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As You Sow So Shall You Reap: From Capabilities to Opportunities

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ABSTRACT *Long-run growth is about the structural transformation (diversification and upgrading) of the economy, itself a function of the accumulation of capabilities that allows a country to produce new and more unique products. In this paper, we develop an "Index of Opportunities" for 96 non-high-income countries. This Index summarises countries' capabilities to undergo structural transformation, as captured by their export baskets. It has four dimensions—sophistication, diversification, "standardness" and possibilities for exporting new products with revealed comparative advantage. We find that China, India, Poland, Thailand, Mexico and Brazil rank high in the index. This means that these countries have accumulated significant capabilities (as reflected in their export baskets) and hence are well positioned for further economic transformation. At the other extreme, Guinea, Malawi, Benin, Mauritania and Haiti score very poorly. While both groups of countries need to focus policy on the development of capabilities that facilitate structural transformation, the nature and degree of policy support required are very different.*

JEL Classification: O10, O57

1. Introduction

The past 20 years have seen a rise in the economic weight of developing countries and their contribution to world GDP growth has increased significantly. The share of these countries in world growth has increased from around 45% in 1990–2000 to almost 60% in the last decade. Among the developing economies, a great deal of attention has been paid to the so-called BRIC countries, Brazil, Russia, India and China (Wilson & Purushothaman, 2003). China and India have seen the fastest growth. However, given their respective per capita incomes of $5000 and $2600 (in 2005 PPP$) in 2007, both are still far behind the advanced countries. Brazil and Russia, with per capita incomes of $9000 and $14 000 in 2007, are closer to the advanced countries. Whether these four economies will eventually catch up with the high-income countries will depend on their

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ability to continue, and to the extent possible accelerate the pace of, the structural transformation of their economies.

Since the early days of development economics, it has been recognised that development is about the transformation of the productive structure and the accumulation of the capabilities necessary to undertake this process. Structural transformation is the process through which countries change what they produce and how they do it. It involves a shift in output and employment structures away from low-productivity and low-wage activities into high-productivity and high-wage activities, as well as the upgrading and diversification of the production and export baskets. This process generates sustained growth which enables countries to increase their income per capita.

In this paper, we develop a new "Index of Opportunities" based on a country's accumulated capabilities to undergo structural transformation. It uses the recently developed metrics of structural transformation developed by Hidalgo *et al.* (2007) and Hausmann *et al.* (2007), explained further in the text. It captures the potential for further upgrading, growth and development. The Index of Opportunities has four dimensions, all related to a country's export basket and its position in the product space: (i) its sophistication; (ii) its diversification; (iii) its "standardness" and (iv) the possibilities that it offers for a country to export new products with revealed comparative advantage (RCA). The idea underlying the index is that, in the long run, a country's income is determined by the variety and sophistication of the products it makes and exports, and by the accumulation of new capabilities.[1]

The level of sophistication of the export basket captures its income content, with a more sophisticated export basket indicating that a country's exports are similar to those of high-income countries. It is calculated as a weighted average of the income level of the products exported, where the latter is defined by the income level of countries that export the products, and calculated as a weighted average of the GDP per capita of the countries that export a given product. Therefore, a high level of sophistication indicates that the export basket is similar to that of the rich countries. Felipe (2010) and Hausmann *et al.* (2007) show that countries with a more sophisticated export basket grow more quickly. We also look at the sophistication level of the products in the "core" of the product space. The core of the product space, as defined by Hidalgo *et al.* (2007), comprises chemicals, machinery, and metal products (320 products, or 41% of the total 779 products). Core products are, on average, more sophisticated than those outside the core. Also, products in the core tend to be better connected to other products, i.e. they use capabilities that can be used elsewhere. Countries with a high sophistication level in the core of the product space have acquired a greater variety of capabilities, which will make it easier to export even more sophisticated products.

The diversification of a country's export basket is measured by the number of products in which the country has acquired RCA. Diversification measures the country's ability to become competitive in a wider range of products. The rationale that underlies our analysis is that technical progress and structural change evolve together (technical progress induces structural change and vice versa; they jointly lead to growth), and underlying both is the mastering of new capabilities. An additional aspect of diversification that we look at is the number of "core" commodities that a country exports with RCA. This is an indicator of the range of capabilities that a country has acquired in the core of the product space. Products in the core are, on average, more sophisticated than those outside the core and have many other products nearby (two products are considered to be "nearby" if they

require similar capabilities for their production), which suggests the possibility of acquiring RCA in them (because they are nearby, a country already has some of the required capabilities to export them successfully). It might be the case that two countries are equally diversified, but, other things being equal, the country that exports more core commodities with RCA is likely to have a greater variety of capabilities and will find it easier to diversify into more complex products. Alternatively, it might also be true that two countries may have RCA in a similar (absolute) number of products in the core, but in one case, the number of core commodities exported with RCA might represent a greater share of the total number of commodities exported with RCA. It may be difficult for a small country to export as many products as a large country (e.g. Switzerland, Singapore, or Ireland). However, this country may have a very sophisticated basket. We account for this factor by incorporating in the index the ratio of the number of core commodities exported with RCA to the total number of commodities exported with RCA.

Another aspect of the export basket is its uniqueness, i.e. how many countries are exporting the same product with RCA. This measure of uniqueness of the export basket, to reflect the lack of uniqueness or to show the ubiquity of the export basket, has been called "standardness" (Hidalgo & Hausmann, 2009).

The final factor that enters the Index of Opportunities is a measure of the potential for further structural change, called "open forest". In a recent paper, Hausmann *et al.* (2008) conclude that countries with a higher open forest are better prepared to react successfully to adverse export shocks. Open forest is a summary measure of how far (as explained in Section 6) products not yet exported with RCA are from those currently being exported with RCA.

The rest of the paper is structured as follows. Section 2 provides a review of the literature on structural transformation and capabilities. Sections 3–6 delve into the dimensions of the index, and Section 7 shows how the index is constructed. We find that China and India are the top-ranked countries among the non-high-income countries (a total of 96 countries).[2] Poland, Thailand, Mexico and Brazil are next, while Russia is ranked 18th, with a significantly lower index. Other Asian countries ranked high are: Indonesia (8th), Malaysia (10th), the Philippines (13th), Vietnam (21st) and Georgia (29th). Section 8 concludes the paper.

2. Literature Review

In the tradition of Kuznets (1966), Kaldor (1967) and Chenery *et al.* (1986), among others, structural transformation shows up in changes in the shares of labour in the different sectors, typically with a decline in that of agriculture and an increase in those of the non-agricultural sectors. For many years, development was equated with industrialisation. The importance of manufacturing derives from its potential for strong productivity growth and the high income elasticity of demand for manufactures. As labour and capital move into these activities, average productivity in the economy increases. Today, it is believed that, as a result of new technologies and standardisation of delivery, some service activities can also experience substantial productivity gains. Examples of these activities are transport services, financial operations, wholesale trade and renting services.

The countries that have succeeded in the process of transformation are those that have managed to change the productive structure of the economy, and have been able to produce and export a more diversified and sophisticated product basket. This is the recent

experience of some countries in Asia, e.g. Korea and Singapore. China is undergoing a deep process of structural transformation that, to a large extent, explains its rapid growth. On the other hand, the countries that have failed are those that are unable to engineer this process. They get stuck in the production and export of a relatively narrow range of goods that are often unsophisticated.

A more recent strand of this literature is concerned with the effects of structural transformation on aggregate growth. The work of Amable (2000), Fagerberg (2000) and Peneder (2003) falls into this strand. Amable (2000) shows that countries that specialised in electronics (e.g. East Asian countries) benefitted from a productivity growth advantage. Fagerberg (2000) shows that countries that managed to increase their shares of technologically progressive sectors (e.g. electronics) experienced higher productivity growth during 1973–1990. Using a shift-share analysis, Peneder (2003) shows that the effect on overall productivity growth of the reallocation of labour across sectors is much smaller than productivity growth within sectors, and that structural change in the direction of industries with significant spillovers and externalities will be conducive to aggregate growth.

Hidalgo *et al.* (2007) and Hausmann *et al.* (2007) have argued that not all activities have the same implications for a country's growth prospects. They show that the composition of a country's export basket has important consequences for its growth prospects. Hidalgo *et al.* (2007) argue that development should be understood as a process of accumulating more complex sets of capabilities (e.g. building bridges, ports and highways; and developing institutions, including property rights, regulations, standards and laws; specific labour skills; and social networks) and of finding paths that create incentives for those capabilities to be accumulated and used (Hidalgo, 2009; Hidalgo & Hausmann, 2009). The implication is that a sustainable growth trajectory must involve the introduction of new goods and not merely involve continuing to produce a fixed set of goods. Hidalgo *et al.* (2007) summarise this idea in the newly developed concept of "product space".[3] Using the product space, Hausmann & Klinger (2006) argue that countries change their export mix by jumping to products that are nearby, in the sense that these other products use similar capabilities to those used by the products in which they excel (i.e. those products in which they have RCA). According to this capabilities approach, comparative advantage depends more on the nation's ability (i.e. capability) to understand, master and use technologies than on factor endowments (see also Lall, 1992, 2000a, 2000b).

What are these capabilities to which the literature refers? They are: (i) human and physical capital, the legal system, institutions, etc. that are needed to produce a product (hence, they are product-specific, not just a set of amorphous factor inputs); (ii) at the firm level, they are the "know-how" and working practices held collectively by the group of individuals comprising the firm and (iii) the organisational abilities that provide the capacity to form, manage and operate activities that involve large numbers of people. According to Sutton (2001, 2005), capabilities manifest themselves as a quality–productivity combination. A given capability is embodied in the tacit knowledge of the individuals who comprise the firm's workforce. The quality–productivity combinations are not a continuum from zero; rather, there is a window with a "minimum threshold" below which the firm would be excluded from the market. Therefore, capabilities are largely nontradable inputs.

In the same vein as Hidalgo *et al.* (2007), Sutton (2001, 2005) argues that some economic activities are more lucrative than others, and that becoming a rich country is

about being able to earn higher real wages. Countries that specialise in such activities enjoy a higher level of real wages. But unlike the traditional neoclassical model, where higher real wages are the result of an increasing capital-labour ratio, Sutton argues that the primary driver of growth is the gradual build-up of firms' capabilities. And moreover, if two countries differ in their levels of capability, this will be reflected as a difference in their real wage levels. In general, low wages do not compensate for low quality, with the consequence that low-quality firms will be excluded from the market. Indeed, one of the most important effects of globalisation is competition in "capability building". This will lead to a shakeout of firms in low-capability countries. Can capabilities be transferred? Maybe yes, but this is a slow, expensive and painstaking process,[4] and from the point of view of a high-quality producer, moving to a low-wage country need not be optimal; first, because such an exporter is likely to operate in an environment where he/she relies on suppliers of intermediate inputs that probably are not present in the low-wage country and, second, because the firm's capabilities are embodied in the tacit knowledge possessed jointly by those individuals who comprise the firm's workforce.

Under the capabilities approach, the shift of a country's output and employment structures away from low value-added activities into high value-added activities might not be easy because venturing into new activities is dependent on the capabilities already accumulated, i.e. the process is path dependent. This is not to say that output and employment structures are rigid and cannot be changed. What it means is that the accumulation of new capabilities, and therefore the ability to venture into new products, is the result of a long and cumulative process (i.e. path-dependence), one that involves a mix of learning, building institutional capacity and an appropriate business environment (Lall, 2000a, 200b). Accumulating and developing capabilities may require specific and targeted government policy interventions.

The path-dependence of export structures implies that trade patterns are much less responsive to changing factor prices than is commonly assumed. Export structures and trade patterns in general are the outcome of a long, cumulative process of learning, agglomeration, increasing returns, institution building and business culture. This means that the world's pattern of specialisation and trade is, fundamentally, *arbitrary*—what each country produces is the result of history, accidents and past government policies, and it is not dictated by comparative advantage given by tastes, resources and technology (see also, Thirlwall & Pacheco-Lopez, 2008).

3. Export Sophistication

The first two factors that we consider in the Index of Opportunities are the sophistication level of the overall export basket (denoted EXPY) and the sophistication level of the core products (denoted EXPY-core).

The sophistication level of the export basket (EXPY) of a country captures its ability to export products produced and exported by rich countries, on the assumption that, in general, the exports of rich countries embody higher productivity, wages and income per capita. The level of sophistication of a country's export basket is calculated as the weighted average of the sophistication of the products (PRODY) exported.[5]

Figure 1 shows the top 30 countries in terms of EXPY (average of 2001–2007). Panel A shows the non-high-income countries and panel B the high-income countries.[6] In general, the export basket of the high-income countries is more sophisticated. Malaysia had the

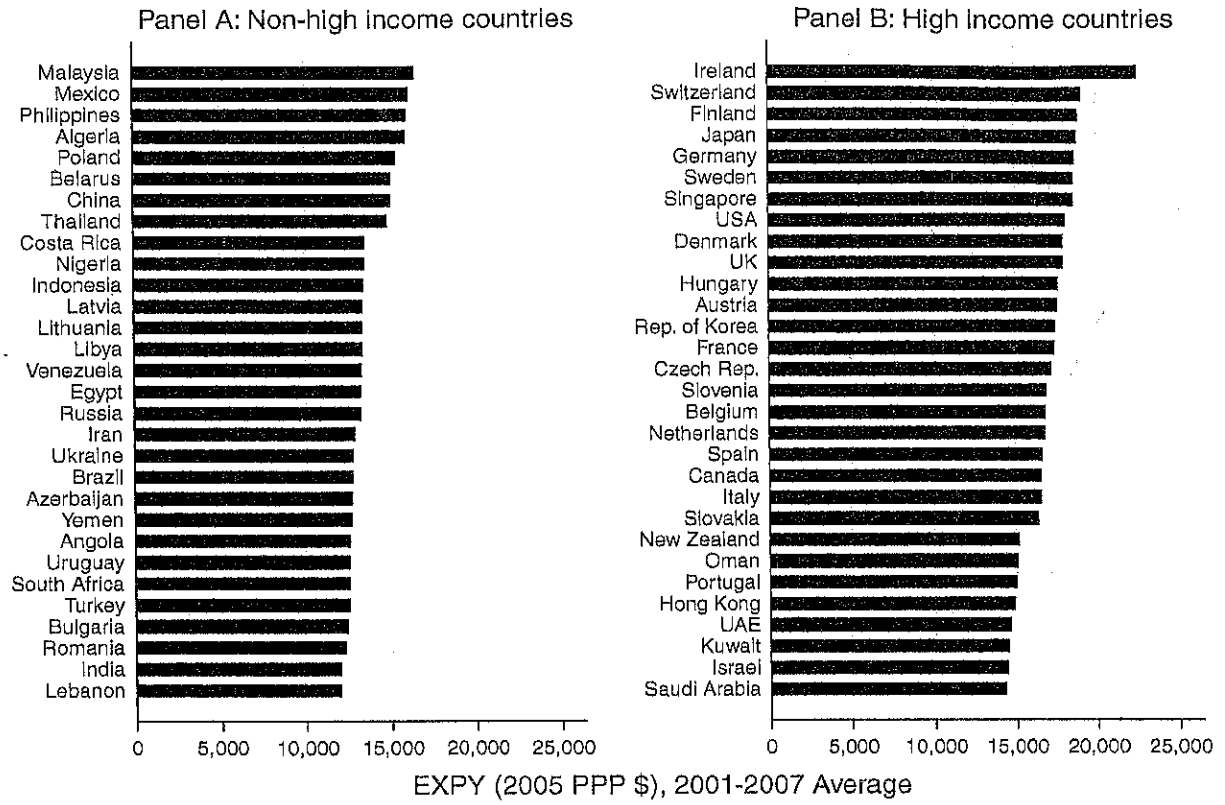


Figure 1. Export sophistication (EXPY), average 2001–2007.
Source: United Nations Commodity Trade Database (UNCOMTRADE), World Development Indicators (WDI), and own estimates.

highest EXPY among the non-high-income countries during 2001–2007, followed by Mexico and Philippines. The sophistication level of China's export basket was around \$9000–\$10 000 in the 1960s (not shown) and increased to \$15 159 during 2001–2007, while India's average export sophistication during 2001–2007 was \$12 005, and it ranked 29th among the non-high-income countries. Both China and India have seen a significant increase in the sophistication level of their export baskets over the last 15 years (Figure 2). On the other hand, the sophistication level of the export baskets of both Brazil and Russia has remained in the \$12 000–\$13 000 range over the same period. Export sophistication is observed also to remain steady in the high-income countries, but this happens at much higher levels of sophistication.

Comparing the sophistication level of the export baskets with the corresponding per capita incomes (Figure 3), we find that countries such as China, Indonesia and the Philippines have higher export sophistication levels than those of Brazil and Russia, although the latter have higher per capita incomes.[7] India's export sophistication (\$12 005) is not significantly different from that of Brazil (\$12 836) or from Turkey's (\$12 549). The latter two, however, have higher per capita incomes. Figure 3 also shows the relationship between sophistication and income per capita. Countries such as China, India, Indonesia, and the Philippines have a more sophisticated export basket than would be expected given their level of development (proxied by per capita income).[8] Among other countries that have a higher-than-expected sophistication level given their per capita income are Algeria, Egypt, Malaysia, Nigeria, Poland and Thailand. On the other hand, Brazil, Russia and the

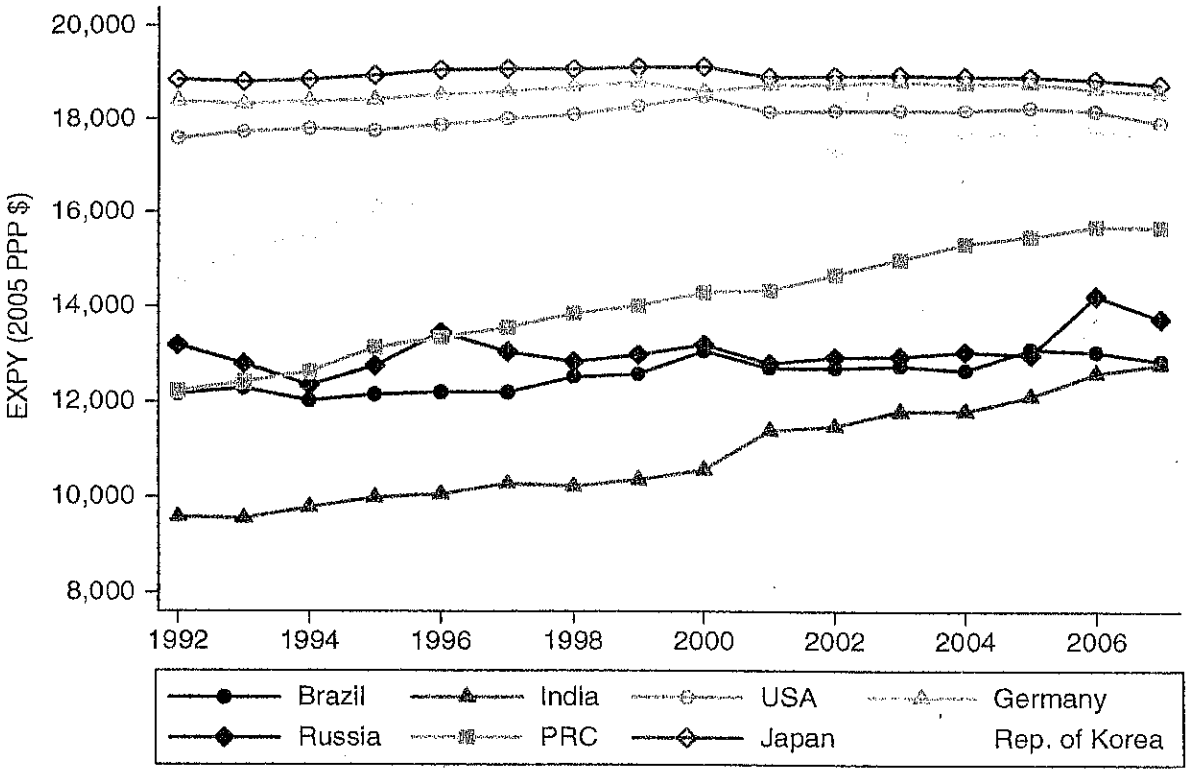
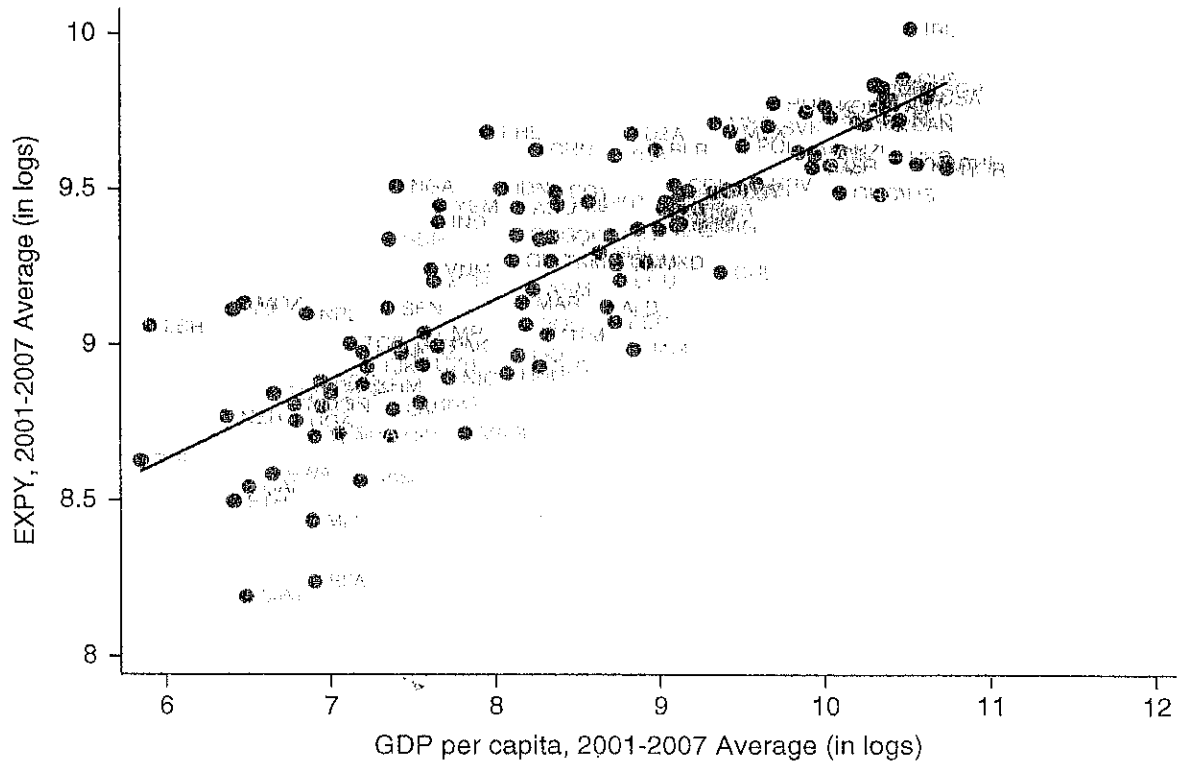


Figure 2. Trend in export sophistication.
Source: UNCOMTRADE, WDI and own estimates.



Note: Countries with population less than 2 million were excluded.

Figure 3. EXPY and GDP per capita, average 2001–2007.
Source: UNCOMTRADE, WDI and own estimates.

advanced countries are closer to the sophistication levels that would be expected for countries in their respective income categories.

To stress the significance of the point made in the previous paragraph, note that the per capita income of today's rich countries when they had levels of export sophistication similar to those of China and India in 2007 was much higher than that of China and India today. For example, Japan's (Korea's) sophistication level in the late 1970s (mid-1990s) was similar to China's sophistication level today, but the per capita income in Japan (Korea) at the time was $17 000 ($16 000), more than three times that of China in 2007, roughly $5000 (measured in PPP, 2005 prices). Similarly, Korea's EXPY in the year 1985 was comparable to that of India in 2007, but at three times the per capita income (Korea's per capita income in 1985 was $7500 and India's per capita income in 2007 was $2600).

Felipe (2010, Table 10.4) estimates that a 10% increase in EXPY at the beginning of the period raises growth by about half a percentage point. From this perspective, the sophistication level of the export basket of some of the lower- and middle-income countries, such as China, India, Indonesia, Thailand and the Philippines gives them a greater chance of rapid growth in the coming years.

A second indicator of sophistication that we use is the sophistication level of the exports that belong to the core of the product space. We call this EXPY-core. This is calculated as overall EXPY (Equation (2), Note 5), except that the set of commodities over which sophistication is measured is restricted to the core of the product space: machinery, chemicals and metals. Core commodities are significantly more sophisticated than

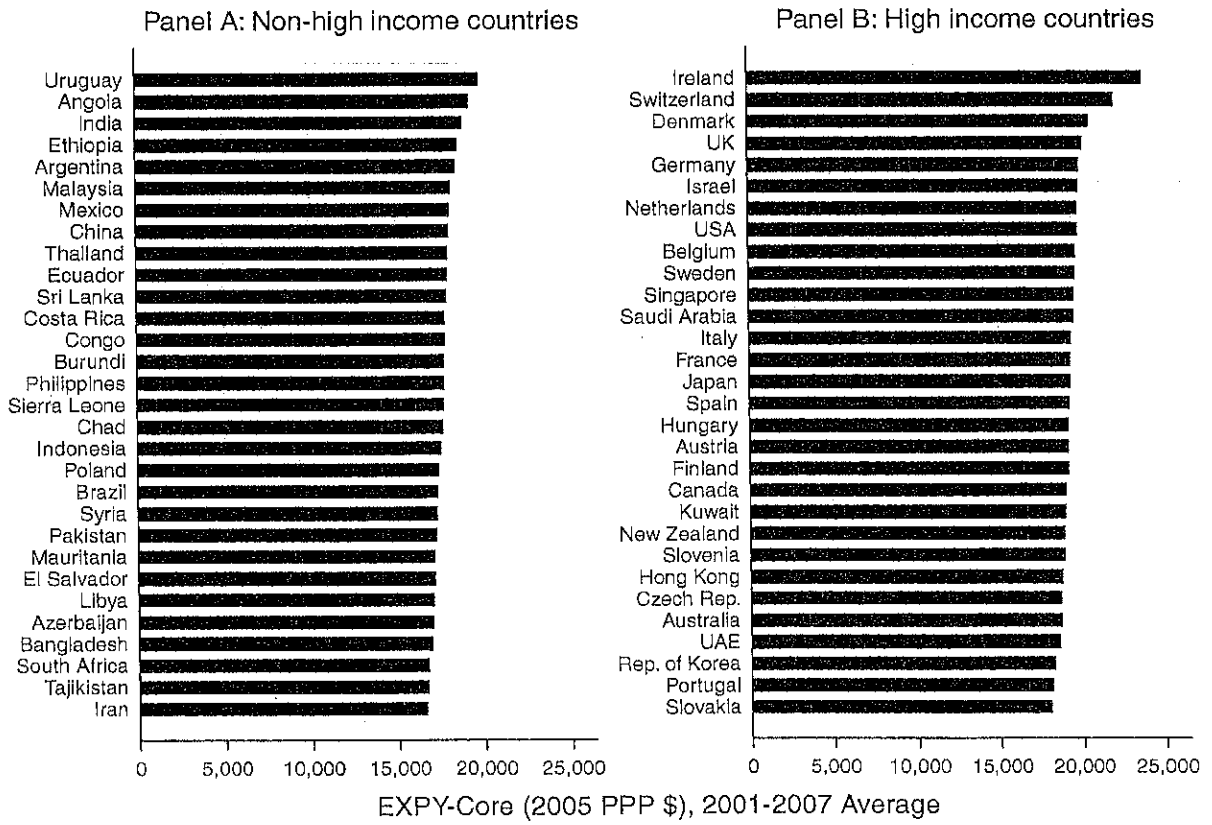


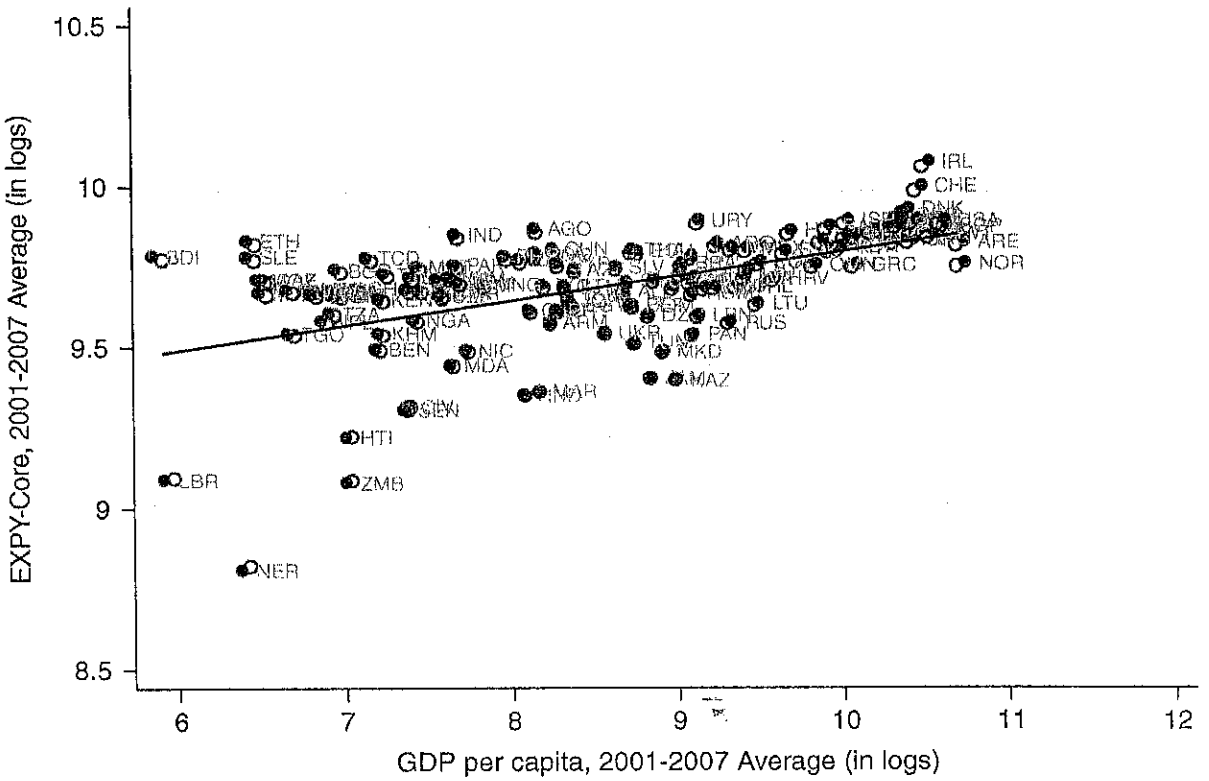
Figure 4. Sophistication of the core (EXPY-core), average 2001–2007.
Source: UNCOMTRADE, WDI and own estimates.

commodities outside the core: the average PRODY of the core is $18 687, while it is $11 634 for products outside the core.

Figure 4 shows the average sophistication level of the core exports for the period 2001–2007. Among the non-high-income countries with the highest sophistication of the core exports, Uruguay's core exports are the most sophisticated, followed by Angola's and India's. It is worth noting that not only does the ranking change, so too does the composition of the top 30 countries, when compared with the overall export sophistication (Figure 1). For example, Bangladesh and Pakistan, which were not in the top 30 in terms of overall export sophistication (Figure 1, panel A), are in the top 30 when we consider the sophistication of the core exports (Figure 4, panel A). Similarly, Argentina, which is just outside the top 30 in terms of overall export sophistication, is in the top 10 when we consider the sophistication of the core exports. China's core exports are less sophisticated than India's, though the difference is small.

The average sophistication level of India's core exports ($18 955) during 2001–2007 is similar to that of France ($19 300), Japan ($19 288), Spain ($19 258), Hong Kong ($18 750), Australia ($18 665), and Korea ($18 308). The latter, however, have much higher income levels than India.

Figure 5 plots the sophistication level of the core exports against per capita income. In general, countries at a higher stage of development have more sophisticated export baskets, but it is worth noting that given their per capita incomes, the sophistication levels of Angola's, India's, China's and Uruguay's core exports is greater than would be



Note: Countries with population less than 2 million were excluded.

Figure 5. EXPY-core and GDP per capita, average 2001–2007.
Source: UNCOMTRADE, WDI and own estimates.

expected at their income levels. On the other hand, the sophistication of Brazil's core exports is close to what one would expect for a country at its stage of development, while Russia's is below the average.

This exercise indicates that the sophistication level of the export basket, and therefore the implicit accumulated capabilities, differs across countries. This reflects the different types of products exported. This brings us to the following question: do countries differ in the number of products exported according to RCA?

4. Diversification

A key insight from Hidalgo *et al.* (2007) is that the more diversified a country, the greater are its capabilities, which allows it to acquire RCA in additional products. In this paper, *diversification* is measured by the absolute number of products that a country exports with RCA. RCA is measured as the ratio of the export share of a given product in the country's export basket to the same share at the world level.[9] For the purposes of this paper, a country is considered to be exporting a product with RCA if the share of that product in that country's total exports exceeds the same share at the global level, i.e. if RCA > 1.

Figure 6 shows the average diversification of the export basket, over the period 2001–2007.[10] During this period, China and India exported 257 and 246 products, respectively, with RCA. Except for Indonesia (which exported 213 products with RCA) and Thailand (197 products), no other lower-middle-income country had an RCA in so many products.

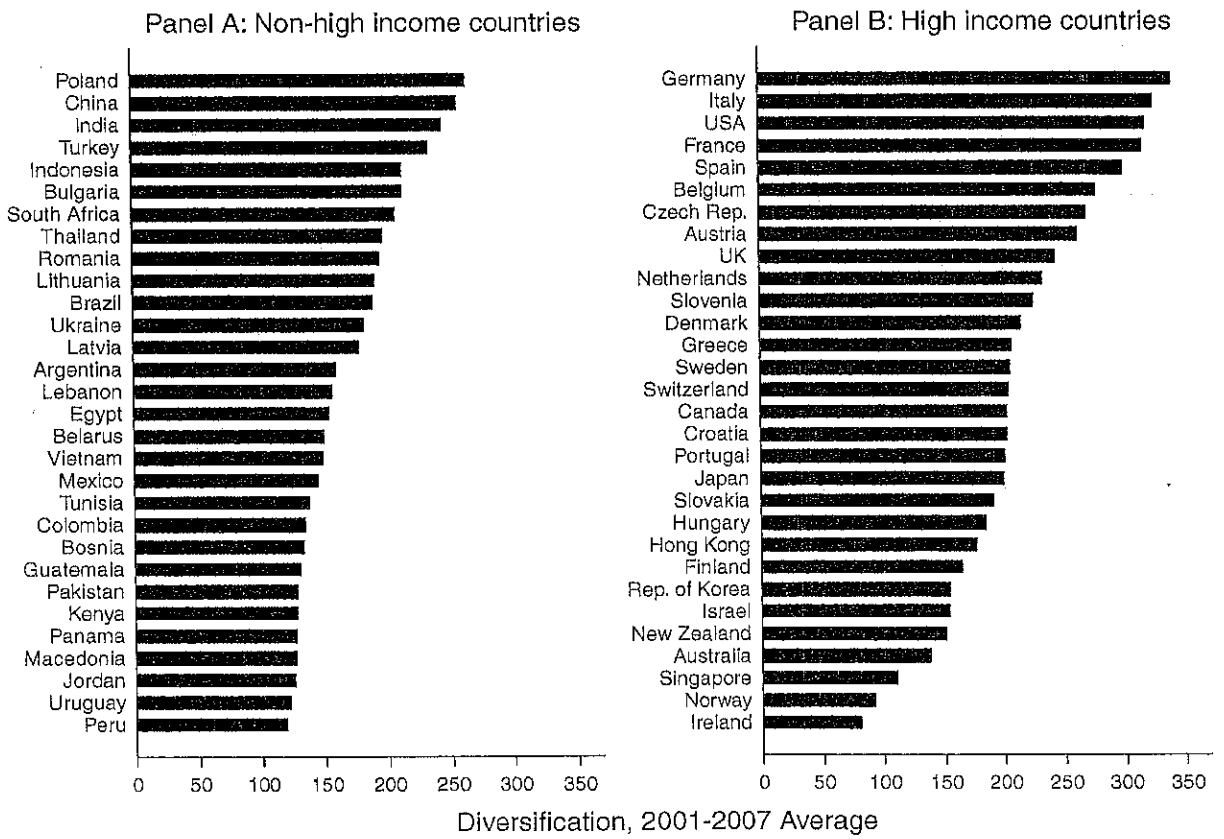
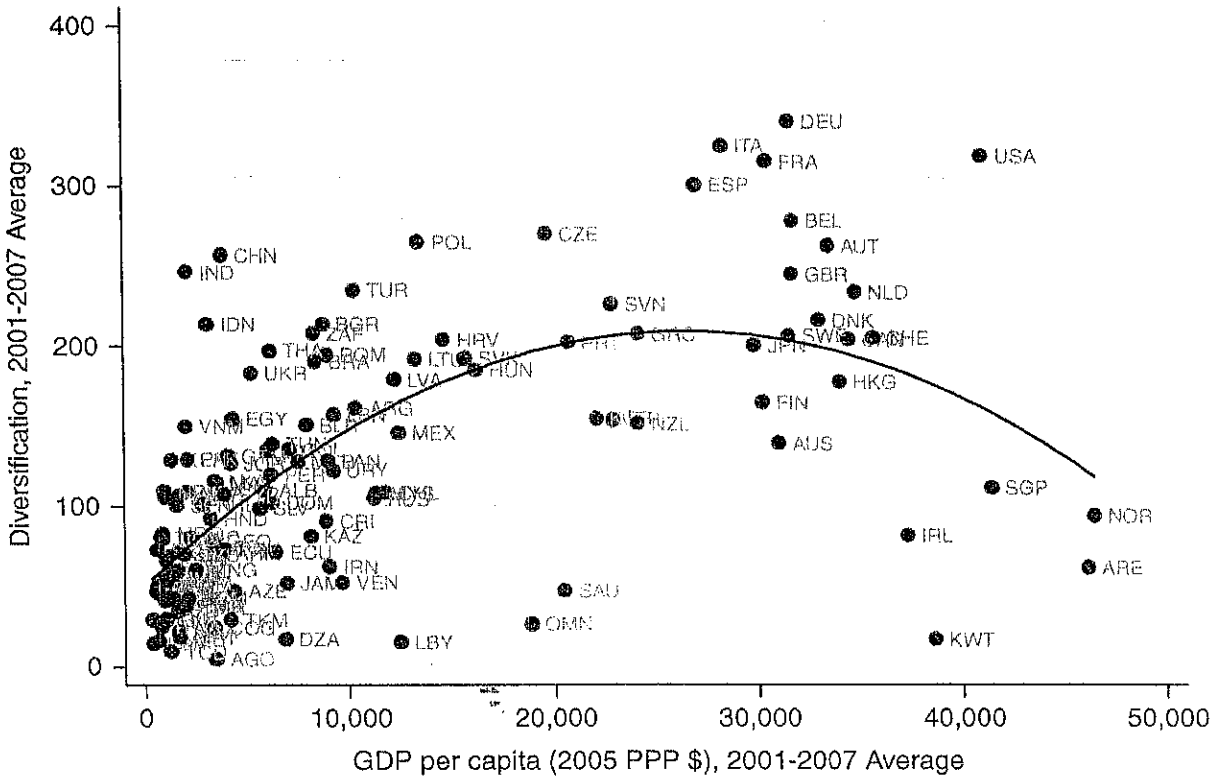


Figure 6. Diversification, average 2001–2007.
Source: UNCOMTRADE and own estimates.

Other countries so diversified were either upper-middle-income countries such as Poland (265), Turkey (235), Bulgaria (214), Romania (194), and Lithuania (192); high-income non-OECD countries such as Slovenia (226) and Croatia (204); or high-income OECD countries such as Germany (340), Italy (325), the USA (318), France (315), Spain (300), Belgium (278), Czech Republic (270), Austria (262), Great Britain (244), the Netherlands (233), Denmark (216) and Japan (200). Korea had RCA in 154 products during the period 2001–2007. Brazil and Russia, both upper-middle-income countries, exported 190 and 105 products, respectively, with RCA.

Figure 7 shows that both China and India are positive outliers in the sense that their export baskets are more diversified than one would expect given their income levels. Indonesia, Poland and Turkey are other non-high-income countries that are positive outliers. Brazil is also above the fitted line; Russia, on the other hand, has RCA in fewer products than would be expected given its income level.

Figure 8 shows the average number of commodities in the core of the product space that countries exported with RCA during 2001–2007. On average, China exported 89 core products with RCA and India 81. Other lower-middle-income countries which exported a large number of core products with RCA are Ukraine (73), Thailand (68) and Indonesia (45). Other countries that have RCA in as many products in the core are either high-income (OECD and non-OECD) countries or are upper-middle-income countries. Brazil exported 73 products in the core with RCA, Russia only 44. For the high-income countries (those in the OECD), it is not uncommon to have RCA in over 100 core commodities.



Note: Countries with population less than 2 million were excluded.

Figure 7. Diversification and GDP per capita, average 2001–2007.
Source: UNCOMTRADE, WDI and own estimates.

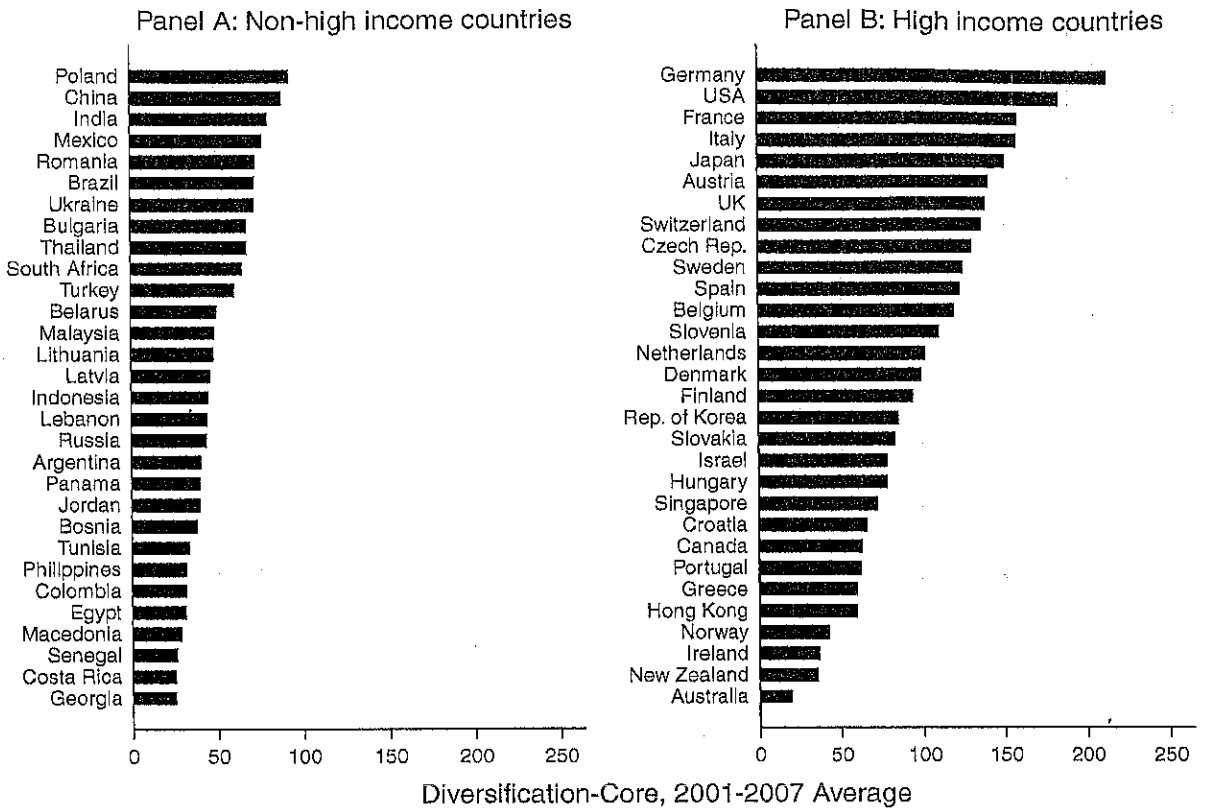


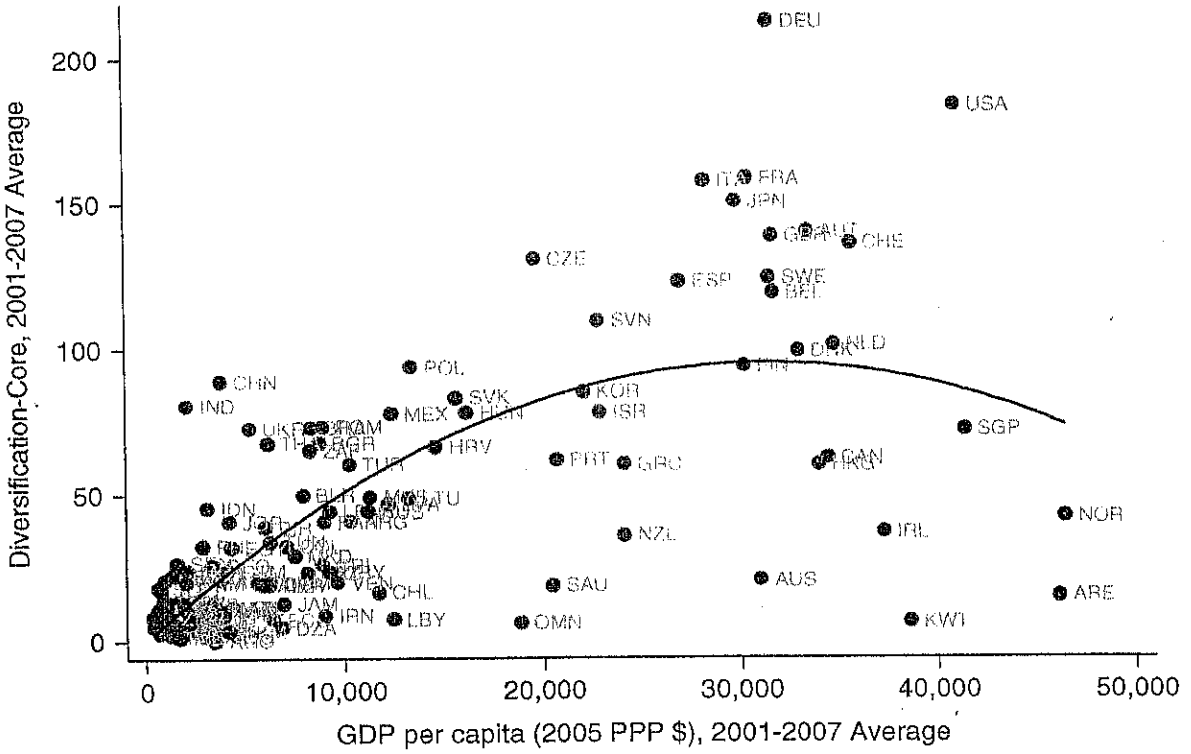
Figure 8. Diversification-core, average 2001–2007.
Source: UNCOMTRADE and own estimates.

The average number of products with RCA in the core for the high-income OECD countries is 105.

Finally, Figure 9 shows that, given their per capita income, China and India stand out in terms of number of core products exported with RCA. Brazil, Mexico, Poland, Romania and Ukraine also stand out in their income group, whereas Russia is close to the fitted line. Oil-rich countries such as Kuwait and Oman, which have a high level of export sophistication, do not do well when it comes to diversification of the export basket.

The above discussion has highlighted the role of the size and nature of capabilities, measured by the number of products exported with RCA, both overall and core products. However, it may be the case that two countries export a similar number of products with RCA, but the nature of the products differs, i.e. one of them has RCA in a greater number of core products. For example, Great Britain and Turkey have RCA in a similar number of products, 244 and 235, respectively. However, in the case of Great Britain, of the 244 products exported with RCA, 139 lie in the core; whereas in the case of Turkey, only 60 out of the 235 lie in the core. Thus, the capabilities in the two countries are of a very different nature. We venture to argue that Great Britain has capabilities that Turkey does not have, and which allow the former to make more sophisticated products.

Similarly, two countries might have RCA in a similar number of core products, but they might differ in the total number of products in which they have RCA. For example, India and Korea export a similar number of core products with RCA, 81 and 85, respectively. However, the overall number of products with RCA of the two countries is quite different:



Note: Countries with population less than 2 million were excluded.

Figure 9. Diversification-core and GDP per capita, average 2001–2007.
Source: UNCOMTRADE, WDI and own estimates.

India exports 246 products with RCA, while Korea exports 155 products. However, since in the case of Korea, 85 of these products are in the core, the share of the latter in the total number of products exported with RCA is significantly higher than in India. This higher concentration of the export basket in core products also seems to indicate that Korea has specialised in more sophisticated products than India. It is the greater number of non-core products exported by India that brings down the overall sophistication of its export basket.

We account for this in the construction of our index by including the number of commodities with RCA in the core as a ratio of the total number of commodities in which that country has an RCA. We call this the *share-core*.

Figure 10 provides a comparison of share-core for non-high- and high-income countries. In general, high-income countries have a larger share of commodities exported with RCA in the core (an average of 45%) than non-high-income countries (an average of 21%). In the case of non-high-income countries, Mexico stands out with a share of 53% of commodities exported with RCA being in the core of the product space. To determine whether this is odd for a country such as Mexico, given its per capita income, we looked at the relationship between share-core and per capita income across countries.

Figure 11 examines share-core across countries relative to their respective per capita income. As mentioned earlier, Mexico is a positive outlier, in the sense that it exports a higher share of commodities (with RCA) in the core than would be expected for a country at its stage of development. While China and India were clear positive outliers in terms of diversification and diversification-core, they no longer stand out from the rest of the countries in their income group when it comes to share-core (although they are above the

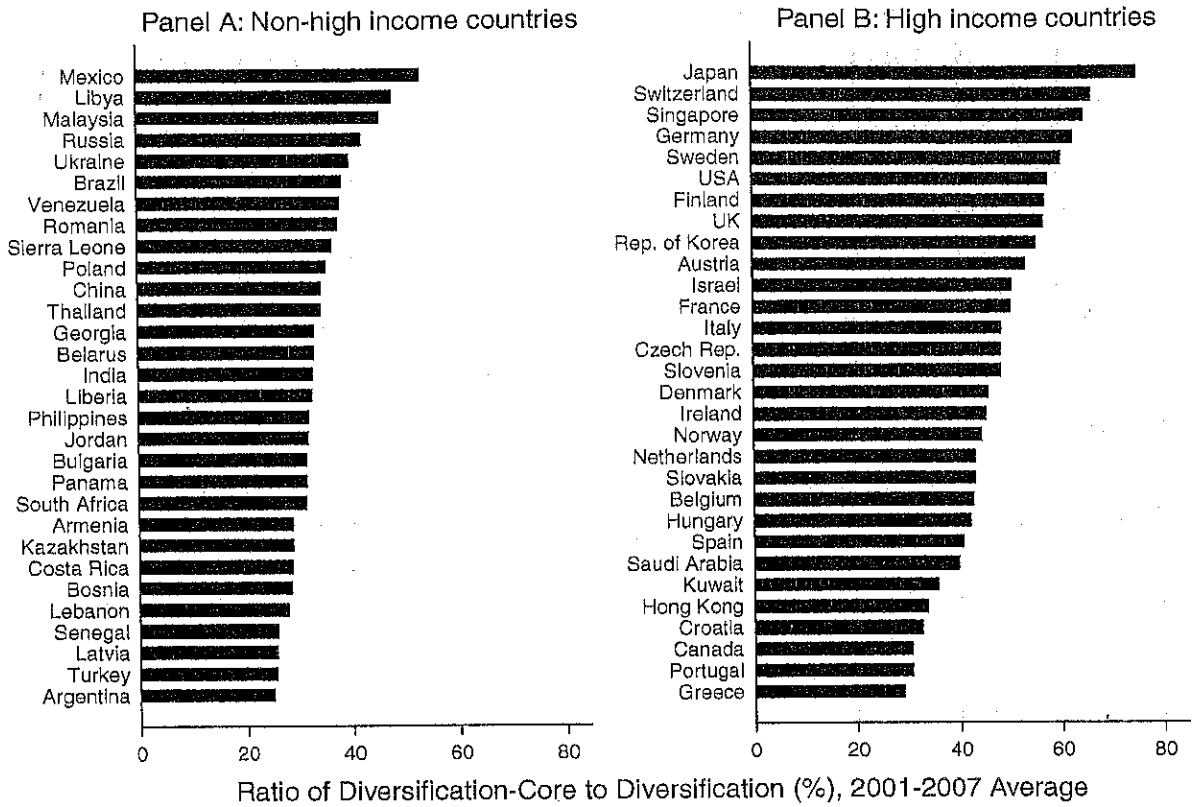
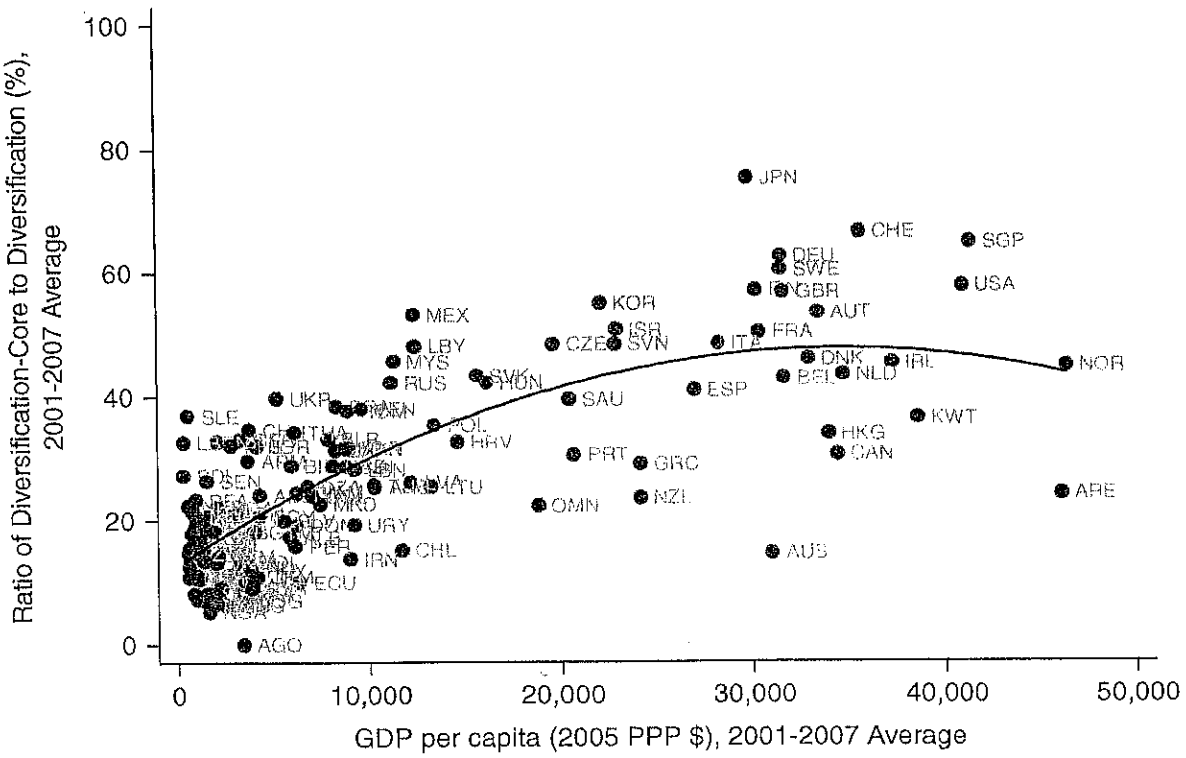


Figure 10. Share-core, average 2001–2007.
Source: UNCOMTRADE and own estimates.



Note: Countries with population less than 2 million were excluded.

Figure 11. Share-core and GDP per capita, average 2001–2007.
Source: UNCOMTRADE, WDI and own estimates.

Open forest provides a measure of the (expected) value of the goods that a country could potentially export, i.e. the products that it currently does not export with RCA. This value depends on how far the non-exported goods are from the goods currently being exported with RCA, and on the sophistication level of these non-exported goods. It is calculated as the weighted average of the sophistication level of all potential exports of a country (i.e. those goods not yet exported with RCA), where the weight is the *density* or distance between each of these goods and those exported with RCA.[12]

One may conclude that, because developed countries, in general, export more products with RCA than developing countries, the possibilities for further diversification of developed countries (and, therefore, of a high value of open forest) are limited. However, this is not exactly what matters for the purposes of open forest. Developed countries have RCA in sophisticated products (e.g. some types of machinery). These products are "close" to many other sophisticated products, for example other types of machinery or chemicals, in the sense that there is a high probability that the country could export them successfully (i.e. that it can acquire RCA) because these products use capabilities similar to those the country already possesses. On the other hand, there are products that are "far" from the current basket (i.e. greater distance and hence low probability that the country will acquire RCA in them) and developed countries will probably not export them. These products tend to have low sophistication (e.g. natural resources, some agricultural products) and contribute little to open forest. Therefore, even though developed countries have RCA in the export of a large number of goods, many of the products that they do not export with

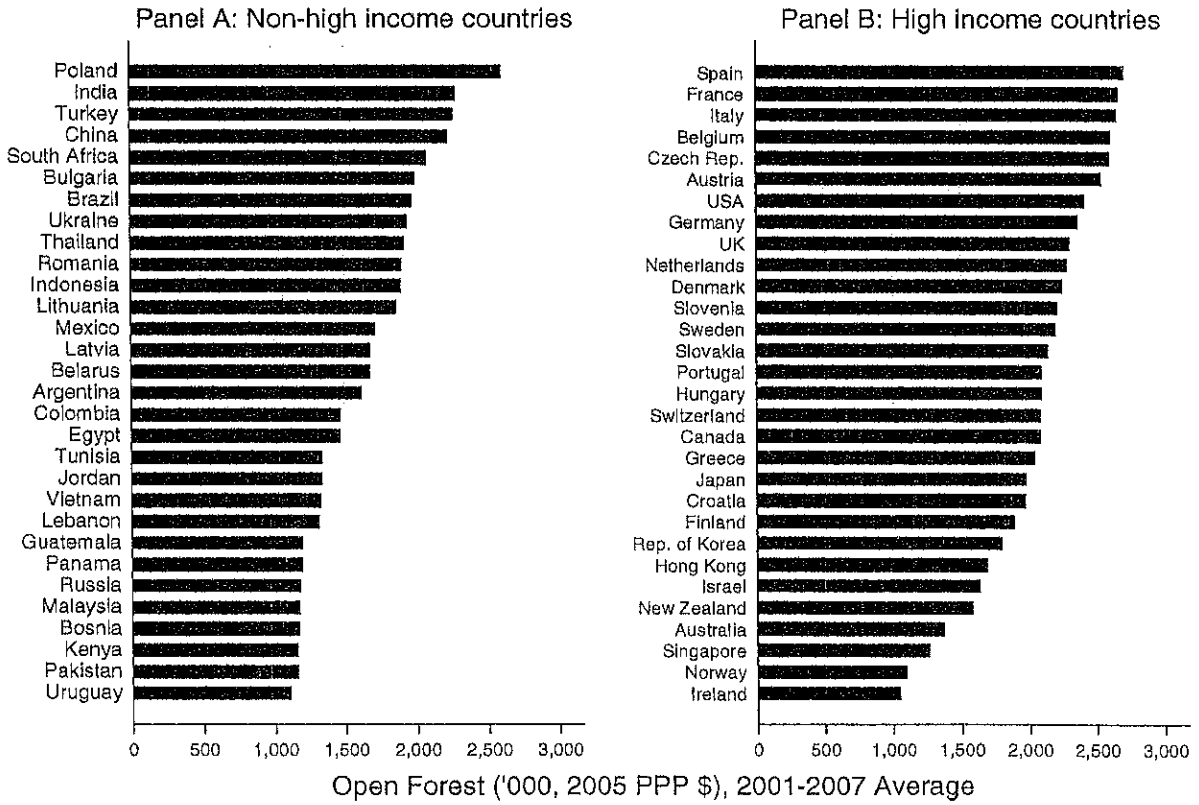


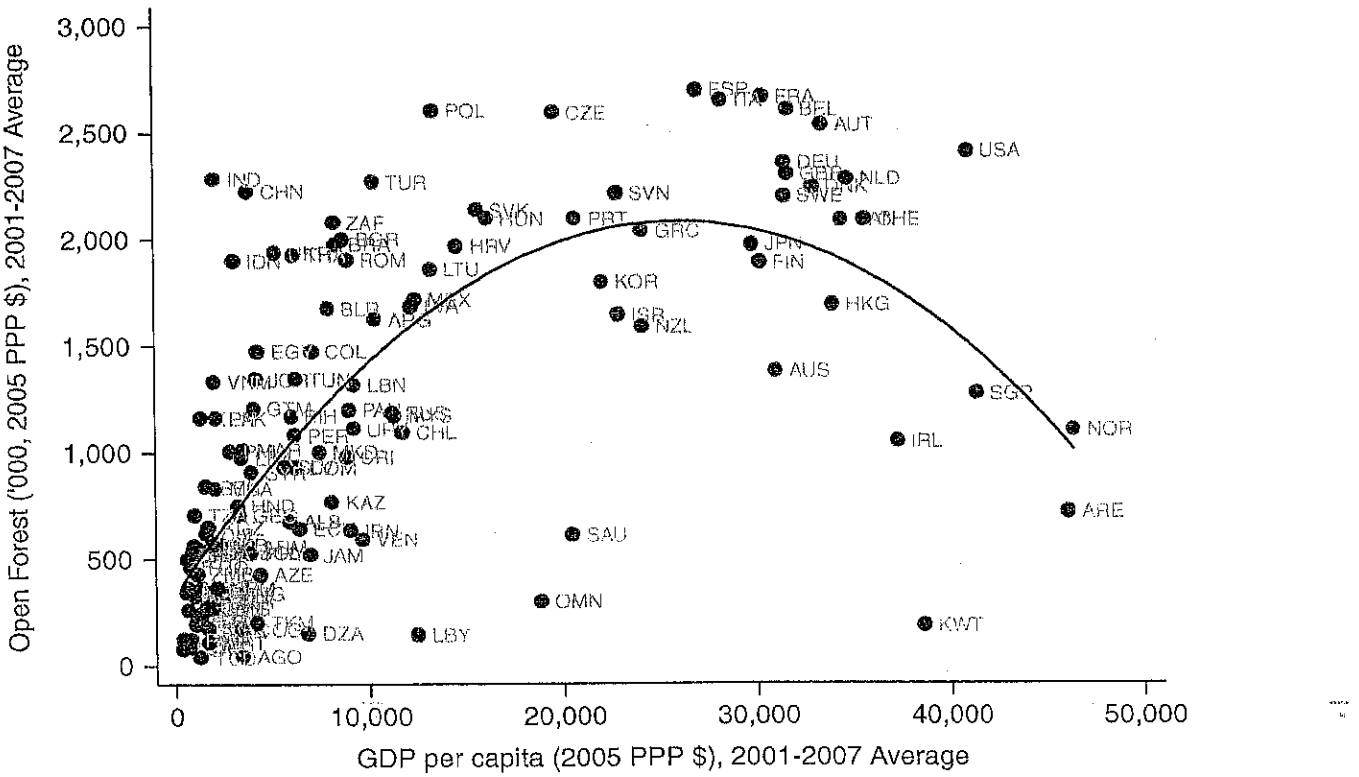
Figure 14. Open forest, average 2001–2007.
Source: UNCOMTRADE, WDI and own estimates.

RCA are highly sophisticated and the probability of exporting them is high. Hence, the relatively high open forest of these countries.

The opposite is true for developing countries. Even though they can potentially export many products (those in which they do not have an RCA) and most of them are sophisticated (e.g. machinery), the probability that these countries export them is low because they do not have the capabilities to do so (i.e. they are far from the current export basket). Hence, the low open forest of these economies.

Figure 14 shows the value of open forest of various countries. For the reasons discussed earlier, high-income countries have a very high value of open forest: the goods not exported with RCA that are close to goods currently being exported with RCA are highly sophisticated. Among the developing countries, Poland has the highest open forest ($2 602 986), followed by India ($2 284 511), Turkey ($2 268 770) and China ($2 227 843). No lower-middle-income country other than China and India has such a high open forest. Other countries with high open forest values are Ukraine ($1 940 032), Thailand ($1 928 222), Indonesia ($1 898 851) and Brazil ($1 978 485). Russia ($1 185 006) has a significantly lower open forest, which highlights the limited opportunities for further diversification available given the sophistication level of their current export basket.

Figure 15 shows the regression of open forest and per capita income. Given their stage of development, China and India are clear outliers, as their open forest value is much higher than would be predicted by the regression. Other countries that have open forest values similar to those of China and India are Slovenia and Turkey. However, they have higher per capita income.



Note: Countries with population less than 2 million were excluded.

Figure 15. Open forest and GDP per capita, average 2001–2007.
Source: UNCOMTRADE, WDI and own estimates.

7. As You Sow So Shall You Reap: Index of Opportunities

We have used the product space to infer countries' capabilities and the opportunities they provide for further structural change. The existing capabilities of a country are an indicator of its capacity to transform its portfolio of exports from less-sophisticated products to more-sophisticated products, and thereby generate future growth. In previous sections, capabilities have been summarised in the form of seven indicators, namely EXPY (Figure 1), EXPY-core (Figure 4), diversification (Figure 6), diversification-core (Figure 8), share-core (Figure 10), standardness (Figure 12) and open forest (Figure 14). In the previous sections, we have shown the top 30 countries according to each indicator. Based on these charts, some countries consistently appear in the top 30, while others are in the top 30 only for some of the indicators. On the other hand, if we look at the performance of some countries relative to their per capita incomes (Figures 3, 5, 7, 9, 11, 13 and 15), we see that some countries are better off in these terms than what would be expected. In this aspect, China and India stand out.

In this section, we combine the information discussed above and develop a new Index of Opportunities to rank countries on the basis of their accumulated capabilities. We rank a total of 96 developing countries. Our methodology is designed to "reward" countries that perform well given their income per capita and "penalise" those that perform poorly given their income per capita. We do this as follows.

We estimate cross-country regressions (using data for both high-income and non-high-income countries) of each of the seven indicators on the level of GDP per capita.[13] Each indicator has two components that enter the construction of the index. One is the actual value of the indicator, which captures the actual capabilities. The other is the residual from the regression of the indicator on GDP per capita. This shows whether a country is a positive or a negative outlier, given its current stage of development. The residual obtained in each case is considered a "reward" or a "penalty". For example, consider export sophistication. We regress export sophistication (EXPY) on GDP per capita (where both are specified in levels). The residual obtained from this regression is a reward if it is positive and a penalty if it is negative. This procedure is repeated for the other six indicators. Referring back to our discussion of standardness in Section 4, a lower value is considered better. In this case, therefore, a negative residual corresponds to a reward and a positive residual to a penalty.

These seven indicators and their residuals from the regressions on GDP per capita are, however, not directly comparable because they are measured by different units. To solve this problem, we rescale all seven indicators and the residuals such that they lie between 0 (minimum value) and 1 (maximum value).[14] For purposes of the construction and rescaling of the index, we do not include the high-income countries, since we are interested in future opportunities for further transformation of the non-high-income countries only. An increasing value, except in the case of standardness, is considered better. To average across the seven indicators, we need to ensure that an increasing value of standardness (and its residual) also corresponds to an improvement. We do so by subtracting the rescaled value of standardness from 1. With all the seven indicators (and their residuals) scaled to lie between 0 and 1, and an increasing value corresponding to an improvement, we averaged the 14 components to obtain the Index of Opportunities.

Table 1 shows the seven indicators (and their corresponding residuals from the regression on GDP per capita) and the Index of Opportunities for the 96 non-high-income

Table 1. Index of opportunities and its components: non-high-income countries

	EXPY		EXPY-core		Diversification		Diversification-core		Share core		Standardness		Open forest		Index of	
Country	Actual	Residual	Actual	Residual	Actual	Residual	Actual	Residual	Actual	Residual	Actual	Residual	Actual	Residual	Opportunities	Rank
China	0.8921	0.9020	0.8694	0.9006	0.9698	0.9767	0.9496	0.9918	0.6497	0.8077	0.9352	1.0000	0.8538	0.9174	0.9011	1
India	0.6486	0.6746	0.9328	0.9874	0.9287	1.0000	0.8611	1.0000	0.6148	0.8399	0.7917	0.8698	0.8759	1.0000	0.8590	2
Poland	0.9105	0.7054	0.8170	0.7393	1.0000	0.7581	1.0000	0.6840	0.6642	0.4721	0.7070	0.5694	1.0000	0.7611	0.7706	3
Thailand	0.8703	0.8254	0.8647	0.8700	0.7411	0.7202	0.7221	0.7186	0.6450	0.7035	0.7656	0.7672	0.7370	0.7410	0.7637	4
Mexico	0.9689	0.7919	0.8746	0.8123	0.5436	0.4081	0.8290	0.5819	1.0000	0.9297	0.8260	0.7213	0.6549	0.5014	0.7460	5
Brazil	0.7127	0.6036	0.8105	0.7874	0.7142	0.6382	0.7802	0.6787	0.7208	0.7137	0.8795	0.8548	0.7566	0.6885	0.7385	6
Ukraine	0.7136	0.6751	0.5542	0.5458	0.6862	0.7027	0.7771	0.7981	0.7467	0.8700	0.7208	0.7335	0.7416	0.7753	0.7172	7
Indonesia	0.7564	0.7702	0.8256	0.8613	0.8042	0.8661	0.4840	0.6647	0.3982	0.5204	0.6976	0.7465	0.7255	0.8396	0.7114	8
South Africa	0.6911	0.5821	0.7677	0.7424	0.7811	0.6947	0.6962	0.6172	0.5892	0.5500	0.7067	0.6626	0.7960	0.7233	0.6857	9
Malaysia	1.0000	0.8501	0.8791	0.8289	0.3977	0.3122	0.5252	0.3808	0.8592	0.7854	1.0000	0.9361	0.4427	0.3533	0.6822	10
Romania	0.6744	0.5491	0.6960	0.6581	0.7301	0.6369	0.7832	0.6608	0.7072	0.6758	0.6647	0.6036	0.7278	0.6490	0.6726	11
Bulgaria	0.6825	0.5622	0.7418	0.7094	0.8042	0.7015	0.7237	0.6215	0.5951	0.5402	0.5945	0.5282	0.7656	0.6850	0.6611	12
Philippines	0.9618	1.0000	0.8399	0.8794	0.3719	0.5247	0.3466	0.5701	0.6028	0.7916	0.6513	0.6992	0.3782	0.5659	0.6560	13
Belarus	0.8946	0.8122	0.7152	0.6898	0.5612	0.5260	0.5328	0.5045	0.6193	0.6017	0.7032	0.6652	0.6389	0.6058	0.6479	14
Turkey	0.6906	0.5359	0.7186	0.6675	0.8859	0.7303	0.6443	0.5064	0.4818	0.3411	0.6134	0.5211	0.8697	0.7277	0.6382	15
Argentina	0.6398	0.4794	0.8959	0.8577	0.6018	0.4992	0.4366	0.3447	0.4762	0.3323	0.6964	0.6134	0.6180	0.5210	0.5723	16
Jordan	0.6064	0.5818	0.6653	0.6767	0.4707	0.5606	0.4336	0.5776	0.5999	0.7282	0.4763	0.4783	0.5092	0.6226	0.5705	17
Russian Federation	0.7445	0.5743	0.5901	0.5192	0.3856	0.3052	0.4718	0.3437	0.7910	0.7031	0.9050	0.8318	0.4473	0.3602	0.5695	18
Egypt	0.7451	0.7309	0.6459	0.6548	0.5771	0.6437	0.3405	0.5016	0.3860	0.4524	0.4595	0.4576	0.5605	0.6610	0.5583	19
Latvia	0.7532	0.5607	0.7520	0.6823	0.6698	0.5138	0.4992	0.3330	0.4855	0.2820	0.5455	0.4099	0.6421	0.4950	0.5446	20
Vietnam	0.5168	0.5329	0.7512	0.7929	0.5584	0.7034	0.2122	0.5037	0.2480	0.3783	0.5695	0.6221	0.5047	0.7006	0.5425	21
Bosnia Herzegovina	0.6099	0.5451	0.7370	0.7343	0.4997	0.5296	0.4137	0.4873	0.5384	0.5746	0.4735	0.4425	0.4414	0.5052	0.5380	22
Lithuania	0.7530	0.5375	0.6579	0.5699	0.7197	0.5344	0.5206	0.3194	0.4734	0.2352	0.5352	0.3798	0.7095	0.5278	0.5338	23
Sierra Leone	0.4226	0.4622	0.8363	0.9001	0.1711	0.4408	0.1924	0.5563	0.6845	1.0000	0.5737	0.6527	0.1229	0.4472	0.5331	24
Colombia	0.6311	0.5437	0.7434	0.7294	0.5030	0.5016	0.3466	0.3927	0.4505	0.4198	0.4990	0.4513	0.5609	0.5677	0.5243	25
Lebanon	0.6465	0.5112	0.6140	0.5662	0.5869	0.5128	0.4733	0.4100	0.5250	0.4323	0.5448	0.4630	0.4984	0.4524	0.5169	26
Uruguay	0.6930	0.5626	1.0000	0.9820	0.4531	0.4052	0.2519	0.2404	0.3617	0.2261	0.6255	0.5541	0.4187	0.3883	0.5116	27
Panama	0.6389	0.5097	0.5503	0.5008	0.4761	0.4305	0.4336	0.3900	0.5941	0.5310	0.6050	0.5360	0.4531	0.4238	0.5052	28
Georgia	0.5411	0.5308	0.6291	0.6476	0.2825	0.4373	0.2748	0.4945	0.6208	0.7941	0.5345	0.5599	0.2612	0.4532	0.5044	29
Tunisia	0.5321	0.4542	0.5227	0.5007	0.5162	0.5354	0.3618	0.4368	0.4574	0.4613	0.4864	0.4521	0.5093	0.5520	0.4842	30
Costa Rica	0.7682	0.6530	0.8434	0.8175	0.3313	0.3158	0.2779	0.2736	0.5386	0.4643	0.4241	0.3349	0.3677	0.3571	0.4834	31
Kenya	0.3312	0.3460	0.6703	0.7134	0.4783	0.6630	0.2382	0.5565	0.3255	0.5091	0.3881	0.4312	0.4383	0.6744	0.4831	32
Nepal	0.4112	0.4421	0.5926	0.6340	0.4032	0.6161	0.2214	0.5621	0.3569	0.5675	0.5219	0.5884	0.2041	0.4992	0.4729	33

(*Continued*)

Table 1. *Continued*

Country	EXPY		EXPY-core		Diversification		Diversification-core		Share core		Standardness		Open forest		Index of Opportunities	Rank
	Actual	Residual	Actual	Residual	Actual	Residual	Actual	Residual	Actual	Residual	Actual	Residual	Actual	Residual		
Kyrgyzstan	0.3315	0.3381	0.7038	0.7455	0.3939	0.5817	0.2366	0.5381	0.3954	0.5809	0.4868	0.5353	0.2384	0.4966	0.4716	34
Rep. of Moldova	0.4881	0.5008	0.4516	0.4700	0.4010	0.5749	0.2565	0.5365	0.4137	0.5873	0.4211	0.4551	0.3094	0.5401	0.4576	35
Venezuela	0.7488	0.6142	0.7138	0.6694	0.1843	0.1777	0.2122	0.1955	0.7128	0.6573	0.5759	0.4909	0.2159	0.2116	0.4557	36
Pakistan	0.3447	0.3434	0.8006	0.8453	0.4800	0.6374	0.1053	0.4180	0.1421	0.2404	0.4485	0.4850	0.4379	0.6434	0.4551	37
Armenia	0.4695	0.4425	0.5886	0.5991	0.2545	0.4001	0.2229	0.4347	0.5438	0.6766	0.5339	0.5511	0.2036	0.3896	0.4507	38
Guatemala	0.3683	0.3245	0.7188	0.7356	0.4882	0.5785	0.2550	0.4448	0.3423	0.4061	0.2868	0.2677	0.4554	0.5829	0.4468	39
Syria	0.6003	0.5815	0.8088	0.8343	0.3955	0.5089	0.1038	0.3356	0.1487	0.1676	0.4612	0.4665	0.3399	0.4948	0.4462	40
Senegal	0.4249	0.4433	0.3272	0.3416	0.3703	0.5677	0.2840	0.5814	0.4889	0.7064	0.3726	0.4098	0.3126	0.5629	0.4424	41
Azerbaijan	0.7036	0.6844	0.7837	0.8026	0.1635	0.3072	0.1206	0.3297	0.4524	0.5344	0.4125	0.4039	0.1523	0.3260	0.4412	42
Kazakhstan	0.6288	0.5182	0.4090	0.3583	0.2946	0.3056	0.2489	0.2790	0.5435	0.4989	0.7462	0.7102	0.2843	0.3112	0.4383	43
Sri Lanka	0.3259	0.2930	0.8535	0.8878	0.4279	0.5506	0.1023	0.3555	0.1546	0.1962	0.4957	0.5139	0.3657	0.5336	0.4326	44
El Salvador	0.5639	0.5034	0.7947	0.8006	0.3631	0.4302	0.2107	0.3462	0.3758	0.3839	0.2610	0.2110	0.3491	0.4426	0.4312	45
Uzbekistan	0.3078	0.3072	0.6818	0.7194	0.2512	0.4584	0.1359	0.4499	0.3420	0.5026	0.5251	0.5742	0.2071	0.4621	0.4232	46
Peru	0.3945	0.3063	0.6492	0.6380	0.4432	0.4791	0.2031	0.3182	0.2983	0.2632	0.4984	0.4674	0.4070	0.4717	0.4170	47
TFYR of Macedonia	0.5379	0.4333	0.4939	0.4566	0.4745	0.4680	0.3099	0.3497	0.4255	0.3731	0.3847	0.3160	0.3763	0.4053	0.4146	48
Burundi	0.1526	0.1735	0.8410	0.9080	0.0944	0.3882	0.0840	0.4855	0.4478	0.7121	0.4901	0.5636	0.0152	0.3703	0.4090	49
Dominican Rep.	0.5426	0.4665	0.6477	0.6358	0.3769	0.4236	0.2107	0.3217	0.3602	0.3393	0.3082	0.2529	0.3488	0.4222	0.4041	50
Ethiopia	0.0998	0.1100	0.9063	0.9753	0.2628	0.5148	0.1145	0.4962	0.2251	0.4165	0.3999	0.4577	0.1797	0.4934	0.4037	51
Mozambique	0.4359	0.4758	0.7430	0.7991	0.1766	0.4437	0.0672	0.4578	0.2299	0.4208	0.3578	0.4097	0.1271	0.4489	0.3995	52
Libya	0.7513	0.5535	0.7880	0.7186	0.0406	0.0000	0.0763	0.0000	0.9045	0.8069	0.5167	0.3735	0.0417	0.0000	0.3980	53
Uganda	0.2108	0.2248	0.6894	0.7388	0.2891	0.5259	0.1481	0.5085	0.3152	0.5175	0.3112	0.3531	0.1903	0.4904	0.3938	54
Algeria	0.9577	0.9057	0.6144	0.5932	0.0483	0.1405	0.0458	0.1707	0.4678	0.4518	0.4778	0.4322	0.0447	0.1546	0.3932	55
Iran	0.7199	0.5966	0.7583	0.7241	0.2222	0.2234	0.0916	0.1241	0.2547	0.0979	0.6408	0.5751	0.2318	0.2416	0.3930	56
Togo	0.2559	0.2765	0.5504	0.5904	0.2902	0.5309	0.1832	0.5410	0.3939	0.6229	0.2650	0.3032	0.1656	0.4749	0.3889	57
Bolivia	0.3884	0.3577	0.7216	0.7440	0.2688	0.4168	0.1053	0.3510	0.2501	0.3107	0.4673	0.4793	0.1929	0.3868	0.3886	58
Yemen	0.6997	0.7298	0.7323	0.7713	0.1465	0.3659	0.0641	0.3842	0.2358	0.3574	0.2149	0.2221	0.1268	0.3878	0.3885	59
United Rep. of Tanzania	0.1865	0.1957	0.6193	0.6622	0.3873	0.6015	0.1252	0.4856	0.2015	0.3678	0.3518	0.3966	0.2612	0.5438	0.3847	60
Albania	0.4280	0.3489	0.6994	0.6949	0.4054	0.4563	0.2031	0.3291	0.3265	0.3100	0.3116	0.2626	0.2494	0.3520	0.3841	61
Chad	0.3500	0.3686	0.8342	0.8908	0.0181	0.2938	0.0183	0.3914	0.3098	0.4937	0.4887	0.5458	0.0000	0.3206	0.3803	62
Chile	0.5128	0.3098	0.7205	0.6540	0.3993	0.3053	0.1756	0.0990	0.2849	0.0435	0.5639	0.4398	0.4114	0.3185	0.3742	63
Mali	0.0765	0.0761	0.6961	0.7450	0.1399	0.4017	0.0901	0.4592	0.3901	0.6081	0.4646	0.5235	0.1121	0.4228	0.3718	64
Liberia	0.3850	0.4265	0.1643	0.1792	0.0373	0.3412	0.0489	0.4573	0.6137	0.9216	0.5466	0.6266	0.0330	0.3839	0.3689	65
Morocco	0.4378	0.4133	0.3764	0.3732	0.4229	0.5439	0.1191	0.3649	0.1826	0.2282	0.3582	0.3582	0.3803	0.5425	0.3644	66
Burkina Faso	0.0134	0.0070	0.6993	0.7483	0.2024	0.4519	0.1420	0.4986	0.3872	0.6038	0.3637	0.4100	0.1198	0.4285	0.3626	67

Nigeria	0.7644	0.8116	0.5961	0.6301	0.0664	0.3185	0.0122	0.3675	0.0972	0.2047	0.3800	0.4165	0.0529	0.3473	0.3618	68
Ghana	0.1916	0.1976	0.7093	0.7572	0.2463	0.4814	0.0763	0.4400	0.1910	0.3467	0.3494	0.3910	0.1986	0.4859	0.3616	69
Tajikistan	0.3036	0.3149	0.7657	0.8155	0.1459	0.3924	0.0611	0.4179	0.2525	0.4145	0.3310	0.3663	0.0824	0.3822	0.3604	70
Ecuador	0.4911	0.4066	0.8610	0.8635	0.2573	0.3222	0.0763	0.2116	0.1866	0.1123	0.3692	0.3184	0.2358	0.3248	0.3598	71
Paraguay	0.3051	0.2600	0.6309	0.6432	0.2633	0.4026	0.0931	0.3284	0.2236	0.2639	0.5100	0.5217	0.1915	0.3746	0.3580	72
Bangladesh	0.2768	0.2935	0.7820	0.8369	0.2386	0.4798	0.0519	0.4273	0.1387	0.2864	0.2348	0.2647	0.2010	0.4932	0.3576	73
Côte d'Ivoire	0.1877	0.1838	0.3360	0.3508	0.2545	0.4730	0.1420	0.4705	0.3531	0.5325	0.4264	0.4697	0.2256	0.4908	0.3497	74
Madagascar	0.2384	0.2551	0.7061	0.7569	0.3017	0.5365	0.0718	0.4501	0.1500	0.3081	0.1903	0.2176	0.1929	0.4930	0.3477	75
Sudan	0.6004	0.6343	0.7060	0.7492	0.1163	0.3614	0.0305	0.3850	0.1542	0.2803	0.1826	0.1962	0.0886	0.3793	0.3475	76
Angola	0.6932	0.6938	0.9578	1.0000	0.0000	0.2043	0.0000	0.2767	0.0000	0.0000	0.3913	0.3968	0.0019	0.2368	0.3466	77
Rwanda	0.1347	0.1443	0.7042	0.7560	0.0790	0.3602	0.0473	0.4365	0.3104	0.5170	0.4357	0.4949	0.0329	0.3669	0.3443	78
Congo	0.6124	0.6064	0.8430	0.8768	0.0762	0.2670	0.0183	0.2922	0.1312	0.1680	0.2854	0.2786	0.0517	0.2786	0.3419	79
Turkmenistan	0.5389	0.5087	0.6915	0.7053	0.0949	0.2573	0.0336	0.2702	0.2019	0.2239	0.3466	0.3332	0.0643	0.2605	0.3236	80
Central African Rep.	0.1176	0.1280	0.7453	0.8014	0.0433	0.3350	0.0260	0.4250	0.2714	0.4724	0.3618	0.4138	0.0190	0.3599	0.3229	81
Honduras	0.2913	0.2604	0.3653	0.3647	0.3379	0.4853	0.1237	0.3822	0.2355	0.3092	0.3044	0.3035	0.2778	0.4704	0.3222	82
Lao People's Dem. Rep.	0.2302	0.2296	0.7534	0.7999	0.2134	0.4389	0.0504	0.3987	0.1443	0.2662	0.1919	0.2061	0.0928	0.3814	0.3141	83
Papua New Guinea	0.2421	0.2363	0.7431	0.7857	0.1295	0.3611	0.0260	0.3668	0.1214	0.2242	0.3265	0.3521	0.0903	0.3682	0.3124	84
Niger	0.2172	0.2386	0.0000	0.0000	0.1607	0.4331	0.1099	0.4938	0.4197	0.6647	0.4860	0.5548	0.1180	0.4441	0.3101	85
Mongolia	0.1921	0.1683	0.7257	0.7604	0.2150	0.4098	0.0412	0.3510	0.1197	0.1945	0.3251	0.3397	0.1177	0.3671	0.3091	86
Cameroon	0.3713	0.3761	0.6908	0.7288	0.1245	0.3553	0.0305	0.3678	0.1412	0.2467	0.1684	0.1737	0.1048	0.3780	0.3041	87
Zambia	0.2565	0.2698	0.1582	0.1646	0.1942	0.4414	0.0870	0.4511	0.2798	0.4623	0.4158	0.4666	0.1538	0.4519	0.3038	88
Nicaragua	0.2838	0.2736	0.4968	0.5166	0.2918	0.4800	0.0779	0.3899	0.1686	0.2672	0.1317	0.1268	0.2062	0.4484	0.2971	89
Jamaica	0.3380	0.2272	0.4139	0.3763	0.1821	0.2459	0.1359	0.2360	0.4618	0.4400	0.2725	0.1999	0.1879	0.2681	0.2847	90
Cambodia	0.2709	0.2801	0.5499	0.5837	0.1843	0.4248	0.0397	0.4032	0.1320	0.2633	0.1407	0.1535	0.1277	0.4208	0.2839	91
Guinea	0.2350	0.2477	0.6868	0.7343	0.0976	0.3655	0.0336	0.4129	0.1955	0.3583	0.0740	0.0842	0.0614	0.3791	0.2833	92
Malawi	0.0000	0.0000	0.6942	0.7466	0.1585	0.4288	0.0519	0.4457	0.1948	0.3758	0.1485	0.1748	0.0877	0.4164	0.2803	93
Benin	0.1257	0.1223	0.5008	0.5312	0.1448	0.3938	0.0687	0.4269	0.2792	0.4515	0.2069	0.2284	0.0684	0.3735	0.2802	94
Mauritania	0.3423	0.3505	0.7956	0.8446	0.0521	0.3059	0.0122	0.3661	0.1157	0.2268	0.0721	0.0705	0.0272	0.3252	0.2791	95
Haiti	0.2620	0.2758	0.2587	0.2729	0.1487	0.4046	0.0504	0.4229	0.2092	0.3726	0.0000	0.0000	0.0666	0.3807	0.2232	96

Source: UNCOMTRADE, WDI and own estimates.

countries.[15] A higher value of index indicates that a country has accumulated more capabilities, and this provides the country with more opportunities to generate and sustain further transformation and growth.[16]

Table 1 shows that, among the non-high-income countries, China has the highest score, followed by India, Poland, Thailand and Mexico. Brazil comes in 6th place and Russia in 18th. Other well-placed Asian countries are Indonesia (8th), Malaysia (10th), the Philippines (13th), Vietnam (21st) and Georgia (29th). To understand the final ranking, one has to look at the 14 partial indicators.[17] China and Thailand rank in the first quintile in all indicators.[18] Mexico ranks 5th; it does very well in all indicators (it is in the first quintile in most of them), except in the residual of the regression of diversification on GDP per capita (fourth quintile). Malaysia is ranked 10th, but in two indicators, the residuals of diversification and open forest, it is in the last quintile, indicating that, given its income per capita, Malaysia should do better. On the other hand, some Asian countries are ranked in the fourth and fifth quintiles (Tajikistan, Bangladesh, Turkmenistan, Lao PDR, Mongolia and Cambodia). This low ranking is a reflection of the position of these countries' export baskets in the product space (in general, low diversification and sophistication). Obviously, this could be reversed through policies, for example to help develop new capabilities.[19]

The Index of Opportunities that we have presented ranks countries according to the accumulated set of capabilities, an indicator of the opportunities to continue transforming and growing. To see how the index performs as a predictor of future growth, we

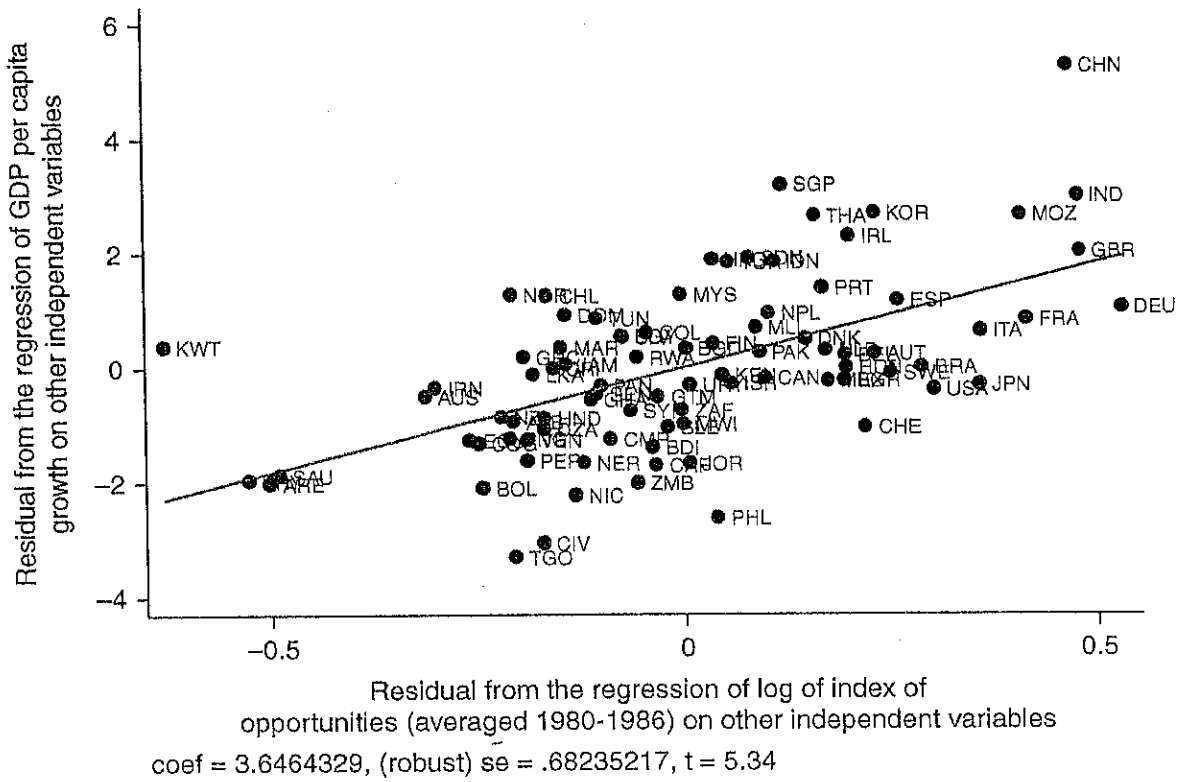


Figure 16. Index of Opportunities (1980–1986) and per capita GDP growth (1980–2007).
Note: Other independent variables are GDP per capita, investment-to-GDP ratio, and secondary education.
Source: GDP per capita and investment-to-GDP ratio are from World Development Indicators (WDI), secondary education is from Barro and Lee, and own estimates for Index of Opportunities.[20]

constructed the index for 1980–1986 (we use exactly the same indicators and the same procedure discussed above). We regressed the average per capita growth rate for 1980–2007 on (variables in logarithms) initial GDP per capita (i.e. in 1980), the average index of opportunities for 1980–1986, the initial investment-to-GDP ratio (i.e. in 1980) and the percentage of the adult population (ages 15 and above) who had completed at least secondary education. The estimated coefficient of the Index of Opportunities (1980–1986) is 3.65, statistically significant at the 1% confidence level. This coefficient implies that a 10% increase in the value of the index yields 0.36 percentage points of additional growth. Figure 16 shows the partial regression plot and indicates that there is a positive and significant relationship between the capabilities (i.e., opportunities or seeds) that existed in early 1980s and the outcomes (i.e., what they reap) in the form of per capita GDP growth over the period 1980–2007.

8. Conclusions

In this paper, we have developed an Index of Opportunities, based on four dimensions that relate to a country's export basket and its position in the product space. The four dimensions are the sophistication of the export basket, its diversification, its standardness (measured by the ubiquity or lack of uniqueness of the export basket) and the possibilities of exporting other products with RCA. The idea underlying the index is that, in the long run, a country's income is determined by the variety and sophistication of the products it makes and exports, and by the capacity of the country to accumulate new capabilities.

The results show that countries such as China, India, Poland, Thailand, Mexico and Brazil have accumulated a significant number of capabilities that will allow them to do well in the long run. To do so, they have diversified and increased the level of sophistication of their export structures. Of course, these are not the only factors that will determine these countries' performance in the long run: good policies and incentives do matter. Our point is that these countries have sown the land with good seeds. If they take care of it (i.e. if they implement appropriate policies, provide support with good governance and provide the right incentives), they should expect a good harvest. At the other extreme, countries such as Guinea, Malawi, Benin, Mauritania and Haiti score very poorly in the Index of Opportunities because their export structures are neither diversified nor sophisticated, and they have accumulated very few and unsophisticated capabilities. These countries urgently need to implement policies that will lead to the accumulation of capabilities.

Notes

[1] Chang (2009) argues that development is largely about the transformation of the productive structure and the capabilities that support it. This is what the index tries to capture.

[2] In the working paper version (Felipe *et al.*, 2010), we also show the index for a total of 130 countries (96 developing and 34 developed countries). For in-depth analyses of China and India, see Felipe, Kumar, Usui, & Abdon (2013) and Felipe, Kumar, & Abdon (2013), respectively.

[3] A detailed explanation of how the product space was developed is available in Hidalgo *et al.* (2007).

[4] Sutton (2005) argues that a good proxy for the cost of transferring a capability is the number of individuals that are needed to assemble in order to form a sufficient subset of employees who can carry a given capability. The important things that must be transferred relate not so much to items that can be successfully reduced to a statement in a manual, but rather to complex and interrelated patterns of working practices that are extremely difficult and time-consuming to unravel and redesign.

[5] Following Hausmann *et al.* (2007), we calculate the level of sophistication of a product (PRODY) as a weighted average of the GDP per capita of the countries exporting that product. Algebraically:

$$\text{PRODY}_i = \sum_c \left[\frac{x\text{val}_{ci} / \sum_i x\text{val}_{ci}}{\sum_c (x\text{val}_{ci} / \sum_i x\text{val}_{ci})} \right] \times \text{GDPpc}_c, \tag{1}$$

where $x\text{val}_{ci}$ is the value of country c's export of commodity i and GDPpc_c is country c's per capita GDP. PRODY is measured in 2005 PPP$. PRODY is then used to compute EXPY as:

$$\text{EXPY}_c = \sum_i \left(\frac{x\text{val}_{ci}}{\sum_i x\text{val}_{ci}} \times \text{PRODY}_i \right). \tag{2}$$

EXPY is measured in 2005 PPP$. We use highly disaggregated (SITC-Rev.2 four-digit level) trade data for the years 2001–2007 from the United Nations Commodity Trade (UNCOMTRADE) database. PRODY is calculated for 779 products. PRODY used is the average of the PRODY of each product in the years 2003–2005. GDP per capita (measured in 2005 PPP$) is from the World Development Indicators (WDI).

[6] Only countries with population of two million and above are included in our analysis.

[7] If the non-high income countries were arranged in descending order of their average per capita income during 2001–2007, China ($3823), India ($2122) and the Philippines ($2846) would not show in the top 30).

[8] The list of country codes and the corresponding countries is provided in Table A1.

[9] We use the measure proposed by Balassa (1965). Algebraically:

$$\text{RCA}_{ci} = \frac{x\text{val}_{ci} / \sum_i x\text{val}_{ci}}{\sum_c x\text{val}_{ci} / \sum_i \sum_c x\text{val}_{ci}}. \tag{3}$$

A country c is said to have an RCA in a commodity i if the aforementioned index, RCA_{ci}, is greater than 1. The index of revealed comparative advantage can be problematic, especially if used for comparison of different products. For example, a country very well endowed with a specific natural resource can have an RCA in the thousands. However, the highest RCA in automobiles is about 3.6.

[10] The measure of diversification shown is the average number of products that a country exported with RCA during 2001–2007. It does not show that a country, say China, had RCA in the same 257 products in each year during 2001–2007.

[11] Following, Hidalgo & Hausmann (2009) "standardness" (or average ubiquity) is computed as

$$\text{Standardness}_c = \frac{1}{\text{diversification}_c} \sum_i \text{ubiquity}_{ic}, \tag{4}$$

where diversification is the total number of commodities in which country c has RCA and the *ubiquity* of commodity i is the number of countries exporting commodity i with RCA.

[12] Algebraically:

$$\text{Open\_Forest}_c = \sum_j \left[\omega_{cj} (1 - x_{cj}) \text{PRODY}_j \right], \tag{5}$$

where $\omega_{cj} = \sum_i \phi_{ij} x_{ci} / \sum_i \phi_{ij}$ is the density; $x_{ci}, x_{cj} = \begin{cases} 1 & \text{if } \text{RCA}_{i,j} \geq 1 \text{ for country } c, \\ 0 & \text{if } \text{RCA}_{i,j} < 1 \text{ for country } c; \end{cases}$ φ_{ij} denotes the proximity or probability that the country will shift resources into good j (not exported with RCA), given that it exports good i with RCA; PRODY_j (see Equation (1)) is a measure of the sophistication of product j (not exported with RCA) and $\omega_{cj}\text{PRODY}_j$ is the expected value (in terms of the sophistication of exports) of good j. Open forest is measured in 2005 PPP$.

[13] We use the average for the period 2001–2007 for each of the seven indicators and for GDP per capita. For diversification, diversification-core, share-core and open forest, the square of GDP per capita was also included as regressor (see Figures 7, 9, 11 and 15).

[14] Each indicator is rescaled as follows. Suppose the original value of the indicator i is X and the rescaled value is X_{new}, then, $X_{new} = (X - X_{min})/(X_{max} - X_{min})$, where X_{min} (X_{max}) is the minimum (maximum) value of indicator i among the set of non-high-income countries in Table 1.

[15] The Index of Opportunities developed in this paper uses EXPY, which relies on PRODY, a product variable constructed as a weighted average of the GDP per capita of all countries that export the product. Therefore, the finding that rich countries export "rich-country" products is somewhat tautological. One can then argue that our Index suffers from the same problem. To solve this problem, Hidalgo & Hausmann (2009) developed a measure of sophistication called "country complexity" that does not rely on income. The complexity measure uses diversification and standardness, which are also used to construct our Index. We follow Hidalgo and Hausmann's method of reflections to construct country complexity and compare it to our Index. The method of reflections looks at trade data as a network connecting two mutually exclusive sets—the set of countries and the set of products that they export with revealed comparative advantage (RCA). To make the method operational, Hidalgo & Hausmann (2009) define diversification as the number of products that a country exports with RCA, and ubiquity as the number of countries that export the product with RCA. The Spearman rank correlation between EXPY and country complexity is 0.8201. This implies, in our view, that economic complexity and EXPY, effectively, convey the same information, and hence, despite the potential circularity in the calculation of EXPY, there is no real difference for our purposes between the two measures. Hidalgo & Hausmann (2009) also find the two measures to be positively correlated. The rank correlation between our index and the index of economic complexity is 0.47 (and statistically significant at the 1% level), which indicates that, although correlated, our index captures other dimensions. Details on the calculations of the complexity measures are available from the authors upon request. We thank a referee for the suggestion to include this discussion in the paper.

[16] We have also checked whether the ranking is influenced by the choice of period over which the data are averaged. We constructed the Index of Opportunities based on averages for 2003–2007 and 2005–2007, and find that the respective correlations with the reported index for 2001–2007 are very high: 0.995 and 0.987, respectively.

[17] With respect to the overall ranking and its interpretation, while there is a clear difference in the value of the indices of China (ranked 1st) and Lithuania (ranked 20th), the difference between the values of South Africa and Malaysia, ranked 9th and 10th, respectively, is of no consequence.

[18] The working paper version (Felipe *et al.*, 2010) shows the quintiles for each of the 14 components.

[19] In the working paper version (Felipe *et al.*, 2010), we also show the Index of Opportunities with both the high-income and the non-high-income countries included (130 countries). To construct this index, we repeat the exercise described previously and rescale each of the indicators (to lie between 0 and 1), this time also including the high-income countries. X_{min} and X_{max} are taken over the set of all (high- and non-high-income) countries. As expected, the high-income countries dominate the top 20. However, what is interesting is that the top eight countries in Table 1 (except Ukraine) make it into the top 20 when considering the larger sample: China is third behind Germany and the USA; India is fifth, just behind Japan, and ahead of France and Italy; Poland is ranked 14th; Thailand is ranked 15th; Brazil 18th; Mexico 19th and Indonesia 20th. Not only do these seven countries rank very high in terms of the overall score, they also rank high on most individual indicators. Some of the 14 components are highly correlated with each other. Out of the 91 possible correlations, 18 are greater than 0.7 (in the sample of developing countries only). One may argue then that these variables are capturing similar information. To avoid this problem, we constructed the index using the first component obtained from a principal components analysis (PCA) based on the 14 variables. We find that the rank correlation between our Index and an index based on PCA is high (0.98), positive and statistically significant.

[20] http://www.barrolee.com/data/yrsch.htm

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Appendix

Table A1. List of country codes

ISO code	Country	ISO code	Country	ISO code	Country
AGO	Angola	GTM	Guatemala	NPL	Nepal
ALB	Albania	HKG	China, Hong Kong SAR	NZL	New Zealand
ARE	United Arab Emirates	HND	Honduras	OMN	Oman
ARG	Argentina	HRV	Croatia	PAK	Pakistan
ARM	Armenia	HTI	Haiti	PAN	Panama
AUS	Australia	HUN	Hungary	PER	Peru
AUT	Austria	IDN	Indonesia	PHL	Philippines
AZE	Azerbaijan	IND	India	PNG	Papua New Guinea
BDI	Burundi	IRL	Ireland	POL	Poland
BEL	Belgium	IRN	Iran	PRT	Portugal
BEN	Benin	ISR	Israel	PRY	Paraguay
BFA	Burkina Faso	ITA	Italy	ROM	Romania
BGD	Bangladesh	JAM	Jamaica	RUS	Russian Federation
BGR	Bulgaria	JOR	Jordan	RWA	Rwanda
BIH	Bosnia Herzegovina	JPN	Japan	SAU	Saudi Arabia
BLR	Belarus	KAZ	Kazakhstan	SDN	Sudan
BOL	Bolivia	KEN	Kenya	SEN	Senegal
BRA	Brazil	KGZ	Kyrgyzstan	SGP	Singapore
CAF	Central African Rep.	KHM	Cambodia	SLE	Sierra Leone
CAN	Canada	KOR	Rep. of Korea	SLV	El Salvador
CHE	Switzerland	KWT	Kuwait	SVK	Slovakia
CHL	Chile	LAO	Lao People's Dem. Rep.	SVN	Slovenia
CHN	China	LBN	Lebanon	SWE	Sweden
CIV	Côte d'Ivoire	LBR	Liberia	SYR	Syria
CMR	Cameroon	LBY	Libya	TCD	Chad
COG	Congo	LKA	Sri Lanka	TGO	Togo
COL	Colombia	LTU	Lithuania	THA	Thailand
CRI	Costa Rica	LVA	Latvia	TJK	Tajikistan
CZE	Czech Rep.	MAR	Morocco	TKM	Turkmenistan
DEU	Germany	MDA	Rep. of Moldova	TUN	Tunisia
DNK	Denmark	MDG	Madagascar	TUR	Turkey
DOM	Dominican Rep.	MEX	Mexico	TZA	United Rep. of Tanzania
DZA	Algeria	MKD	TFYR of Macedonia	UGA	Uganda
ECU	Ecuador	MLI	Mali	UKR	Ukraine
EGY	Egypt	MNG	Mongolia	URY	Uruguay
ESP	Spain	MOZ	Mozambique	USA	USA
ETH	Ethiopia	MRT	Mauritania	UZB	Uzbekistan
FIN	Finland	MWI	Malawi	VEN	Venezuela
FRA	France	MYS	Malaysia	VNM	Vietnam
GBR	UK	NER	Niger	YEM	Yemen
GEO	Georgia	NGA	Nigeria	ZAF	South Africa
GHA	Ghana	NIC	Nicaragua	ZMB	Zambia
GIN	Guinea	NLD	Netherlands		
GRC	Greece	NOR	Norway		