Export sophistication, growth and the middle-income trap*

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9.1 Introduction

Structural transformation is at the heart of economic development. Successful developing countries progressively change their production structure, replacing low value added activities and unsophisticated goods with higher value added activities and more sophisticated products. A low-income country usually relies heavily on extractive resources, monoculture export and subsistence agriculture. Economic take-off starts with the shift of existing resources into processing activities and the production of basic manufacturing goods. During the "industrialization stage" mechanization spreads to the primary sector, thereby sustaining the fall in agricultural employment. At the same time, strong complementarities with the service sector ensure a steady rise in employment and output in commercial services, transportation and finance.

In these initial stages of diversification, the growth path invariably begins inside the global production frontier, with developing countries undertaking the manufacture of goods already produced elsewhere. Inside the frontier, countries are looking to catch up with those already at the frontier through rapid capital accumulation and technological adaptation in activities already in the industrial pipeline. These goods are also the ones that will drive export diversification.

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To sustain the development process, however, inside-the-frontier innovations are not enough. An emerging literature highlights the importance of capabilities and the need for a country to progressively increase its capability to develop and diffuse new products (and processes) and so to catch up (see the chapter by Nübler in this volume). Hence, it is the ability of a society and of firms to accumulate skills and knowledge, to combine the productive knowledge of its individuals and to develop collective competencies that determines its ability to diversify and increase internal value added and so to produce goods that are progressively more sophisticated and competitive in international markets, challenging the advanced competitors on the technological frontier.

Structural change and the development of capabilities are nevertheless challenging endeavours. Changing the economic structure of the economy requires the acquisition and refinement of productive knowledge. This may become a chicken-and-egg problem when learning takes place mainly in industries. A country cannot produce goods of which it has no knowledge, and it does not accumulate knowledge of products that it does not produce. Hausmann et al. (2011) acknowledge this, pointing out that countries move from the products that they already produce to others that are similar in terms of the knowledge required to produce them. Industrial development is assumed to be a gradual and path-dependent process, and countries are unable to jump into distant products.

Hausmann et al. (2011) examine differences among countries in terms of the complexity of products they export; they assume that a country's export structure reflects its capabilities to shift and diversify into products identified as related to products it already produces. Countries displaying a more complex and varied productive or export structure are assumed to have developed more capabilities. A country's economic complexity is measured by the number, variety, and rarity of the goods that it exports.

Hausmann et al. find that economic complexity is not perfectly correlated with each country's level of income but that the divergence between the expected and the actual level of economic complexity of a country is a good predictor of future economic growth. That is, countries with a more complex productive structure than that predicted by their level of income exhibit faster growth in subsequent years.

Nübler (in this volume) develops an explicit concept of capabilities, arguing that capabilities are not only created through learning in industries but also by knowledge acquired in formal education and in social networks such as families and communities, and, furthermore, that transformation of these knowledge systems in the labour force can open up options for jumping into distant products in the product space. Hence, a sustained process of productive transformation and of catching up from low- to middle- and eventually into advanced income ranks

requires deliberate and continuous learning at different places – in society, in schools, in firms – in order to expand options for gradually increasing sophistication of exports and for jumping into advanced technological regimes.

Historically, few middle-income countries have been able to enter the group of high-income economies. This suggests that, at middle levels of income, sustaining structural transformation and economic growth becomes more difficult. On one hand, these countries have reached a level of development high enough to prevent them from competing on the same ground with low-income countries. On the other hand, they still lack the proper knowledge structure in the labour force and the mix of institutional and production factors that would enable them to enter and compete in knowledge-intensive products. As a result, many of the countries that reach middle-income status are unable to continue the process of income convergence with rich economies and remain trapped in what has been called the middle-income trap.

For example, a majority of Latin American countries, although they had achieved a relatively high level of development as early as the end of the nineteenth century, have been held back by a failure to diversify and upgrade their manufacturing sectors. More recently, among the group of successful East Asian economies, growth performance has differed significantly; more constrained growth has been associated with the expansion of manufacturing activities inside global value chains such as performing simple assembly or processing of light industry products for export (e.g. garments, footwear, and foodstuffs) or the supply of electronic parts and components. In comparison to the high achievers such as China, Taiwan (China) and the Republic of Korea, middle achievers Malaysia and Thailand and low achievers Indonesia and the Philippines have found it difficult to establish domestic producers able to diversify and upgrade to the more technologically sophisticated parts of the chain (Ohno, 2009; Studwell, 2013).

The successful structural transformation experienced by the Asian first-tier newly industrialized countries (NICs) has been analysed recently by Jankowska, Nagengast and Perea (2012). Their study is based on the Product Space methodology (Hidalgo et al., 2007), which maps the relative proximity, or similarity, of traded products and shows that, in the case of the Asian NICs, structural transformation was a gradual process. New production was sequentially developed in industries (e.g. iron, steel and electronics) using skills and capabilities transferable with relative ease from existing industries. This strategic increase in high "connectivity" sectors[1] allowed undertaking a gradual yet systematic transition towards higher value added activities, especially those requiring similar technology and

[1] A high connectivity sector is one that can easily jump to other potential exports.

production techniques. By contrast, Latin American countries tend to be characterized by economic specialization in industries that are relatively far from high value added products, leading to less connectivity of their export profiles.

This chapter examines empirically this linkage between, on one hand, the dynamics and the composition of the export structure (as measured in particular by the level of sophistication of the exported products) and, on the other hand, economic growth. We do not look directly at structural change. In a sense we test the impact of the type of exports on growth without looking into the channel of transmission. To factor out the key features that characterize growth-enhancing products, we employ the measure of product sophistication developed by Hausmann, Hwang and Rodrik (2007). This measures sophistication of traded goods based on the income levels of countries exporting such goods. We then normalize this measure to a 0–100 scale. According to this index, the higher the average income of its exporters, the more sophisticated the product, i.e. a high (low) level of sophistication indicates that the product is exported mainly by rich (poor) countries.[2] In line with Hausmann, Hwang and Rodrik (2007), our illustrative regressions confirm that the sophistication of exports has a positive and significant effect on economic growth. However, we find no evidence of direct effects of technological intensity or export diversification on economic performances.[3]

The main contribution of this paper lies in the study of the dynamic variations in the export structure and the likelihood of remaining trapped at intermediate levels of income. We assume a Markov process and group countries on the basis of their export sophistication. Then we estimate how the probabilities of transition between groups change through time. Our results cast a shadow on the development perspectives of many developing countries, which are exposed to the risk of being unable to shift their production to highly sophisticated products. In line with the results of Hausmann et al. (2011), our analysis shows that, even in the long run, countries are unlikely to jump to products that are far from the knowledge embedded in the goods that they already produced. Knowing which export goods promote higher income levels is clearly not enough. The absence of productive knowledge

[2] This index is very similar to the sophistication index proposed by Lall, Weiss and Zhang (2006). There are small differences in the calculation process of each index. However, both of them capture the fact that a high sophistication level is correlated with high levels of per capita income.

[3] This is in line with the results of Imbs and Wacziarg (2003) and Klinger and Lederman (2006). They suggest that, while developing countries are characterized mainly by progressive diversification and inside-the-frontier innovation, more advanced economies tend to concentrate their exports and base their growth on a narrower set of products and services on the frontier, leading to a more specialized economic structure. Running regressions on a vast sample of countries at different levels of development therefore is likely to produce insignificant estimates for the coefficient gauging the impact of export diversification on economic growth.

and capabilities hinders countries from producing the goods that promote growth. These findings support the framework of catching up suggested by Nübler in this volume. Nübler argues that collective capabilities are not created automatically, but rather they require deliberate policies to enrich the knowledge structure in the labour force and to build "smart" enterprise routines and institutions in the country, in addition to creating the right incentives to invest in a new range of activities crucial to climbing the ladders of sophistication and to fostering development.

In a closely related contribution, Felipe, Kumar and Abdon (2010) provide empirical support for the contention that countries that are unable to upgrade and diversify their exports may become caught in a middle-income trap. They classify countries according to the sophistication and connectivity of their exports. They find that 120 of 154 countries are in a "bad product" trap, as they export mostly unsophisticated and unconnected products. They conclude that escaping this trap will require policy interventions aimed at addressing the market failures that are pervasive in many developing countries.

The remainder of this chapter is organized as follows. Section 9.2 describes the data on export sophistication and discusses the methodology. Section 9.3 summarizes the results of the growth regressions. Section 9.4 presents the dynamic results on sophistication and highlights the risk of middle-income-traps. Section 9.5 offers some concluding remarks.

9.2 Export sophistication index: Methodology and descriptive statistics

9.2.1 Methodology

To measure the quality of exports and its variations over time and to determine whether it is crucial to the process of development, we focus on a key characteristic of a country's export package: sophistication. We use a measure of export sophistication created by Hausmann, Hwang and Rodrik (2007). It is an outcomes-based measure of the sophistication of a country's export package – essentially the GDP per capita associated with the basket. This metric has two clear advantages over those used in the previous literature. First, it is defined at a highly disaggregated level (in the case of Hausmann, Hwang and Rodrik, HS 6-digits), which allows a fine-tuned evaluation. Second, it is outcomes-based, whereas past metrics were based on a priori assumptions of sophistication (e.g. all agriculture is less sophisticated, all manufactures are more sophisticated).

The export sophistication index attempts to capture the implied productivity of exported goods. The intuition behind it is that, when exporting a good, countries *reveal* their productivity levels, like the concept of revealed comparative advantage. For instance, in the absence of trade interventions, products exported by richer countries will have features that allow high wage earning producers to compete in world markets. Advanced technological content is certainly one of these features, but is not the only one. Other factors, such as the availability of natural resources, marketing or branding, quality of infrastructure, transportation costs or the degree of fragmentability of the production process,[4] may also play an important role in determining a country's export basket.

In this context Hausmann, Hwang and Rodrik (2007) developed a methodology to construct a quantitative index that ranks traded goods according to their implied productivity and that in a broad sense captures the different factors determining a country's export basket.[5] The overall assumption is that the higher the average income of the exporter, the more sophisticated the export. We follow Hausmann, Hwang and Rodrik (2007) and construct an export sophistication index by country for every second year during the period 1996–2008.

The index is constructed in three stages. The first stage involves measuring the GDP per capita (i.e. the implicit productivity level) associated with each exported product. This product level measure of sophistication is designated $PRODY_k$ and is calculated as the revealed comparative advantage (RCA)-weighted gross national income (GNI) per capita of each country exporting product *k*:

$$PRODY_k = \sum_j \frac{\frac{X_{kj}}{X_j}}{\sum_j \frac{X_{kj}}{X_j}} Y_j$$

where X_{kj} represents the value of exports of product *k* by country *j*; X_j the total value of exports of country *j*; and Y_j its GNI per capita. So, if a product accounts for a large share of poor countries' export baskets but a small percentage of rich countries' export baskets, then it will have a lower *PRODY*, as it is a "poor-country" export. Conversely, if a product accounts for a large share of rich countries' export packages but is not significant among poor countries' exports, it will have a higher *PRODY*, as it is a "rich country" export.

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[4] The fragmentability of production has intensified in recent years. When the production process is divisible, parts of it may be relocated to low-wage countries, reflecting the possibilities of separating segments of the value chain.

[5] A similar metric has been developed by Lall, Weiss and Zhang (2006).

In stage II we use this product level variable to measure the overall level of income associated with a country's export basket, i.e. the export sophistication level of country *j* during year *t* ($EXPY_{jt}$). This is done by evaluating the average of the *PRODY* of all goods that a country exports, each PRODY weighted by its share of total exports. Formally:

$$EXPY_{jt} = \sum_k \frac{X_{kjt}}{X_{jt}} PRODY_k$$

Naturally, since *PRODY* is measured using the GNI per capita of the typical exporter, rich countries have a high *EXPY* and poor countries have a low *EXPY*. This is by construction: rich countries export "rich country" goods and poor countries export "poor country" goods. There is significant variance in this relationship, however. There are many countries that have roughly equivalent levels of GNI per capita, but some of them have somehow managed to export a relatively more sophisticated set of products than others.

Finally, in stage III, we construct the export sophistication index, SI_{jt} by normalizing the export sophistication level, $EXPY_{jt}$, to a scale from 0 to 100 for every year. The country with the highest *EXPY* is set at 100 and the country with the lowest *EXPY*, at zero. The formula we apply for this normalization is:

$$SI_{jt} = \frac{EXPY_{jt} - EXPY_t(Min)}{EXPY_t(Max) - EXPY_t(Min)} * 100$$

SI_{jt} is, then, the normalized productivity level, on a scale 0–100, associated with country *j*'s export basket.

Sophistication measures of this kind display a positive correlation with technological intensity. Such a correlation, however, is not as close as would have been anticipated by standard trade theory. Lall, Weiss and Zhang (2006) show that there are cases where high technology products have low levels of sophistication, suggesting, for instance, that some production processes can be fragmented and, thus, parts of the process relocated to lower wage countries.[6] Likewise, there are low technology products with high sophistication levels as measured by the index, suggesting that the products have specific requirements for natural resource or logistics, or other needs that are out of reach for poorer countries – or that these products are subject to policy interventions.

[6] For instance, Srholec (2007) shows that the specialization of some developing countries in high-tech exports can be attributed to the effect on trade statistics of international fragmentation of production in electronics.

9.2.2 Descriptive statistics

We calculate the sophistication index (SI) for 158 countries for every second year during the period 1996–2008, i.e. 1996, 1998...2008.[7] The countries included are those for which data on exports by product, GNI per capita and per capita growth rates were available for the period under examination. The construction of the SI is based on two data sources: (i) UNCTADstat, for trade data by country for 259 products, using the Standard International Trade Classification (SITC) Rev. 3 at the 3-digit level, and (ii) World Development Indicators, for data on GNI and per capita growth rates.

Table 9.1 presents some descriptive statistics for our sophistication index, SI.

Table 9.2 presents the countries with the highest and the lowest average SIs in the sample for the analysed period.

In order to illustrate how the export sophistication level of some countries varied across time, figure 9.1 depicts the evolution of the SI for selected

Table 9.1 Descriptive statistics for the SI, 1996–2008

Year	No. of countries	Mean	Standard deviation
1996	158	43.06	25.39
1998	158	45.79	23.55
2000	158	48.21	24.99
2002	158	46.88	25.48
2004	158	44.33	23.59
2006	158	45.93	22.98
2008	158	44.65	23.88

Table 9.2 Top five and bottom five countries by average SI, 1996–2008

Country	Highest average SI	Country	Lowest average SI