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OPERATIONALIZING THE PRODUCT SPACE: A ROAD MAP TO EXPORT DIVERSIFICATION

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United Nations Conference on Trade and Development (UNCTAD)

Abstract

Much of industrial development is a gradual and path-dependent process. Countries move from the products that they already produce to others that are similar, in terms of capital requirements, knowledge and skills. Not all the feasible new products however contribute in the same way to aggregate value added and growth. A key challenge along the diversification process is the identification of those sectors and goods that are feasible and at the same time have a higher potential to sustain economic development. This paper proposes a methodology that operationalizes the notion of product space, developed by Hausmann and Klinger (2007), Hausmann et al. (2007), and Hidalgo et al. (2007), in order to assist countries to identify those new products that could augment aggregate value using the existing productive capabilities embedded in the current production structure.

I. INTRODUCTION

Economic development is a long and challenging process of structural transformation. It involves large-scale changes as new and leading sectors emerge as drivers of employment creation and technological upgrading. This process is particularly challenging for developing countries since their efforts to upgrade and diversify their economies take place in an interdependent world where earlier industrializers have already accumulated significant cost and productivity advantages. In this context, it is critical to use targeted and selective government policies to sustain the transformation process and boost economic dynamism.

There is not however a uniform model of effective policy intervention. History shows that successful governments have addressed different challenges and used a variety of policies encompassing, for instance, market building, technological upgrading, removal of infrastructural bottlenecks and support to enterprise development.

This paper focuses only on one of the challenges in the process of structural transformation: the gradual introduction of more advanced (and higher value-added) goods in the productive structure. It presents a simple methodology to identify potential sectors and goods where a country is more likely to be competitive, given its productive capabilities. In doing so, we operationalize the notion of the product space, developed by Hausmann and Klinger (2007), Hausmann et al. (2007), and Hidalgo et al. (2007).

We consider 94 countries and 3 special territories and build a dataset that classifies all goods not-yet produced by each country into different groups. The different groups contain products that are progressively farther from the current export basket. The further the group the more difficult it is for a country to produce those goods. Then, we identify in each group those products with highest sophistication.

The paper is intended solely to present the data, lay out the methodology and show how it can be made operational. Our approach is entirely supply-side based and implicitly assumes demand to be present for any of the products identified. In fact, our methodology simply determines which goods are feasible to produce (i.e. goods not so distant from the current export basket in the product space) and also improve average sophistication, but does not look into their effective marketability.

The methodology can be seen therefore as a tool to pre-screen products and locate them in the product space, but policymakers would need to complement this analysis by looking at the existing demand, in internal and external markets, and design appropriate policies.[1] Policymakers would also need to choose the appropriate policy mix to support those goods identified as potentially worth to produce and export. In this sense, this paper proposes a new instrument to be added to the policymakers' toolset and by no means an alternative to existing industrial policymaking practices.

The remainder of the paper is organized as follows. Section II provides some background on the product space literature. Section III presents the methodology in detail. Section IV presents the potential benefits of implementing our methodology, its feasibility and some of its limitations. Section V considers the case of Ethiopia, and lays out a roadmap to choose sectors and products sufficiently close to the current export basket and with higher sophistication. Section VI contains the conclusion.

II. BACKGROUND

In a series of articles, Hausmann and Klinger (2007), Hidalgo et al. (2007) and Hidalgo and Hausmann (2009) explain economic development as a process of learning how to produce (and export) more complex products.[2] They show that a country's development path is determined by its capacity to accumulate the capabilities required to produce different and progressively more sophisticated goods. In this framework, capabilities are the set of product-specific factors (capital, knowledge, institutions, etc.) needed to produce a good. At the firm level, they are the "know-how" or working practices held collectively by the group of individuals comprising the firm.[3]

Hidalgo et al. argue that the assets and capabilities needed to produce one good are imperfect substitutes for those needed to produce another good, but this degree of asset specificity varies from product to product.[4] Correspondingly, the probability that a country will develop the capability of competitively producing one good is related to its current capability to produce other goods that are similar or closely related, and for which the existing productive capabilities can be easily adapted. According to this view, economic development is not only a process of continuously improving the production of the same set of goods, but more importantly, a process that pursuits new lines of activity associated with higher levels of productivity.

The notion of product space introduced by Hidalgo et al. (2007) encapsulates these ideas. The product space is a representation of all products exported in the world, where the distance between each pair of products represents the probability of producing one of them for a country that already produces the other. The lack of connectedness between the products in the periphery (low-productivity products)

[1] On the relevance of demand side policies in the context of industrial policy making see UNCTAD *TDR* (2006, 2013 and 2014).

[2] These papers are related to the literature on structural transformation pioneered by Kaldor (1967) in the 1950s and 1960s.

[3] Bell and Pavit (1995) and Lall (1992) provide a framework to analyse the industrial "technological capabilities" required for innovation.

[4] For example, the human, physical and institutional capabilities needed to produce cotton trousers are likely to be closer to those needed to produce cotton shirts than to those needed to produce computer monitors.

and in the core (high-productivity products) explains the difficulties poor countries face to reach a production structure that fosters income level convergence with rich economies.[5]

To measure the productivity (or sophistication) of different products, Hausmann, Hwang and Rodrik (2007) suggested a measure based on the income per capita of countries with comparative advantage to produce a specific good. More precisely, the sophistication of a product is calculated as an average of the income per capita of the countries exporting the good, weighted by each country's share in the global exports of the product. Economic (or country) sophistication on the other hand, is given by the productivity level associated with a country's export basket, and it is calculated as a weighted average (where the weight is the share of the product in the country's export basket) of the sophistication of the products exported by the country.

Hausmann et al. (2007) show that not all products have the same effect on economic development. There are productive capabilities used for the production of some goods that can be easily redeployed for the production and export of other goods with higher value added. And there are other products that embody capabilities that can hardly be used for the production of other goods. They also show that their measure of economic sophistication is a good predictor of future growth.

We operationalize the above mentioned methodology by mapping on the product space the export structure of 97 economies and classifying for each of them the not yet produced goods according to their degree of sophistication and distance from the current export basket. We then build a simple algorithm to identify the most sophisticated not yet produced goods at different distances from the current export basket.

III. THE METHODOLOGY

Our approach builds on the idea that at each moment in time an economy faces a set of upgrading possibilities and that it needs to select among them, assuming no constraints on the demand side. We therefore adopt a measure of productive capabilities which gives us information on the feasible set of new production and export possibilities, and a measure of the value associated with each one of these possibilities. In our analysis, we use variables previously used in earlier contributions to the product space literature.

A. Proximity and distance

The product space is a geometrical representation of products, built on the notion of *proximity* between different goods. Several factors may determine the level of proximity between products. For instance, Leamer (1984) stresses the importance of the intensity of broad factors of production such as labour, land, and physical capital; Lall (2000) emphasizes instead the level of technological sophistication; and Rodrik et al. (2002) look at the role played by institutions.[6] All of these measures are based on a priori notions on what makes a product more similar to another, assuming that factors of production, technological sophistication or institutional quality exhibit little specificity.

The product space literature builds on a purely outcome-based measure, based on the idea that if two goods are related, because they require similar institutions, infrastructure, physical factors, technology, or some combination thereof, then they will tend to be produced in tandem; whereas highly dissimilar

[5] The metaphor adopted by Hausmann and Klinger (2007: 2) is that "products are like trees, and any two trees can be close together or far apart, depending on the similarity of the needed capabilities. Firms are like monkeys, who derive their livelihood from exploiting the tree they occupy".

[6] See also Acemoglu et al. (2001).

goods are less likely to be produced together. For example, a country with the ability to export apples will probably have most of the conditions suitable to export pears. They would certainly have the soil and the climate, together with the appropriate packing technologies, frigorific trucks and containers. They would also have the human capital, particularly the agronomists that could easily learn the pear business. However, when we consider a different business such as mining, textiles or appliance manufacture, all or most of the capabilities developed for the apple business are useless.

Closely following Hausmann and his co-authors to generate such an outcome-based measure of proximity based, on the assumption that similar products are more likely to be exported in tandem, we do not consider marginal exports and focus only on those products for which the country examined has a revealed comparative advantage (RCA). We thus use the notion of RCA introduced by Balassa (1977), which puts forwards that a country *j* has an comparative advantage in product *k* if the share of this product within the country's export basket is larger than the share of this product in the global market (RCA > 1),

$$RCA_{jk} = \frac{X_{jk} \Big/ \sum_{jk} X_{jk}}{\sum_{j} X_{jk} \Big/ \sum_{j} \sum_{k} X_{jk}}$$

where X_{jk} is the value of exports by country *j* of good *k*.

This definition of RCA allows us to set a threshold for a country's exports. When RCA_{jk} is greater or equal to 1, we say that country *j* is an effective exporter of product *k*, and when RCA_{jk}<1 we say that country *j* is not an effective exporter of that product.

Using RCA as an indication of a country effectively exporting a good, Hausmann and Klinger (2007) define the proximity between goods *k* and *h* as:

$$\varphi_{kh} = min\{P(RCA_k > 1 | RCA_h > 1), P(RCA_h > 1 | RCA_k > 1)\},$$

where $P(RCA_k > 1 | RCA_h > 1)$ is defined as the probability that a country exports good *k* with RCA > 1, given it also exports good *h* with RCA > 1. More specifically, proximity is calculated by comparing how many countries that export product *k* with RCA > 1 also export product *h* with RCA > 1. For example, if 10 countries export product *k* with RCA > 1, and 5 out of those 10 countries also export product *h* with RCA > 1, then the *proximity* (or the general probability to export) for product *k* in relation to product *h* is 0.5.

This definition considers the minimum of the two conditional probabilities because conditional probability is not a symmetric measure: P(*k*|*h*) is not equal to P(*h*|*k*), yet the notion of proximity between two goods is symmetric. More importantly, as the number of exporters of any good *k* falls and eventually goes to one, the conditional probability of exporting another good given you export *k* becomes a dummy variable, equal to 1 for every other good exported by that particular country, and 0 otherwise, thus reflecting the peculiarity of the country and not the similarity of the goods. Focusing

on the minimum of the pairs of conditional probabilities solves this problem since we would get a high value of proximity only if all countries exporting good *k* would also export good *h*.[7]

Since we are interested in the probability of moving from a given set of products (the current export basket) to a new not-yet exported product *h*, we adopt the aggregate measure of proximity proposed by Hausmann and Klinger (2007): *distance*. Distance is the conditional probability of exporting a new good *h*, given the current export structure. Intuitively, this implies that if a country exports goods embedding most of the capabilities required to produce a new product *k*, the likelihood of producing this good and start to export it is relatively high.

The capabilities that a country possesses are captured by the proximity between the products that it currently exports and the particular product of interest *h*. The capabilities that are lacking can be inferred from the proximity between the products the country does not export and product *h*. Distance is, therefore, the sum of the proximities between a particular good and all the products that country *j* is not exporting, normalized by the sum of proximities between all products and product *h*. If country *j* exports most of the goods connected to product *h*, then the distance will be short, close to 0. But, if country *j* only exports a small proportion of the products that are related to product *h* then the distance will be large (close to 1). Formally, the distance between the export basket *b* and a new product *h* is given by,

$$distance_{bh} = \frac{\sum_{k=1}^{N}(1-M_{kh})\varphi_{kh}}{\sum_{k=1}^{N}\varphi_{kh}},$$

where {1,N} denotes the entire product space and M_{kh}=1 if country exports product *k* with RCA>1 and 0 otherwise. For a country that does not export any good, the two sets coincide and the *distance* is maximal and equal to 1. By contrast, for a country that already exports all the products in the product space the latter set is empty and the *distance* is equal to 0.

We classify all the new potential products into 10 different groups, sorted by distance, from the closest (group 1) to the farthest (group 10) from the current export basket.

B. Export sophistication

To measure the quality of exports and its variation over time we use a measure of export sophistication introduced by Hausmann et al. (2007). The export sophistication index attempts to capture the implied productivity of exported goods, by relating the gross domestic product (GDP) per capita to the export basket of the country. The intuition behind it is that, when exporting a good, countries implicitly reveal their productivity levels. 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 may also play a role in determining a country's export basket.

[7] Hausmann and Klinger (2007) clarify this issue through an example. Suppose Australia is the only country in the world that exports ostrich meet. If we consider the simple conditional probability as a measure of proximity, then all other goods exported by Australia, like minerals or wine would appear to be very close to ostrich meat. Focusing on the minimum of the pairs of conditional probabilities instead would imply that the probability of exporting metal ores given that you export ostrich meat is large, but the probability that you export ostrich meat given that you export metal ores is very low, since Chile, Peru and Zambia do not export ostrich meat but do export metals. If the products were really close together, all countries exporting metal ores would also export ostrich meat, but this is not the case, and the proximity measure captures it.

Hausmann et al. (2007) developed constructed 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.[8] The overall assumption is that the higher the average income of the exporter, the more sophisticated the export is. We follow Hausmann et al. (2007) and construct an export sophistication index by country.

We measure the level of sophistication both at the product and at the country level. We first calculate the GDP per capita (i.e. the implicit productivity level) associated with each exported product. This product-level measure of sophistication is designated $PRODY_k$. It is calculated as the RCA-weighted gross national income (GNI) per capita of each country exporting product *k*:

$$PRODY_k = \sum_j \frac{\frac{X_{kj}}{X_j}}{\sum_j \left(\frac{X_{kj}}{X_j} \right)} Y_j \cdot$$

where X_{kj} represents the value of product *k* exported 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.

We then 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:

$$EXPY_{jt} = \sum_{lk} \frac{X_{kjt}}{X_{jt}} PRODY_k \quad .$$

Naturally, since PRODY is measured using the GNI per capita of the typical exporting country, 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.

We finally normalize 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:

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

[8] A similar metric has been developed by Lall et al. (2006).

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. As anticipated above, however, such a correlation is not as close as would have been anticipated by standard trade theory. Lall et al. (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 re-located to lower wage countries. 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.

C. Picking products

We consider 97 countries at different levels of economic development and build a dataset collecting information on the position of each country in the product space and on their upgrading possibilities, at a progressively increasing distance from the current export basket.[9] More precisely, for each country we classify all not-yet produced items into ten different groups progressively farther from the current export basket. We later identify in each of this group those products with the highest sophistication.

To clarify our approach to product-selection, consider figure 1 below which depicts the upgrading opportunities of an imaginary country A in the product space. The vertical axis measures the level of sophistication of different products while on the horizontal we report the distance among them. The export bundle of country A is represented by the shaded area located next to the vertical axis, while the small circle inside this area indicates the average level of sophistication of the goods exported by country A. The figure also depicts the different upgrading opportunities faced by the country and characterizes both the sophistication level of the potential new products (i.e. the vertical axis value of any product outside the bundle) and its distance from the current export basket. The further away the country's current export basket is from a specific good, the less likely it is for the country to start producing that good. In the figure, for example, country A is more likely to produce T-shirts than wrist-watches and weighing machinery than semiconductors. However, as shown in the figure, the latter would provide a much bigger gain in terms of sophistication.

Taken together, these two measures provide important information on what is more feasible and profitable to produce in terms of contribution to economic growth. For instance, semiconductors are very far away from the set of production capabilities present in the country. T-shirts and sportswear are more likely to be produced, but the effort may not be worth it since the country already produces more sophisticated goods. On the other hand, the country is equally likely to produce wrist-watches, bookbinding machinery and weighting machinery. However, pursuing the production of bookbinding machinery and wrist-watches is more profitable because they have a higher level of sophistication.

One can consider our methodology as first reproducing a bi-dimensional space, analogous to the one depicted for country A, for any of the economies in our sample. Then we identify the most sophisticated potential new products at different levels of distance (in the case of country A, these would be trousers, sportswear, wrist-watches and finally semiconductors).

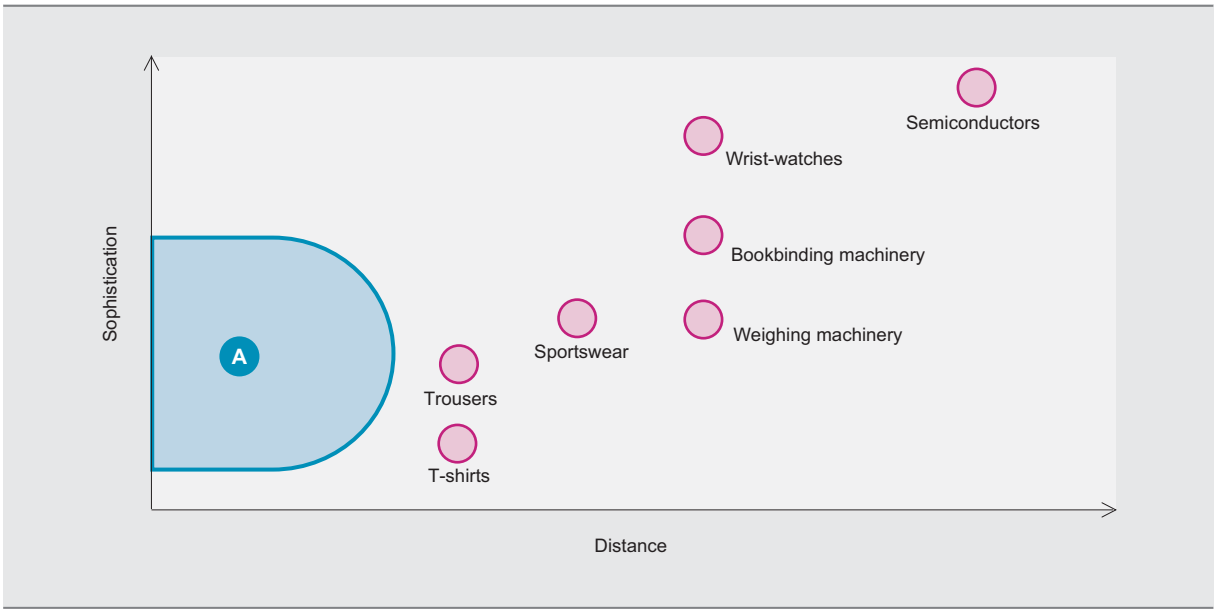
We also identify within the existing export structures those most sophisticated items whose production could be easily intensified. In order to do this, we classify country by country the exported goods and categorize each good on the basis of its RCA; we identify: (1) *transition* products (RCA < 0.5 in 2008, RCA > 1 in 2012), (2) *underdeveloped* products (RCA < 0.5 in 2008, RCA < 0.5 in 2012), (3) *established* products (RCA > 1 in 2008, RCA > 1 in 2012), and (4) *losing* products (RCA > 1 in 2008, RCA< 1 in 2012). This allows us to identify goods that are more sophisticated than the average

[9] See the annex for the list of countries and special territories included in the sample.

of the ones already exported by each country while at the same time being relatively well placed in terms of competitiveness on the international markets.

Figure 1

Distance and sophistication in the product space – products outside the export basket



Source: Authors' illustration.

We can again make use of the graphical representation presented above to get the intuition of our approach. Figure 2 depicts in the product space the different goods already produced by country A and part of its export bundle of (i.e. the squares inside the shaded blue area). We aim at identifying those products with a higher level of sophistication than the average (e.g. shapes of iron in country A's example) also well placed in terms of competitiveness on the international markets.

Figure 2

Distance and sophistication in the product space – products inside the export basket

Source: Authors' illustration.

IV. APPLYING THE METHODOLOGY: FEASIBILITY, EFFECTIVENESS AND LIMITATIONS

A. Preliminaries

We now apply the methodology described above to our sample of countries and special territories[10] and briefly analyse the outcome. To examine whether the goods identified are relatively close to the existing production structure (and therefore feasible) and would at the same time positively affect overall export sophistication, we consider two different points in time, 2008 and 2012, and compare the changes in the export basket that actually occurred between these two years (the *actual* change) with the changes that would have been observed if the export basket had started to include the products identified by our methodology (the *potential* change).

In order to construct the potential export basket, for each country we evaluate first the position in the product space in 2008 and then select those products close enough to the existing basket, but displaying higher sophistication. In particular, we add to the actual basket the 10 products that are closest to the 2008 basket and provide a sophistication value above the country's average.[11] Projecting how the export basket would have evolved allows us to show that, for all the countries and special territories in the sample, the distance between the 2012 and the 2008 baskets remains almost identical once we replace the potential basket with the real one. At the same time, for many of the economies present in our dataset, the potential basket exhibits a significantly higher level of sophistication.[12]

As a preliminary step we introduce the notion of *sophistication gain*, defined as the growth rate of average sophistication between 2008 and 2012 generated by the introduction of a new export basket.

$$sophistication\ gain_j^b = \frac{av.soph^b{}_{j2012} - av.soph_{j2008}}{av.soph_{j2008}}$$

where $av.soph^b{}_{jt}$ indicates the average sophistication of an export basket *b*, either actual or potential, of country *j* at time *t*. We calculate the average sophistication of the basket of a country *j*, at time *t*, as the weighted average of the sophistication levels of all the exported goods:

$$av.soph^b{}_{jt} = \frac{\sum_k (PRODY_{kt} * ExpValue_{kjt})}{\sum_k ExpValue_{kjt}}, with\ k \in b$$

where $ExpValue_{kjt}$ indicates the export value at time *t* of a product *k* belonging to the export basket *b*, for a specific country *j*. For simplicity, we consider the same value of product-specific sophistication (*PRODY)* in the calculations relative to both the actual and the potential basket.[13]

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[10] Our sample comprises 94 countries and 3 special territories (Bermuda, Faroe Islands and Mayotte).

[11] In order to provide conservative estimates on the impact of the new products on average sophistication, we attribute to each of them a share of the potential 2012 basket equivalent to 50 per cent of the average share of exported goods in 2012.

[12] The analysis is done for the years 2008 and 2012, i.e. the earliest and most recent years for which comprehensive data at the 4-digit level of the SITC-classification are available.

[13] In order to generate the 2012 potential basket, we need to assume a potential export value for each of the new products introduced in the basket. In reality, this implies that export shares shift, which in turn will affect the value of *PRODY*. Future research in this area should incorporate this issue.

The movement of a country's export basket in the product space is measured by evaluating variations in the average distance of a certain basket from all remaining not-yet produced goods. Similarly to sophistication, the *distance gain* is calculated as follows,

$$distance\ gain_j^b = \frac{ag.distance_{j2012}^b - ag.distance_{j2008}}{ag.distance_{j2008}}$$

where $ag.distance_{jt}^b$ indicates the aggregate *distance* of the export basket *b*, either actual or potential, of country *j* at time *t* from all remaining not-yet produced goods:

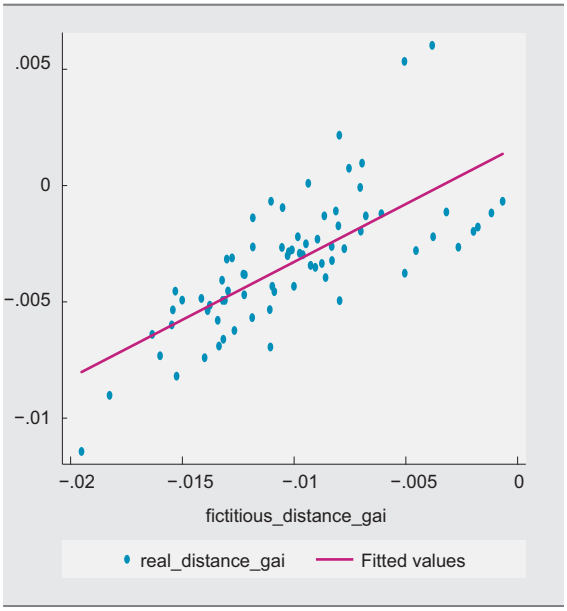
$$ag.distance_{jt}^b = \sum_h distance_{bh}\,, with\ h \in -b$$

B. Feasibility

To check the feasibility of the results of our methodology we construct for each country and special territory in our sample a potential export basket for 2012 and compare the displacement brought about by this new basket with respect to the original 2008 position with the (actual) displacement observed in the data.

Figure 3 illustrates the results. The y-axis measures the observed changes in average distance towards new products between 2008 and 2012. A negative actual distance gain implies that a country has reduced the average distance towards the set of new products outside the export basket between 2008 and 2012. The x-axis measures instead the changes in average distance towards new products between 2008 and 2012 that we would have observed if the new export basket had come to include the products identified by our methodology. The figure shows that for almost all of our sample countries and special territories the potential distance gain is only slightly larger than the actual distance one. This suggests that the products identified by our methodology could indeed be exported with the country's current capabilities.

Figure 3
Actual and potential distance gain



Source: Authors' calculations, based on data from *UN Comtrade*.

Countries like China and South Africa, for example, could have exported the (10) identified products with the existent capabilities in 2008 since the actual and potential distance are exactly the same (see table 1). As shown in table 2, countries like Bolivia and Algeria, on the other hand, might need to acquire some additional capabilities in order to introduce in the export basket the items identified Taken together, these results suggest that moving towards export baskets that include the products identified by our methodology would have required no or only little improvement in the productive capabilities of our sample countries and special territories.

Table 1

Top-3 difference in distance gain

Country	*Actual*	*Potential*	*diff*
South Africa	-0.018	-0.018	0.000
China	-0.977	-0.977	0.000
Serbia	-0.212	-0.212	0.000

Source: Authors' calculations, based on data from *UN Comtrade*.

Table 2

Bottom-3 difference in distance gain

Country	*Actual*	*Potential*	*diff*
Bolivia	0.339	0.332	-0.007
Maldives	0.785	0.778	-0.007
Algeria	-0.098	-0.105	-0.007

Source: Authors' calculations, based on data from *UN Comtrade*.

C. Effectiveness

We now consider the gains in aggregate sophistication that countries would have experienced if they had improved their productive capabilities such that they could have moved towards the more sophisticated export baskets discussed in the previous section. This assessment employs the sophistication gain methodology, discussed above.

Tables 3 and 4 display the actual sophistication gain (*Actual*) along with the potential one that would have been realised by implementing our suggestions (*Potential*) and the difference among the two (*diff and % diff*) for the countries and special territories in our sample that would have benefited the most (and respectively the least) from the introduction of the recommended new products.

Table 3

Top-3 difference in sophistication gain

Country	*Actual*	*Potential*	*diff*	*% diff*
Maldives	10,656	14,628	3,972	37%
Tonga	409	900	492	120%
Bolivia	176	455	279	159%

Source: Authors' calculations, based on data from *UN Comtrade*.

Table 4

Bottom-3 difference in sophistication gain

Country	*Actual*	*Potential*	*diff*	*% diff*
Slovakia	326	334	7	2%
Switzerland	2,951	2,953	3	0.1%
Denmark	19	21	2	11%

Source: Authors' calculations, based on data from *UN Comtrade*.

The sophistication gains that could have been obtained by moving towards the potential export baskets are striking, especially for developing economies. For instance, in the case of Bolivia, the potential basket would have led to a threefold improvement in sophistication as compared to the current

basket.[14] Figures 4 and 5 further illustrate that this difference between effective and potential sophistication gains is particularly high in low income countries.

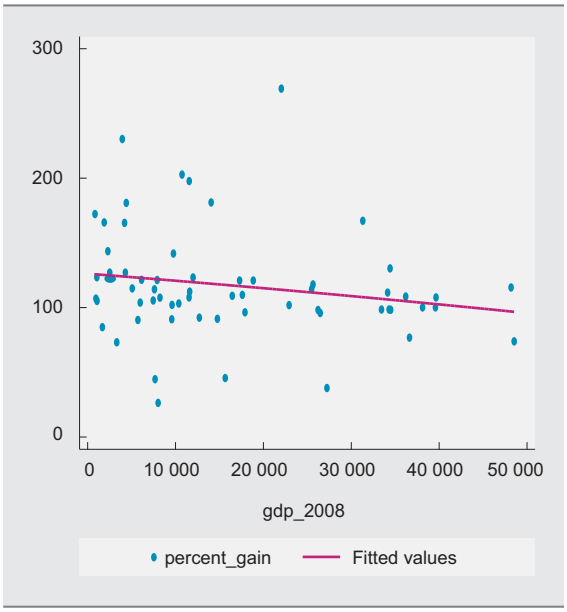
Figure 4

GDP per capita in 2008 and difference in sophistication gain (diff)

Source: Authors' calculations, based on data from *UN Comtrade*.

Figure 5

GDP per capita in 2008 and difference in sophistication gain (% diff)



Source: Authors' calculations, based on data from *UN Comtrade*.

For illustrative purposes we can also translate the estimated sophistication gains into growth gains. Hausmann, Hwang and Rodrik (2007) estimate that a 10 per cent increase of the average sophistication boosts growth by half a percentage points. According to this estimation, between 2008 and 2012, Bolivia could have experienced additional growth of almost 8 per cent and Tonga 6 per cent. On average, for the 97 countries and special territories in our sample the additional growth resulting from the increased in sophistication could have been 2.2 per cent, i.e. an average growth rate of nearly 0.5 per cent per year.

The results for developed countries are relative less striking in terms of sophistication gains. One possible explanation is that richer economies such as Switzerland and Denmark have in general a more diversified export basket, thus a much smaller subset of potential new products to be added to the export basket. Another possible explanation is that these countries are the ones that set the benchmark of sophistication and thus they have less room for improvement; they are already sophisticated.

D. Data and methodological limitations

The above methodology based on the use of trade data and the sophistication index is subject to a number of limitations. First, we note that trade data is only a proxy for the productive structure of an economy, and in some cases can substantially deviate from actual sectoral contributions to GDP. The accuracy of using a country's export structure as a proxy for its productive capabilities depends on the

[14] The size of the sophistication gain is very high in some of the countries of our sample because the initial export basket displays extremely low levels of sophistication so that there is therefore more room for improvement.

country's degree of trade openness, domestic market size, and a range of similar factors. Ideally, to study what countries produce and what they could easily begin to produce, it would be better to use production data. However, such data are not available for a large number of products, countries, and years, especially for developing economies. We therefore use international data on trade from the UN Comtrade Database.

The UN Comtrade Database contains detailed cross-country information linking countries to the products that they make using a comparable standardized classification across time. The advantages of this dataset is that, following the Standard International Trade Classification Revision 2 at the 4 digit level (SITC4), it provides information of the export baskets of countries using over 1,000 different product categories. While export data at an even higher level of disaggregation can be obtained from the UN Comtrade Database, we decided to use the 4-digit classification for comparability Hidalgo et al. (2007), who work with international trade data with products disaggregated at the four-digit level using data from Feenstra et al. (2005). We use UN Comtrade data to ensure we use the most recent data available, given that the goal of our methodology is to provide timely information to assist policymakers.[15]

While using trade data offers great advantages, it also has important limitations. First, countries may be able to produce goods that they do not export. The fact that they do not export them, however, suggests that they may not be very good at them. Countries may also export goods they do not produce because they simply serve as trading hubs.[16] Second, UN Comtrade data is not always complete. Specifically, as some countries now have transitioned to more granular systems of classification, once the data is converted into the 4-digit system, information is lost. As a result, a number of countries have a significant share of 'unclassified transactions' in the database. Finally, because the data are collected by customs offices, they include only goods and not services. Nevertheless, services trade data have neither the level of disaggregation nor the time coverage to allow for the type of analysis undertaken in the current study.

Also the index that we employ to capture the level of sophistication of a product or a country's export sector has been subject to several criticisms (Yao, 2009). The sophistication index relies in fact on two critical assumptions, namely that exports only use domestic inputs in their production and that the product classification scheme is detailed enough to exhaust all critical differentiations for any given type of product.[17] It is important to discuss in detail both of them.

First, the logic behind the sophistication index is that only domestic factors are embodied in a country's exports, which makes it possible to infer from trade theory that rich countries with abundant capital and human capital will necessarily export skill-intensive sophisticated products. Given the nature and scale of processing trade, this assumption does not hold necessarily true especially for those economies heavily involved in global supply chains. As argued by some scholars , a country like China is likely to import high-tech components from the Republic of Korea and Japan under the processing trade regime and then export them as assembled products, with local labour-intensive assembly operations as the only value added (Van Assche and Gangnes, 2010). The sophistication index relative to Chinese exports might therefore represent an upward biased estimate of the actual sophistication level. However, the value of the sophistication index associated with exports that are technological-intensive but are manufactured with low-skilled labour using imported components, like

[15] In a later stage of analysis when applying our methodology to a specific country case-study, besides SITC we also employ the additional International Standard Industrial Classification (ISIC) to highlight patterns in the export basket under scrutiny.

[16] The case of Singapore which represents one of Asian main energy trading hub is illustrative. It is among the top 10 countries in terms of refined petroleum products exports (and imports) but rank only at the 17th place in terms of annual production.

[17] For example, all products made in different parts of the world with the same identification k, shall not differ significantly in quality, function and other key parameters.

most electronic products, is generally low. This is the case since, precisely because of their nature (being produced using imported components), they tend to weigh heavily in the export baskets of developing countries.[18]

Second, the calculation of the sophistication index is based on the SITC classification and the SITC codes may not be sufficient for identifying products in international trade. The use of 4-digit disaggregation in fact provides a fairly detailed account of differentiation between products, but may still fail to distinguish between products exhibiting very different unit values.[19] Huge disparities in unit values for products identified with the same SITC codes signal that they should be treated as totally different products (that is, as products with different levels of quality or vertically differentiated products), otherwise we could end up with an upward (or downward) biased export sophistication index. Rodrik (2006) shows, for example, that China's unit values of most of its leading electronics exports are lower than those of the Republic of Korea, Malaysia, or Singapore.

Despite these drawbacks, classifying the products on the basis of the sophistication index created by Hausmann and his co-authors is by now very common in the literature and has two clear advantages over other classifications used in the past (Fortunato and Razo, 2014). First, it is defined at a highly disaggregated level which allows for very detailed analysis and also partly addresses the concern related to unit values discussed above. Second, it is outcome-based, whereas metrics used previously were based on a priori assumptions of sophistication (e.g. agricultural products are less sophisticated than manufactures).

V. CASE STUDY: ETHIOPIA

In this section we consider the case of Ethiopia and apply our methodology to its export structure in 2012. We identify those products that could be relatively easily introduced in the production structure of the country, given its production capabilities, and at the same time would maximize the country's aggregate export value.[20] We also examine Ethiopia's existing export basket and select those products that are already produced and exported by the country, but in a proportion that is below their potential contribution to aggregate value added.

A. Introducing new products

We first order all the potential new products that could be introduced in Ethiopia's export basket on the basis of 10 distance groups (group 1 is the group closest to the current export basket, 10 is farthest away). We then measure the level of sophistication of each one of these products and compare it with the average sophistication of the current export bundle. We find that Ethiopia is in relative close range to the production of goods with a sophistication level above the country's 2012 average.

[18] If one looks to the sophistication level of final electronic goods, for example, the great majority of them fall outside from the first quintile of the sophistication distribution.

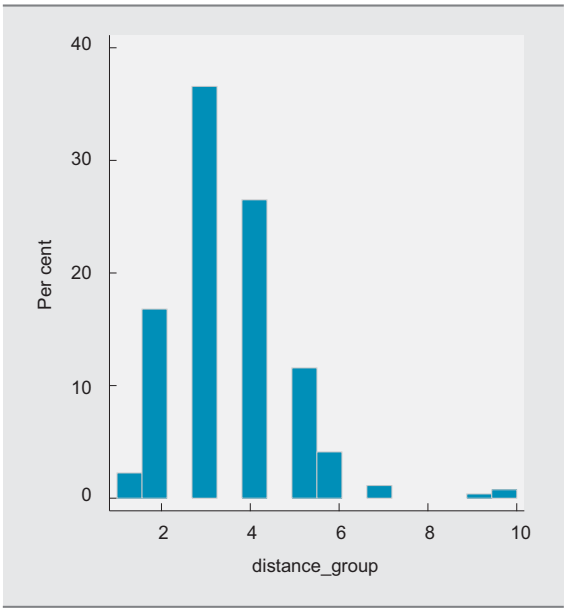
[19] Yao (2009) discusses this problem in the case of the United States–China trade flows.

[20] In order to show the feasibility and effectiveness of our policy advices in the specific case of Ethiopia, we applied the methodology also to the 2008 export basket. We found that if the (10) propositions (for new products) were pursued, the aggregated sophistication gain could have been significantly higher (actual sophistication gain: 1.103; potential sophistication gain: 1.343). At the same time, the difference between the change in distance that occurred in reality and the change in distance that would have been needed to start producing the identified new products is relatively small (actual distance gain: -0.004; potential distance gain: -0.008).

This emerges clearly once we plot the distribution of new products with above-average sophistication across distance groups (figure 6). Most of the goods whose production would increase the average sophistication of exports are in fact located close to the 2012 basket (in group 2, 3 and 4).

Figure 6

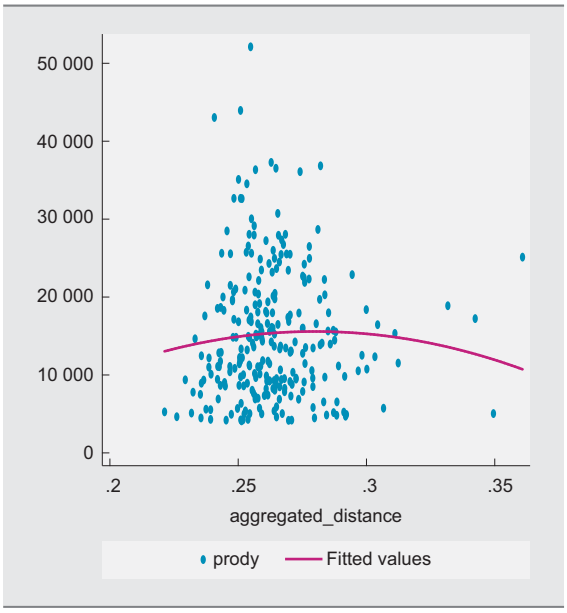
Distribution of new products



Source: Authors' calculations, based on data from *UN Comtrade*.

Figure 7

Distance and sophistication



Source: Authors' calculations, based on data from *UN Comtrade*.

Next, we consider the relation between distance from the current basket and embedded sophistication of the identified new products. As shown in figure 7, moving away from the current export basket at relative little distance the average sophistication level tends to increase, although great variation exists. Moving beyond this threshold, however, makes the sophistication embedded in new products tend to decrease. In other words, the most promising new export opportunities concern products that require productive capabilities the country already possesses.

Table 5 indicates the most sophisticated products within the closest distance group (1) identified with our methodology and reports for each of them the distances from both the 2012 export basket (*aggregate distance*) and the level of sophistication (*prody*). The table shows how Ethiopia's export basket already contains most of the capabilities that would allow starting the production of products able to raise the aggregated sophistication level of the country's exports, such as swimwear and fabrics.

On a more aggregated level, table 6 displays the sophistication level of all potential new groups of products, categorized according to ISIC[21] lying in the first two distance groups from the 2012 Ethiopian export basket. Limiting our analysis to the first two distance groups allows us to highlight products that might be more easily produced given the existing productive capabilities of the country. We find that iron and steel industries offer the best prospects in terms of sophistication improvements for the Ethiopian economy. Other suggestions include industries for manufacturing of machinery, mining activities and possibly forestry related industries.

[21] The International Standard Industrial Classification of All Economic Activities.

Table 5
New products closest by the current export basket

Distance group	*SITC*	*SITC name*	*Leamer name*	*Lall classification*	*Aggregated distance*	*Prody*
1	8456	Swimwear	Labour intensive	Low-technology manufactures	0.221	5,257
1	6539	Pile and chenille fabrics, woven, of man-made fibres	Capital intensive	Medium-technology manufactures	0.226	4,639
1	6565	Embroidery	Capital intensive	Low-technology manufactures	0.229	9,367
1	6532	Fabrics, woven, 85% plus of discontinuous synthetic fibres	Capital intensive	Medium-technology manufactures	0.231	5,117
1	6563	Yarn	Capital intensive	Low-technology manufactures	0.232	7,759
1	7754	Electric shavers and hair clippers, parts thereof, nes	Machinery	Medium-technology manufactures	0.233	14,651
2	5622	Mineral or chemical fertilizers, phosphatic	Chemical	Medium-technology manufactures	0.235	7,498
2	5815	Tubes, pipes and hoses	Chemical	Not classified	0.235	4,492
2	7111	Steam and other vapour-generated boilers; super-heated water boiler	Machinery	Medium-technology manufactures	0.235	12,438
2	7722	Printed circuits, and parts thereof, nes	Machinery	Medium-technology manufactures	0.235	8,927

Source: Authors' calculations, based on data from *UN Comtrade*.

Table 6
Average sophistication by ISIC classification for distance group 1 and 2

ISIC (Rev.2) 3-digit sector	*Mean(prody)*
Forestry	18,657
Other mining	19,510
Food manufacturing	12,851
Beverage industries	6,931
Manufacture of textiles	8,204
Manufacture of wearing apparel	12,177
Manufacture of industrial chemicals	7,838
Iron and steel basic industries	32,654
Non-ferrous metal basic industries	18,278
Manufacture of fabricated metal products	12,438
Manufacture of machinery, except electric machinery	19,659
Manufacture of electrical machinery	11,789

Source: Authors' calculations, based on data from *UN Comtrade*.

B. Reshuffling the export basket

The analysis above concerns solely those products that Ethiopia does not yet produce. But it is also possible to obtain gains by increasing the export share of products with higher sophistication within the current export basket. We therefore study also the existing export structure to identify promising avenues for the future. We do so by looking first at the level of export competitiveness (using the RCA) and at the sectoral composition (using the Leamer classification) of the exported products, and then selecting the most promising products from the basket.

Figure 8 illustrates Ethiopia's current exports by plotting the sophistication level and the total export value of each exported item. In the figure, we also highlight changes in the level of competitiveness of each product on the international markets. By using the RCA-based classification discussed above, we distinguish four types of products: (1) products that are gaining market share or in transition (in blue); (2) underdeveloped products (in brown); (3) established products (in green); and (4) products which are *losin*g ground (in yellow).

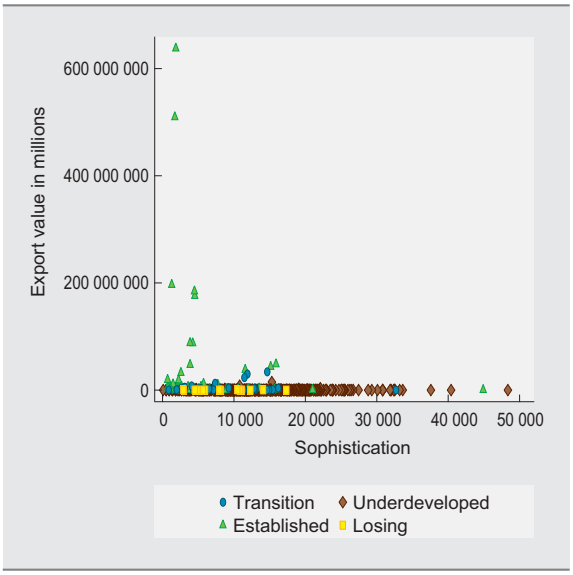
The figure suggests that Ethiopia currently relies upon a small subset of products that exhibit a low sophistication level, while products with higher sophistication tend to be underdeveloped and exported in substantially smaller quantities. Eliminating the major exports and limiting our inspection to products with an export value below US$ 5mn does not change results of the analysis. Most established and transition exports generally display low levels of sophistication (figure 9).

We next consider the sectoral distribution of Ethiopian exports. Figure 10 plots the sophistication level and the total export value of the products, but distinguishes them according to the Leamer classification.[22] The figure shows that Ethiopia exports mainly animal products and machinery at relatively low levels of sophistication.

[22] We apply the Leamer classification, as it provides a simple but effective characterization of 10 products groups.

Figure 8

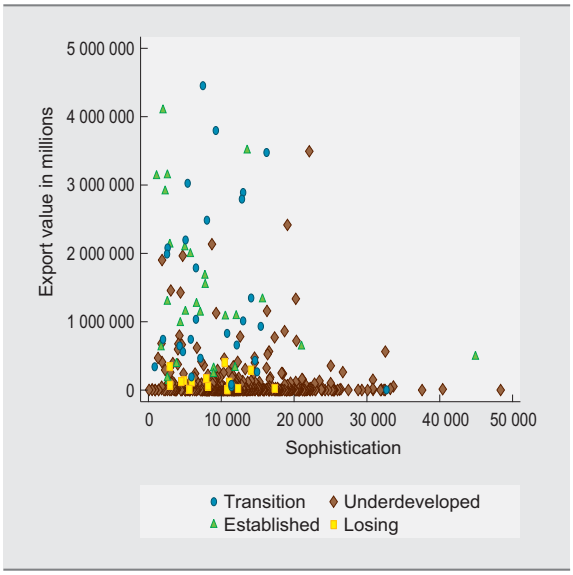
Ethiopia's export basket and RCA



Source: Authors' calculations, based on data from *UN Comtrade*.

Figure 9

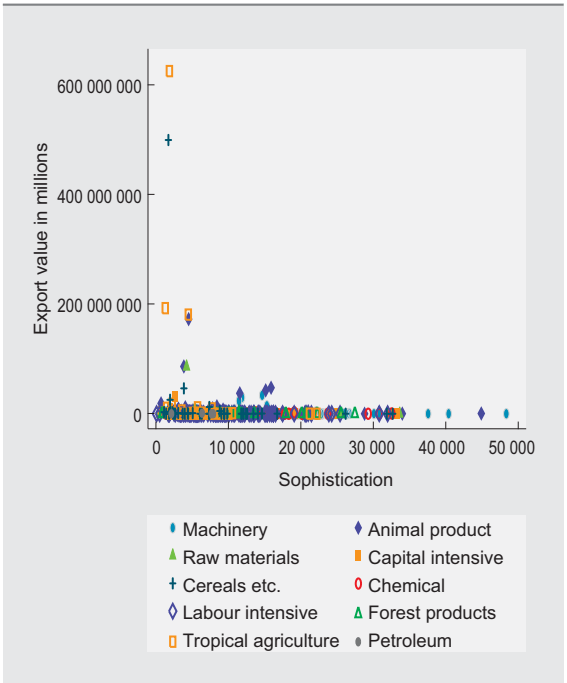
Ethiopia's export basket and RCA, selected products



Source: Authors' calculations, based on data from *UN Comtrade*.

Figure 10

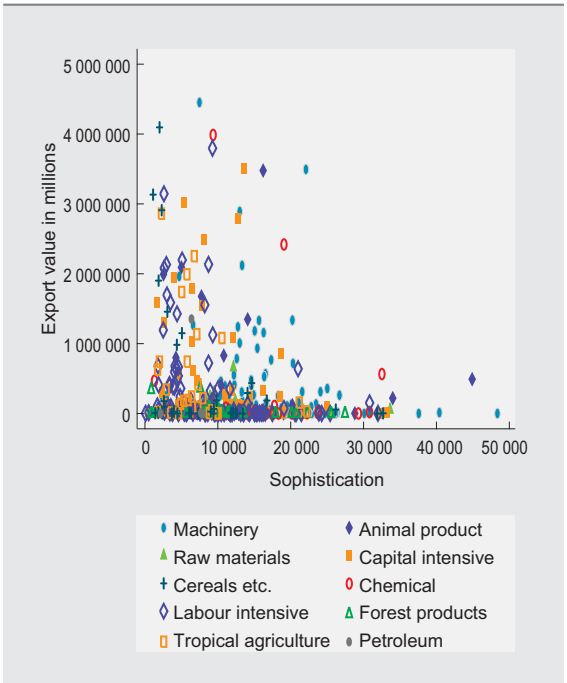
Ethiopia's export basket and Leamer classification



Source: Authors' calculations, based on data from *UN Comtrade*.

Figure 11

Ethiopia's export basket and Leamer classification, selected products



Source: Authors' calculations, based on data from *UN Comtrade*.

These results are supported when we look at those products with an export value below US$ 5mn (figure 11). Low sophisticated goods classified as labour intensive and tropical agriculture dominate exports along with machinery and capital-intensive products of low levels of sophistication. Ethiopia also exports some more sophisticated machinery and capital-intensive goods, but on a substantially lower scale.

As a final step, we identify the more sophisticated products that Ethiopia exports. We find 537 products with a sophistication level above the country's average. Table 7 provides an overview on the top-10 products in this group, where "value" refers to the export value in 2012.

Table 7
Highly sophisticated products within export basket

SITC	*SITC name*	*Leamer name*	*Lall classification*	*Prody*	*Value*	*RCA 2008*	*RCA 2012*	*Product*
8854	Wrist-watches	Machinery	Medium-technology manufactures	48,360	787	0	0.001	2
352	Fish, salted	Animal products	Not classified	44,900	490,374	3.405	4.171	3
7265	Offset printing machinery	Machinery	Medium-technology manufactures	40,406	12,947	0.002	0.001	2
7268	Bookbinding machinery; parts thereof, nes	Machinery	Medium-technology manufactures	37,578	175	0	0.001	2
351	Fish, dried	Animal products	Other transactions	34,001	218,626	0.013	0.817	-
6861	Zinc and zinc alloys, unwrought	Raw materials	Natural resource-based manufactures	33,640	53,949	0	0.03	2
6768	Shapes of Iron	Capital intensive	Low-technology manufactures	33,208	17,991	0.010	0.006	2
2641	Jute and other textile	Cereals, etc.	Natural resource-based manufactures	32,682	3,268	0	1.064	1
5416	Glycosides, glands, antisera, vaccines and similar products	Chemical	High-technology manufactures	32,529	563,437	0.236	0.057	2
7453	Weighing machinery	Machinery	Medium-technology manufactures	32,493	634	0.129	0.001	2

Source: Authors' calculations, based on data from *UN Comtrade*.

Note that for most of the products listed in the table, Ethiopia is relatively uncompetitive on international markets, with a RCA below 0.5 in both 2008 and 2012. Fish (both salted and dried) represents a noticeable exception. The production of textiles, identified as a product group in which Ethiopia gained competitiveness mean over the period 2008–2012, could also bring additional increases in sophistication.

Apart from fish and textiles, the products listed in table 7 do not seem promising solutions however. We need therefore to identify other products that would provide a boost to aggregate sophistication but where the country is more competitive in international markets. Table 8 presents the top-10

suggestions in terms of sophistication concentrating on those products in the 2012-export basket that are characterized as either *transition* (1) or *established* (3).

The table shows that Ethiopia is competitive in some animal products and machinery that also offer potential to increase average sophistication. These rather simple products could function as the first step in the upgrading process towards more sophisticated products.

Table 8

Highly sophisticated and competitive products within export basket

SITC	*SITC name*	*Leamer name*	*Lall classification*	*Prody*	*Value*	*RCA 2008*	*RCA 2012*	*Product*
352	Fish, salted	Animal products	Not classified	44,900	490,374	3.405	4.171	3
2641	Jute and other textile	Cereals, etc.	Natural resource-based manufactures	32,682	3,268	0	1.064	1
6631	Hand polishing stone, grindstones, grinding wheels, etc.	Labour intensive	Natural resource-based manufactures	21,012	640,142	1.226	1.663	3
222	Milk and cream	Animal products	Commodities	16,219	3,476,665	0.042	1.471	1
121	Meat of sheep	Animal products	Commodities	15,890	48,439,344	51.309	89.250	3
7233	Road rollers, mechanically propelled	Machinery	Medium-technology manufactures	15,660	1,330,259	2.275	1.271	3
7451	Power hand tools, pneumatic or non-electric, and parts thereof, nes	Machinery	Medium-technology manufactures	15,432	932,490	0.001	1.108	1
19	Live animals	Animal products	Not classified	15,148	43,576,540	186.545	174.749	3
7861	Trailers and transports containers	Machinery	Medium-technology manufactures	14,932	266,586	0.383	1.193	1
7929	Parts, nes of the aircraft and associated equipment, and parts thereof, nes	Machinery	High-technology manufactures	14,675	34,119,344	0.124	5.577	1

Source: Authors' calculations, based on data from *UN Comtrade*.

VI. CONCLUSION

This paper presents a methodology designed to operationalize the concepts of product space and export sophistication. The methodology allows identifying the most promising sectors and products to be developed, given the productive capabilities of an economy.

We applied this methodology to a sample of 94 countries and 3 special territories (Bermuda, Faeroe Islands and Mayotte) during the period 2008–2012 to compare the changes in these countries' export baskets with those that would have been possible according to our methodology. We find substantial differences in terms of average sophistication, especially for less developed countries which would have found their economies much closer to the sophistication frontier if they had been able to move to the potential export basket.

These results suggest that the methodology can be used to identify sophistication-enhancing products for developing countries. We do not suggest however that it would be easy for developing countries as a whole to make their export baskets more sophisticated. Such a conclusion would in fact be subject to a fallacy of composition critique. We believe however that this risk may be minimal because different countries start from different production bases in the product space; a methodology that selects new products on the base of the "distance" from the current basket is therefore likely to lead countries starting from different initial positions to different products.

The substantial gap highlighted by the comparison of what most developing countries have reached in terms of aggregate sophistication of their exports and what they could have reached raises an important question: what prevented these countries from developing a productive and export structure closer to the one identified by our methodology?

Many scenarios are possible and the root causes of the observed low rates of transformation can be linked both to domestic factors, such as local barriers to undertake new activities (e.g. underdevelopment of the financial sector or undersupply of skilled labour force), and to the global macroeconomic context (i.e., adverse terms-of-trade movements, exchange rates, etc.). As the relative importance of these factors is likely to vary across countries, in future research it would be interesting to go deeper into the exploration of the different constraints to structural transformation focusing on country experiences and case-studies.

ANNEX

Country and special territories sample

Albania, Algeria, Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan, Bahamas, Belarus, Belgium, Belize, Bermuda, Bhutan, Bolivia (Plurinational State of), Bosnia and Herzegovina, Brazil, Brunei Darussalam, Bulgaria, Cambodia, Canada, Cape Verde, Chile, China, Colombia, Cook Islands, Costa Rica, Côte d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Faeroe Islands, Fiji, Finland, France, French Polynesia, Georgia, Germany, Ghana, Greece, Greenland, Guatemala, Guyana, Hong Kong (China), Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kyrgyzstan, Latvia, Lebanon, Lithuania, Luxembourg, Macao (China), Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mayotte, Mexico, Montenegro, Mozambique, Namibia, Netherlands, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Other Asia (nes), Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Poland, Portugal, the Republic of Korea, Republic of Moldova, Romania, the Russian Federation, Rwanda, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, State of Palestine, Sudan (former), Sudan, Sweden, Switzerland, Syrian Arab Republic, Thailand, the former Yugoslav Republic of Macedonia, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turks and Caicos Islands, Uganda, Ukraine, United Arab Emirates, United Kingdom, United Republic of Tanzania, United States of America, Uruguay, Viet Nam, Yemen, Zambia, Zimbabwe.

REFERENCES

Acemoglu D, Johnson S and Robinson J (2001). The Colonial Origins of Comparative Development: An Empirical Investigation. *American Economic Review*, 91(5): 1369–1401.

Balassa B (1977). Revealed Comparative Advantage Revisited: An Analysis of Relative Export Shares of the Industrial Countries, 1953–1971. *The Manchester School of Economic and Social Studies*, 45(4): 327–344.

Bell M and Pavitt K (1995). The development of technological capabilities. In: Haque IU, ed. *Trade, Technology, and International Competitiveness*. Washington, DC, The World Bank.

Chang H (2002). *Kicking Away the Ladder: Development Strategy in Historical Perspective*. London, Anthem Press.

Feenstra R, Lipsey H, Deng A and Mo H (2005). World Trade Flows: 1962–2000. Working Paper No. 11040, National Bureau of Economic Research, Cambridge, MA, January.

Fortunato P and Razo C (2014). Export Sophistication and the Middle Income Trap. In: Kozul-Wright R, Nübler I and Salazar J, eds. *Transforming Economies: Making industrial policy work for growth, jobs and development*. Geneva, ILO.

Hausmann R and Klinger B (2007). Structural Transformation and Patterns of Comparative Advantage in the Product Space. Working Paper No. 128, Centre for International Development, Harvard University, Cambridge, MA, August.

Hausmann R, Hwang J and Rodrik D (2007). What you export matters. *Journal of Economic Growth*, 12(1): 1–25.

Hidalgo C (2009). The dynamics of economic complexity and the product space over a 42 year period. Working Paper No. 189, Center for International Development, Harvard University, Cambridge, MA, December.

Hidalgo C and Hausmann R (2009). The building blocks of economic complexity. *Proceedings of the National Academy of Sciences*, 106(26): 10570–10575.

Hidalgo C, Klinger B, Barabási A and Hausmann R (2007). The product space conditions the development of nations. *Science*, *317*(5837): 482–487.

Imbs J and Wacziarg R (2003). Stages of diversification. *American Economic Review*, 93(1): 63–86.

Kaldor N (1967). *Strategic Factors in Economic Development*. Ithaca, NY.

Kozul-Wright R, Nübler I and Salazar J (eds.) (2014). *Transforming Economies: Making industrial policy work for growth, jobs and development*. Geneva, ILO.

Lall S (1992). Technological capabilities and industrialization. *World Development*, 20: 165–186.

Lall S (2000). The technological structure and performance of developing country manufactured exports, 1985–98. *Oxford Development Studies*, 28(3): 337–369.

Lall S, Weiss J and Zhang J (2006). The "sophistication" of exports: a new trade measure. *World Development*, 34(2): 222–237.

Leamer E (1984). *Sources of Comparative Advantage: Theory and Evidence*. Cambridge MA, MIT Press.

Nübler I (2014). A theory of capabilities for productive transformation: Learning to catch up. In: Kozul-Wright R, Nübler I and Salazar J, eds. *Transforming Economies: Making industrial policy work for growth, jobs and development*. Geneva, ILO.

Rodrik D (2006). What's So Special About China's Exports? *China & World Economy*, 14(5): 1–19.

Rodrik D (2008). *Normalizing industrial policy*. Washington, DC, The International Bank for Reconstruction and Development/The World Bank.

Rodrik D, Subramanian A and Trebbi F (2002). Institutions Rule: the primacy of institutions over geography and integration in economic development, Working Paper No. 9305, National Bureau of Economic Research, Cambridge MA, October.

UNCTAD (*TDR 2006*). *Trade and Development Report, 2006. Global Partnership and National Policies for Development*. United Nations publication, sales no. E.06.II.D.6, New York and Geneva.

UNCTAD (*TDR 2013*). *Trade and Development Report, 2013. Adjusting to the changing dynamics of the world economy*. United Nations publication, sales no. E.13.II.D.3, New York and Geneva.

UNCTAD (*TDR 2014*). *Trade and Development Report, 2014. Global governance and policy space for development*. United Nations publication, sales no. E.14.II.D.4, New York and Geneva.

Van Assche A and Gangnes B (2010). Electronics production upgrading: is China exceptional? *Applied Economics Letters*, 17 (5): 477–482.

Yao S (2009). Why are Chinese exports not so special? *China and World Economy*, 17: 47–65.

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