share in what it exports. The extensive margin is similarly defined as

[1] This mapping between the Theil decomposition and the margins was first proposed by Cadot et al. (2009).

$$EM^i = \frac{\sum_{k \in G_1^i} x_k^W}{\sum_{k=1}^{m} x_k^W}; \tag{8}$$

that is, it tells how much the goods which *i* exports count in world trade.

2.3 The other margins

Brenton and Newfarmer (2007) proposed an alternative definition of the extensive margin based on bilateral flows. The index measures how many of destination market *j*'s imports are covered (completely or partly—the index does not use information on the value of trade flows) by exports from *i*. Formally, 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

$$g_k^{ij} = \begin{cases} 1 & \text{if } k \in G_1^{ij} \\ 0 & \text{otherwise} \end{cases} \tag{9}$$

and

$$m_k^j = \begin{cases} 1 & \text{if } k \in M_1^j \\ 0 & \text{otherwise.} \end{cases} \tag{10}$$

Brenton and Newfarmer's index for country *i* is then

$$IEMP_i = \frac{\sum_{k \in G_1^i} g_k^{ij}}{\sum_{k \in G_1^i} m_k^j}. \tag{11}$$

The numerator is the number of products that *i* exports to *j*, while the denominator is the number of products that *j* imports from somewhere and that *i* exports to somewhere. It is expressed in (11) as the subset, among *i*'s exports, of goods that are imported by *j* from any source. 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 take place actually.

Finally, yet another non-traditional margin of export expansion is the survival of trade flows, analyzed for the first time in Besedes and Prusa's seminal work. 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 also be a margin for export promotion. We will however leave the export-survival margin outside of the present review.

3. Putting the measures at work

3.1 Overall evolution

Although one might expect that diversification of economic activities rises monotonically with income, Imbs and Wacziarg's seminal work (Imbs and Wacziarg 2003) showed that this is not the case. Past a certain level of income ($9'000 in 1985 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.

Since then, a number of 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 percent of its total manufacturing exports from exporting one product—"ceramic bathroom kitchen sanitary items not percelain"—to one destination, Italy, capturing 94 percent of the Italian import market for that product." (p. 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 × destination level (their unit of analysis) closely follows a power law; that is, the probability of a big hit decreases exponentially with its size.

In terms of evolution, Klinger and Lederman (2006) used a panel of 73 countries over 1992-2003, while Cadot et al. (2009) used a larger one with 156 countries representing all regions and all levels of development between 1988 and 2006. In both cases, and in Parteka (2007) as well, concentration measures obtained with trade data turned out to be much higher than those obtained with production and employment data.[2] 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 et al.). 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.

3.2 Which margin matters?

Decompositions of the growth of exports into intensive- and extensive-margin growth have typically shown that the latter dominates by far. The pioneer work of Evenett and Venables (2002) used 3-digit trade data for 23 exporters over 1970-1997 and found that about 60% 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. Brenton and Newfarmer

2 The reason has to do with the level of disaggregation rather than with any conceptual difference between trade, production and employment shares. Whereas Imbs and Wacziarg calculated their indices at a relatively high degree of aggregation (ILO 1 digit, UNIDO 3 digits and OECD 2 digits), Cadot et al. (2009) uses 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 lumped together in "mammoth" lines.

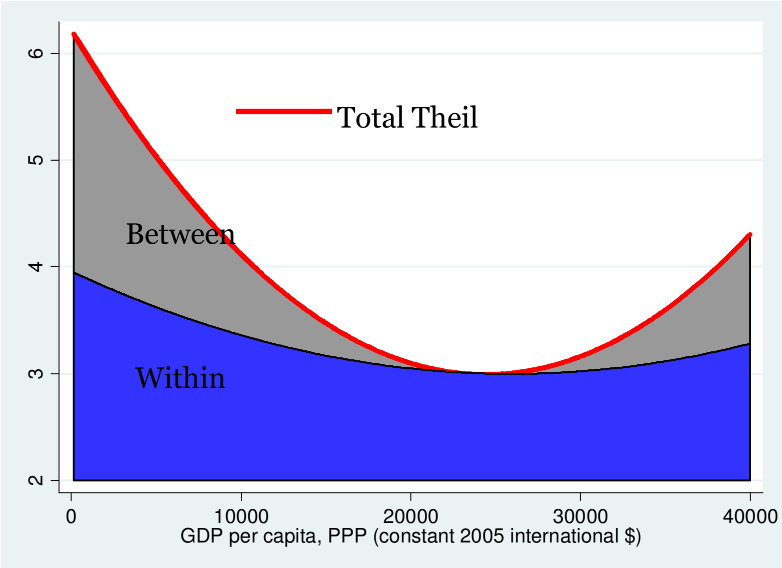
(2007), using SITC data at the 5 digit-level over 99 countries and 20 years, found that intensive-margin growth accounts for the biggest part of trade growth (80.4%). Amurgo-Pacheco and Pierola (2008) found that extensive-margin growth accounts for only 14% of export at the HS6 level for a panel of 24 countries over 1990-2005. Thus, in spite of the attention it has received in the literature, the extensive margin accounts for only 14% to 40% of trade growth.

Although not predominant quantitatively as a driver of export growth, the extensive margin can react strongly to changes in trade costs, an issue we will revisit later on in this survey. For instance, Kehoe and Ruhl (2009) found that the set of least traded goods, which accounted for only 10% of trade before trade liberalization, may grow to account for 30% of trade or more after liberalization. Activity at the extensive margin also varies a lot along the economic development process. Klinger and Lederman (2006) and Cadot et al. (2009) show that the number of new exports falls rapidly as countries develop, after peaking at 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.[3]

3 The average number of active export lines is generally low at a sample average of 2'062 per country per year (using Cadot et al.'s sample), i.e. a little less than half the total, with a minimum of 8 for Kiribati in 1993 and a maximum of 4'988 for Germany in 1994 and the United States in 1995.

Figure 1 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 1
Contributions of within- and between-groups to overall concentration, all countries



Source: Cadot et al. 2009.

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).

As discussed in the previous section, the extensive margin in

Figure 1 is measured only by the number of exports, not their economic importance. Correcting for the economic importance of the products introduced calls for Hummels and Klenow's decomposition. Using UNCTAD trade data at the HS6 level (5,017 product lines) for 1995, Hummels and Klenow (2005) performed a cross-sectional analysis of exports for 126 countries in decomposing exports into extensive and intensive margins. Interestingly, they found that 38% of the higher trade of larger economies to typical markets is explained by the intensive margin while 62% occurs for the extensive margin. That is, once the extensive margin is corrected for the importance of the new exports introduced, the previous result (the relative unimportance of the extensive margin) is reversed.

Digging deeper into the specificities of the extensive margin along the lines discussed in the previous section, several studies have disentangled its product and geographic components. Evenett and Venables (2002) found that, on average 10% of total export growth can be accounted by the introduction of new products and about one third by sales of long standing exportables to new trading partners. Hummels and Klenow (2005) mentioned that countries export on average to fewer than 13% of the countries that actually import the good. This idea was developed by Brenton and Newfarmer (2007) using the index described in the previous section. They showed that growth at the extensive margin (20% of total exports growth) was mostly driven by geographic diversification (18% of total export growth). Their work incidentally showed that the poorest countries do less well in exploiting the available markets for the goods they produce, as variation in their index across income levels is much larger than variation in traditional extensive-margin indices.

4. Drivers of diversification

4.1 Diversification and productivity: chicken or egg?

Traditional trade theory has little insight to offer on the potential determinants of export diversification beyond the observation that, in Ricardian models, causation runs from productivity to trade patterns and not the other way around. Recent developments from "new-new trade theory" give a bit more insight. In the specification proposed by Melitz (2003) 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. However, causation runs only one way, like in Ricardian models, as productivity 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 firm level, the correlation between exporting status and productivity, in Melitz's model, comes only from a selection effect.

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 (e.g. Chaney 2008, Feenstra and Lee 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 ones 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—say, technology-driven—increase in firm productivity across the board, i.e. affecting equally all firms and all sectors. Think of a multi-sector heterogeneous-firm model à la Bernard, Redding and Schott (2007) in which the distribution of firm-level productivities is Pareto in all sectors but differs in Melitz's $\tilde{\varphi}$ (and only in it). Ordering sectors by increasing value of $\tilde{\varphi}$, for a given trade cost there will be a cutoff $\tilde{\varphi}_0$ such that sectors with $\tilde{\varphi} > \tilde{\varphi}_0$ have an upper tail of firms that are productive enough to export (comparative-advantage sectors), and sectors with $\tilde{\varphi} \leq \tilde{\varphi}_0$ don't (comparative disadvantage sectors). Ceteris paribus, the productivity shock will raise the number of sectors with $\tilde{\varphi} > \tilde{\varphi}_0$, 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 e.g. Haddad 1993, Aw and Hwang 1995, Tybout and Westbrook). 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 Columbia, Mexico and Morocco. Subsequent studies (Bernard and Jensen 1999; Eaton et al. 2004, 2007; Helpman et al. 2004; Demidova 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 (2008) 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 has put 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), Parteka (2007) and Cadot et al. (2009), all found a U-shaped relationship between export concentration and GDP per capita by regressing the former on the latter. 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% cumulated increase in country-level TFP. Put differently, changes in export variety explain 1% 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%). Thus, product variety does not seem to explain much of the permanent TFP differences across countries, but an increase in export diversification—say, due to a decrease in tariffs—seems to trigger non-negligeable 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.

4.2 Diversification, market access, and trade liberalization

Returning to a formulation in which export diversification is on the left-hand side, 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 Tamberini (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 twenty 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 et al. (2009), who show that distance to trading centers and market access (proxied by a host of bilateral and multilateral trading arrangement) are key determinants of diversification.

Although preferential trade liberalization has received considerable attention in the empirical literature (e.g. Amurgo-Pachego, 2006, Gamberini, 2007, Feenstra and Kee 2007, or Dutt et al., 2009) as a driver of product diversification, unilateral trade reforms have not. Yet, we will see in Section 5 that the link between import diversification and TFP is strongly established at the firm level. Thus, import liberalization can be taken as a positive shock on TFP which should, according to the argument discussed in the previous section, raise the number of industries with an upper tail of firms capable of exporting—and thus overall export diversification. Indeed, arguments running roughly along this line can be found in Bernard, Jensen and Schott (2006) or in Broda, Greenfield, and Weinstein (2006), although the statistical linkage between trade liberalization and export diversity has not been tested formally so far.[4] This section presents a brief statistical analysis of this relation.

To do so, we combine the Theil index of export concentration computed at the HS6 level by Cadot et al. (2009) for 1988-2006 with the trade liberalization date of Wacziarg and Welch (2008). The sample used includes 134 countries over 1988-2006, with 68% of country-year observations occurring in liberalized regimes (see annex Table A1). As Table 1 shows, the conditional mean of Theil's concentration index is 4.2 in a liberalized regime vs. 5.8 in a non-liberalized one.

Table 1
Two-sample t test with unequal variances

[4] Using plant level panel data on Chilean manufacturers, Pavcnik (2002) evidences that the massive Chiliean trade liberalization of the 1970s has significantly improved *within* plant productivity through import deiversification (see Section 6).

		Mean	Mean if NO trade liberalization	Mean if trade liberalization	Test Ho: (2)=(3) Ha: (2)>(3)
		(1)	(2)	(3)	(4)
Theil		4.672	5.805	4.155	***
	Nber of obs.	*2400*	*753*	*1647*	
Theil_within		3.596	4.149	3.373	***
	Nber of obs.	*1864*	*535*	*1329*	
Theil_between		1.039	1.684	0.779	***
	Nber of obs.	*1864*	*535*	*1329*	
Nber of products exported		2,235.5	1,219.4	2,700.0	*****a/**
	Nber of obs.	*2400*	*753*	*1647*	

a/ Ho: (2)=(3) versus Ha: (2)<(3)

We then run fixed-effects regressions of the Theil index on a binary liberalization indicator defined by the dates of liberalization (equal to one 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 Welsh (2008):

$$Theil_{it} = \lambda_i + \delta_t + \phi LIB_{it} + \varepsilon_{it} \qquad (12)$$

where $Theil_{it}$ is the Theil index of country *i* exports in year *t*, LIB_{it} a dummy equals to 1 if t is greater than the year of liberalization (defined by Wacziarg and Welsh) 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 1988-2006 shows a highly significant within-country difference in export diversification between a liberalized and a non-liberalized regime (ϕ reported in

Table 2 column 1).

We also regress equation (12) using the Theil index's decomposition (within-groups vs. between-groups, see Section 2) and the number of exported products as the left-hand-side variable. Results are reported in

Table 2 columns (2)-(4). Controlling for country and year effects, it seems that countries that undertook trade liberalization reforms export more products and have a significant more diversified structure of exports along the extensive margin. By contrast, no significant difference in export concentration is found along the intensive margin.

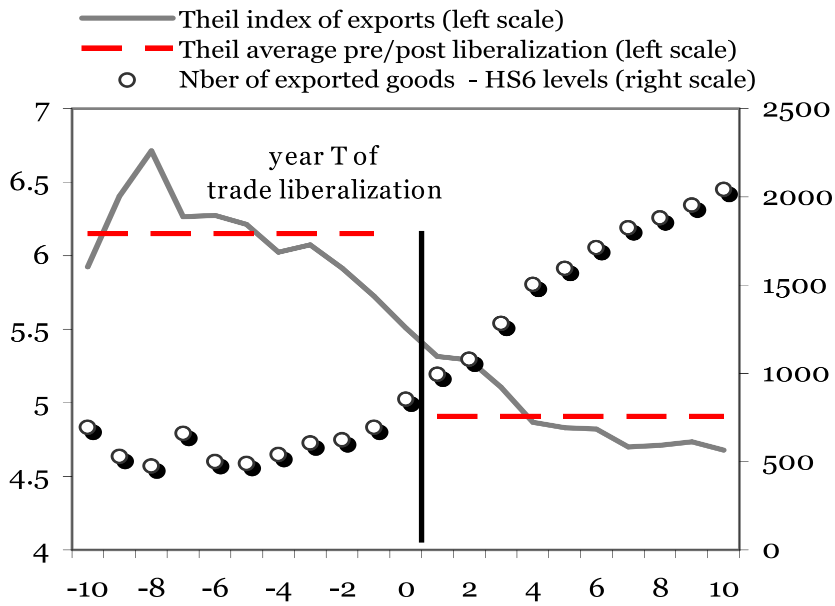
Table 2
Fixed-Effects Regressions of Diversification index on Liberalization Status

	Theil	Theil-within	Theil_between	Nber
Liberalization (LIB)	-0.366***	0.011	-0.334***	255.0***
	(3.8)	*(0.1)*	*(3.7)*	*(3.0)*
Number of Obs.	2400	1864	1864	2400
Number of countries	134	134	134	134
Period	1988-2006	1990-2004	1990-2004	1988-2006
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
R^2 within	0.31	0.26	0.62	0.66

Note: standard errors in parenthese, heteroscedasticity consistent and adjusted for country clustering; * p=0.1, ** p=0.05, ***:0.01

Figure 2 shows the time path of export diversification for an average country before and after liberalization. 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 10 years before and after liberalization. The sample is made of 95 countries that underwent permanent (non-reversed) liberalizations. A strong diversification trend (shrinking Theil index) is apparent over the entire post-liberalization windows, and particularly strong in the 5 years following it. The figure also suggests an anticipation effects in the three years preceding liberalization.

Figure 2
Time pattern of exports diversification pre and post liberalization



In order to further examine the timing of export diversification, we follow Wacziarg and Welsh (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*.

Table 3
Fixed-Effects Regressions of Diversification index on Liberalization Timing

	Theil		Nber	
Trade Liberalization in T				
D1 [=1 if T-3≤t≤T-1]	-0.059	*(0.46)*	-123.0	*(0.98)*
D2 [=1 if T≤t≤T+2]	-0.276*	*(1.67)*	31.3	*(0.21)*
D3 [=1 if T+3≤t≤T+5]	-0.464**	*(2.57)*	216.6*	*(1.64)*
D4 [=1 if T+6≤t≤T+8]	-0.464**	*(2.27)*	290.3*	*(1.67)*
D5 [=1 if t>T+8]	-0.610***	*(2.67)*	444.0**	*(2.23)*
Number of Obs.	1715		1715	
Number of countries	95		95	
Period	1988-2006		1988-2006	
Country fixed effects	Yes		Yes	
Year fixed effects	Yes		Yes	
R^2 within	0.37		0.72	

Note: standard errors in parenthese, heteroscedasticity consistent and adjusted for country clustering; * p=0.1, ** p=0.05, ***:0.01

Table 3 shows that the anticipation effect apparent in Figure 2 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.

5. Export diversification and growth

In this section, we move export diversification from the left-hand side to the right-hand side of the equation, i.e. from dependent to explanatory variable, but replacing the focus on productivity of the previous section by a focus on *growth*. Specifically, we will review the existing evidence on the relationship between initial diversification and subsequent growth, starting with a widely discussed hypothesis dubbed the “natural resource curse”.

5.1 The "natural-resource curse"

The central empirical findings behind the belief in a "natural resource curse" are the results of cross-sectional growth regressions in Sachs and Warner (1997) showing that a large share of natural-resource exports in GDP is statistically associated, ceteris paribus, with slow growth. Similar results can be found in the work of Auty (2000, 2001). There is no dearth of possible explanations for this negative correlation, but a good start is a set of arguments put forth by Prebisch (1959): 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). Let us review the empirical support for each of these arguments in turn.

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 (suprising) 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% a 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." (p. 134).

The second argument in support of the natural resource curse has to do with the second moment of the price distribution. Easterly and Kray (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 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, changes in commodity prices account for a bit more than 4% of it, shocks in foreign aid about 3%, and climatic and humanitarian disasters about 1.5% each, leaving a whopping 89% 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, which is calculated as

$$PRODY_k = \sum_j \omega_{kj} Y_j \tag{13}$$

where *k* stands for a good, *j* for a country, Y_j is country j's GDP per capita, and

$$\omega_{kj} = \sum_j \left[\frac{x_{kj}/x_j}{\sum_k (x_k/x)} \right] \tag{14}$$

is a variant of Balassa's index of revealed comparative advantage (in which x_{kj} stands for country *j*'s exports of good *k*, x_j for country j's total exports, x_k for world exports of good *k*, and *x* for total world exports). 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 tradeable sectors through cost inflation and exchange-rate appreciation. Thus, natural resource might by themselves prevent the needed diversification out of them. Dutch-disease effects can, in turn, be aggravated by unsustainable policies like 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 et al.'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% to 1.80% a year (depending on the production function's functional form) against 0.22% to 0.93% 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 (2008) 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 omitted-variable bias, natural-resource dependence must be instrumented by a truly exogenous measure of 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.[5] Thus, it is fair to say that at this stage the evidence in favor of a resource curse is far from clear-cut.

5.2 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 (2008) also found that export diversification correlates with subsequent GDP growth, especially if the initial pattern of export specialization is close to that of the US.

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 fly very well 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 don't know why, as many of the arguments that could support

[5] 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 and for institutions à la Acemoglu, Johnson and Robinson. The debate is thus not quite close.

it were questioned in the debate on the natural-resource curse (e.g. 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 2 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 good policies that make it an attractive production platform for multinationals, 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.

6. Another look at trade diversification: Imports

Discussing trade diversification while overlooking that of imports would miss half the story. Trade liberalization or facilitation has indeed entailed a large increase in imports diversification. Countries not only import more but they also import more varieties. Such diversification in imports has important implications for aggregate welfare, productivity, employment, and inequality. These are the focus of the next sections.

6.1 Gains from diversity and “import competition”

Krugman (1979)’s seminal paper was the first to show how countries gain from trade through imports of new varieties. Since then, most models of the new and new-new trade type encompass a “love-for-variety” element at the consumer and/or the producer level. However, empirical work assessing the gains from trade due to increased import diversification (i.e., an increase in the number of varieties imported) remains scarce, and the results point to modest gains.

Broda and Weinstein (2006)’s paper stands as an exception. The paper provides evidence of the welfare gains due to growth in varieties imported. As is common in the literature, a variety is defined as the smallest product category available (seven- to ten-digit) and categories produced in different *countries* are seen as different varieties. The paper shows that, over the past tree decades years (1972–2001), the number of varieties (products × origin countries) imported by the U.S. has more than trebled while the share of imports in US GDP more than doubled. Roughly half of the increase in varieties is caused by an increase in the number of products, the other half resulting from an increase in origin countries.

The authors find that consumers have a low elasticity of substitution across similar goods produced in different countries, yet at the same time the welfare gains due to increase product diversity seem small. Using their elasticities of substitution, they calculate an exact import-price index (one that accounts for the increase in varieties) and show that it is 28% lower than the conventionally measured one. This is large, but assuming an economic structure as in Krugman (1980), they show that consumers are willing to spend only 2.6% of their income to have access to these extra varieties; put differently, U.S. welfare is 2.6 percent higher than otherwise due to the import of new varieties.

Using Indian data, Goldberg et al. (2008) find that lower input tariffs reduced the conventional import price index of intermediate inputs by reducing the price of existing imported inputs, but also reduced the *exact* price index by adding new varieties; as a result, the exact price index is a modest 4.7% lower that the conventional one on average.

A rise in diversification of import may also lead to productivity gains through "import competition". As a country import new products from abroad, local producers of close substitute have to shape up in order to stay competitive. Productivity increase through this competitive effect but also though rationalization as less productive firms are forced to exit. For example, using Chilean data for 1979-1986, Pavcnik (2002) shows that following trade liberalization productivity of plants in the import competing sector increased by 3 to 10 % more than in other sector of the economy. She 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 Ivory Coast, Tybout and Westbrook (1995) for Mexico and Krishna, Mitra (1998) for India or Fernandes (2007) for Columbia. All these papers find a positive effect of increased import competition on domestic productivity. Trefler (2004) shows that Canadian plants labor productivity increased by 14% following the Canada-U.S. Free trade agreement. It also provides industry level evidence for those industries that experience the biggest decline in tariffs. Productivity increases by 15% (half of this coming from rationalization) while employment decreases by 12% (5% for manufacturing as a whole). This paper is one of the few to consider both the impact on productivity and on employment of lower tariffs trough more diversified imports. As stated in the paper, it points out the issue of adjustment costs which encompasses unemployment and displaced workers in the short run. It is worth mentioning that Trefler finds a rise in aggregate welfare.

Another strand of literature focuses on gains from increasing varieties of imported inputs. In such case, most gain is measured in term 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. Increase import of input may also impact the labor market as varieties produced abroad may substitute for local labor or/and may require specific labor 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.

6.2 Imported inputs: productivity, employment and more.

As evidence in Hummels et al. (2001), Yi (2003) or Strauss-Kahn (2004) the share of imported inputs in production has increase drastically over the past 30 years (e.g., Hummels et al. finds an increase of 40% between 1970 and 1995). Amador and Cabral (2009) shows 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, as the one listed below, also provide evidence of such an increase in the use of imported intermediate good and henceforth of an increased diversification in imported inputs. For example, Goldberg et al. finds that imported inputs increased by 227% from1987 to 2000 in India while imported final goods rose by 90% 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.

How do intermediate goods affect productivity? Halpern at al. (2009) suggest two mechanisms: access to higher quality and better complementarity of inputs. The complementarity channel encompasses elements of gains from varieties 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 evidence by Broda and Weinstein (2006). 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) (Keller (2004)).

Several studies have analyzed the effect of an increase in imported inputs on productivity. Coe and Helpman (1995) and Coe et al. (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% 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 inputs. They find that a decrease in inputs tariffs of 10 percentage point increases productivity by 12% in importing firms whereas non-importing firms benefit only by 3% suggesting productivity gains through technology effect embodied in the imported inputs rather than trough import price effect. [6] Similarly, Kasahara, and Rodrigue (2008) uses Chilean manufacturing plants 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 import positively impact current productivity). Muendler (2004) does not find however a substantial impact of increased use of imported inputs on productivity for Brazil in the early 1990s. Loof, H. and M. Anderson (2008) uses a database of Swedish manufacturing firms over an eight-year period (1997-2204) and finds that the distribution of imports across different origin countries matters (i.e., productivity is increasing in the G7-fraction of total import). By and large, empirical studies thus evidence that diversification of imported inputs increases the productivity of domestic firms.

As mentioned above this increase in productivity may occur through several channels: increased quality and/or complementarity. Very few papers to date analyze the relative contribution of these mechanisms. A notable exception is Halpern at al. (2009). The authors use a panel of Hungarian firms from 1992 to 2003 to examine the quality and variety channel (imported inputs are assumed imperfect substitutes to domestic inputs),

[6] 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.

through which imports can affect firm productivity. [7] 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 good 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 good produced domestically (diversification in production) and exported (diversification in exports). Kasahara and Lapham (2006) extend 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 import and export are complementary, import protection acts as export destruction. Goldberg et al. (2008) shows 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.

The literature thus provides strong evidence that an increase in the import of intermediate goods boosts productivity. This growth in productivity is a direct consequence of the rise in the number of varieties of imported inputs trough the channels of a better complementarity with domestic varieties and of learning effect of foreign technology. The increase 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 increase diversification on employment, the

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

evidence is scarce. As far as we know, no study analyzes the impact of imported inputs diversification on the labor market. Productivity in most studies is measure as total factor productivity and is therefore X-neutral (no impact on employment). Moreover, if domestic and foreign intermediate goods are not perfectly substitute, as shown in several studies, higher diversification of imported inputs should not affect the aggregate level of employment.

6.3 Skilled labor and absorptive capacities

It is however likely that the benefit of higher productivity accrue to the countries/industries which present a significant level of absorptive capacities. Human capital and spending in R&D stands 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) shows that import is a major channel of international technology transfer and finds that some countries benefit more from foreign technology than others. As asserted by the authors, such finding suggests an important difference in absorptive capacity. On the same token, Serti and Tomasi (2008) finds than importers sourcing from developed countries are more capital and skilled 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 et al. (2009). This paper not only evaluates the impact of increased imports on firms’ productivity but it also explores the importance of firms absorptive capacity in firms abilities 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 et al. (2009) uses a panel of Spanish firm from 1991 to 2002 which includes information on the proportion of skilled labor per firms. As mentioned above, such variables may proxy for absorptive capacities. Firms with a share of skilled labor 10% 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 the one found with lower skilled-labor-intensive firms, firms heterogeneity in absorptive capacities seems to affect greatly the contribution of imported input and equipment in increasing productivity.

Although more 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), there exist some evidence that skilled labor is a necessary requirement for technology transfer. The positive impact of the diversification of imports seems hence conditional on the absorptive capacities of a country or industry.

6.4 Increased import diversification in intermediate inputs as a substitute to unskilled labor?

Finally, the increase in imported inputs may have an impact on inequalities between skilled and unskilled workers if it reflects a substitution of domestic labor by foreign labor for cost purposes. A domestic firm may indeed find profitable to source inputs internationally instead of producing them locally. A first wave of studies considering this issue focused on manufacturing firms. It includes Feenstra and Hanson (1996, 1999) for the US, Egger and Egger (2003) for Austria, Hijzen, et al. (2005) for the UK or Strauss-Kahn (2004) for France. These papers investigate the impact of an increase in imported inputs on relative demand and/or wage differentials between skilled and unskilled workers. All papers on the topic evidence that international sourcing has a major and significant impact on relative wage or/and employment. Authors find that the growth in imported inputs accounts form 11% to 30% of the observed increase in inequality across skill groups.

More recent literature on the issue focuses on the sourcing of services. A new feature of international trade is indeed the increase in the size and varieties of services traded. For example, Amiti and Wei (2006) shows that imported service inputs from U.S. manufacturing firms has grown at a annual rate of 6% over the 1992-2000 period. Amiti and Wei (2006) for the U.S. as well as Amiti and Wei (2005) for the U.K. find little evidence of the impact of the rise in service imports on employment. It could be argue however that (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 labor markets as the U.K. and the U.S. the main effect should be observe trough changes in factor prices (i.e., wages) rather than employment. Geishecker and Gorg (2008) uses household level panel data combined with industry level data on imported services inputs for the 1992-2004 period. The paper can therefore analyze the effect of the growth in imported service inputs on individual worker wages. They find that the real wage of the low and medium skilled workers decrease while the real wage of the most skilled increases. Thus increased diversification in service imports leads to an increase in inequality between workers in different skill groups.

7. Conclusions and policy implications

One would wish that the enormous amount of attention that export diversification has attracted, both theoretically and empirically, would naturally lead to robust policy prescriptions, for which developing countries are hungry. Unfortunately, how best to achieve export diversification, and how it should rank in the list of government priorities, are still very much open questions—part of a wider debate on the usefulness of industrial policy.

In spite of the many open questions, a few remarks emerge from the literature as it stands today. First, however many demands trade experts get from governments on helping to pick winners, the literature has very little to say about that. For one thing, some of the winners are products that today simply do not exist. Even the savviest experts would find it difficult to give governments a road map for entering markets that don't exist.

Second, the export-diversification literature has focused largely on the *what* is produced rather than on the *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 labor. 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. This implies that policy advice based on reasoning à la Hausmann, Hwang and Rodrik (export what rich countries export, and you will become rich) may be simply missing a traditional determinant of trade patterns—factor endowments. 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 only sensible policies are then supply-side ones, like the one India followed for years when it gradually built a world-class network of technology institutes.

Third, as Easterly et al. (2009) show, the probability of a big hit decreases exponentially with its size, making "picking winners" a lottery game. What industrial planner would have dreamt of advising the Egyptian government to aggressively target the Italian market for "ceramic bathroom kitchen sanitary items, not porcelain"? We know very little about the channels by which some producers of that stuff got informed of the market opportunities. Who is well positioned, of the market or government, to identify potential "big hits"? One traditional argument in favor of industrial policy is that the government is better placed than the market to overcome market failures (say in the search for information). But the market compensates for this by its ability to generate an endless stream of gamblers, each trying his luck in a particular niche. Besedes and Prusa's work (see e.g. Besedes and Prusa 2008 and references therein) shows the importance of this trial-and-error process by the very low survival rate of export spells (periods of uninterrupted exports in one product between two countries). This costly search is probably best left to the market which can provide an endless stream of adventurers. However, the argument cuts both ways. On one hand, the market generates a very active export-entrepreneurship activity (especially in low-income countries) that is likely to produce, one day or another, a hit; on the other hand, much of the criticism against government policy implicitly assumes that it should succeed all the time. Many industrial-policy failures may be necessary before one public project succeeds, just like for private investors, and a valid critique of government "picking winners" should not just count how many projects failed; it should show that success is *not possible*, or that the search process is inefficient.

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 XIXth century, Japan under the Meiji, Germany at the turn of the XXth 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 in the diffusion of the Industrial Revolution. We don't 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 List's famous expression, "kicking away the ladder".

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Table A1
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)
Angola	closed	8.18	Ecuador	1991	6.02
Albania	1992	4.60	Egypt, Arab Rep.	1995	4.69
Argentina	1991	3.58	Spain	1959	2.13
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
Burundi	1999	7.36	Gabon	closed	7.56
Belgium	1959	2.20	United Kingdom	Always	2.15
Benin	1990	6.90	Georgia	1996	4.74
Burkina Faso	1998	6.87	Ghana	1985	5.73
Bangladesh	1996	4.68	Guinea	1986	6.97
Bulgaria	1991	2.76	Gambia, The	1985	6.26
Belarus	closed	4.01	Guinea-Bissau	1987	6.98
Bolivia	1985	5.21	Greece	1959	2.89
Brazil	1991	3.11	Guatemala	1988	4.45
Botswana	1979	7.34	Guyana	1988	6.10
Central African Republic	closed	6.66	Hong Kong, Chin	Always	2.56
Canada	1952	3.15	Honduras	1991	4.84
Switzerland	Always	2.32	Croatia	closed	2.74
Chile	1976	4.57	Haiti	closed	5.08
China	closed	2.17	Hungary	1990	2.55
Cote d'Ivoire	1994	5.63	Indonesia	1970	3.71
Cameroon	1993	6.22	India	closed	2.98
Congo, Rep.	closed	7.45	Ireland	1966	3.63
Colombia	1986	4.88	Iran, Islamic Rep	closed	7.45
Cape Verde	1991	5.77	Iceland	closed	5.12
Costa Rica	1986	4.97	Israel	1985	3.78
Cyprus	1960	3.71	Italy	1959	1.56
Czech Republic	1991	2.04	Jamaica	1989	5.92
Germany	1959	1.71	Jordan	1965	4.85
Denmark	1959	2.22	Japan	1964	2.47
Dominican Republic	1992	4.65	Kazakhstan	closed	5.16
Algeria	closed	6.98	Kenya	1993	4.73

Table A1 (cont'd)

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)
Kyrgyz Republic	1994	4.81	Paraguay	1989	5.70
Korea, Rep.	1968	2.71	Romania	1992	2.93
Liberia	closed	6.72	Russian Ferderat	closed	4.34
Sri Lanka	1991	3.58	Rwanda	closed	7.26
Lesotho	closed	6.10	Senegal	closed	5.07
Lituania	1993	3.37	Singapore	1965	3.66
Luxembourg	1959	3.20	Sierra Leone	2001	5.98
Latvia	1993	3.99	El Salvador	1989	4.72
Morocco	1984	3.82	Slovak Republic	1991	2.67
Moldova	1994	4.08	Slovenia	1991	2.39
Madagascar	1996	5.11	Sweden	1960	2.39
Mexico	1986	3.51	Swaziland	closed	4.64
Macedonia, FYR	1994	3.43	Syrian Arab Repu	closed	6.57
Mali	1988	7.22	Chad	closed	7.83
Mozambique	1995	5.74	Togo	closed	6.00
Mauritania	1995	6.73	Thailand	Always	2.91
Mauritius	1968	4.93	Tajikistan	1996	6.29
Malawi	closed	6.68	Turkmenistan	closed	7.23
Malaysia	1963	3.64	Trinidad and Tob	1992	5.72
Niger	1994	6.64	Tunisia	1989	3.83
Nigeria	closed	7.99	Turkey	1989	2.73
Nicaragua	1991	5.20	Tanzania	1995	5.09
Netherlands	1959	2.00	Uganda	1988	6.74
Norway	Always	4.60	Ukraine	closed	3.16
Nepal	1991	5.27	Uruguay	1990	3.73
New Zealand	1986	3.26	United States	Always	1.97
Pakistan	2001	3.81	Uzbekistan	closed	5.98
Panama	1996	4.25	Venezuela	1996	6.27
Peru	1991	4.60	Yemen, Rep.	Always	7.91
Philippines	1988	4.06	South Africa	1991	3.41
Papua New Guin	closed	6.33	Congo, Dem. Rep	closed	6.43
Poland	1990	2.36	Zambia	1993	6.58
Portugal	Always	2.73	Zimbabwe	closed	4.80