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A Product Space Perspective on Structural Change in Morocco

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Abstract

Drawing on international trade data, this paper uses the product space approach to analyze changes in Morocco's goods exports in 1990–2010 and future export priorities. The level of Morocco's gross domestic product and its moderate growth match the predictions of product space analysis, informed by changes in the income potential of Morocco's export basket, reflecting relatively strong capabilities (a high density) in products with relatively low potentials in income and diversification. Morocco's peripheral position in the product space map matches its slow growth and points to the difficulty of diversification into more sophisticated products. Encouraging changes since 1990 include the development of a revealed comparative advantage for medium- and high-tech manufactures, which in 2010 represented around 40 percent of total goods exports. However, the number of goods involved is relatively small and this transformation has not sufficed to raise per capita growth to the average for middle-income countries. Export projections up to 2025 suggest that future developments will follow the trends of the past. Among sectors, high growth is likely for phosphate-based fertilizer exports. However, like edible oil products, which also may grow rapidly, phosphates are hampered by low income and diversification potentials. Along with various other manufactured products, electronics and the automotive industry are promising sectors that may offer more lasting positive contributions to Morocco's future development. Beyond goods, Morocco's policy makers should also consider the potential contributions of service exports, which in recent years have enjoyed rapid growth.

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A Product Space Perspective on Structural Change in Morocco

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1 Introduction[1]

On what sectors will Morocco's future export growth be based? What are the implications of Morocco's current export structure for future structural transformation? This paper tries to shed some light on these issues by means of a detailed analysis of the evolution of Morocco's structure of goods exports since 1990 and the implications of these developments for the future sector priorities. In terms of method, we rely on product space (PS) analysis, pioneered by Hausmann and Klinger (2006).

The paper is organized as follows: Section 2 provides a brief introduction to the basic features of the PS framework. Section 3 elaborates on the PS methodology and the PS concepts used in this paper, including a discussion of how its design and data limitations point to the need to complement it with analysis using other approaches. Section 4 presents the results of our PS analysis for Morocco. A more detailed presentation of PS concepts is found in Annex 1 while Annex 2 presents complimentary PS statistics for Morocco.

On a cautionary note, the findings presented in this paper are preliminary since they have not yet benefitted from discussions with local experts and policy makers – they are exclusively derived from empirical analysis of international trade data.

2 Basic Features of the Product Space Framework

The process of structural change, experienced by developing countries as they move up in the development spectrum, may be seen as characterized by two phenomena that come hand in hand. The first is economic diversification (Imbs and Wacziarg 2003). Empirical evidence suggests that non-agricultural activities in poor, stagnant, and underdeveloped economies are concentrated in a small number of sectors that tend to be very low-value added and geographically concentrated. Over time, as economic growth accelerates, a wider range of capacities are created, permitting the production of a wider range of goods and services. As a result, non-agricultural production starts to become more diversified, both in terms of sector structure and geographical location. Given this fairly regular pattern, economic diversification is recognized as an intrinsic part of sustained economic growth, leading to the pursuit of policies that promote diversification in growth strategies, especially for low-income countries (Commission on Growth and Development. 2008).

A second phenomenon that appears during the process of structural change is an increase in the complexity of the economic system, in other words, an increase in the human capacity to produce goods and services that are technologically more sophisticated and that satisfy a larger variety of needs. As part of this second phenomenon, the economy starts to employ new production inputs coming from different sources: discovered or created locally, or brought in via foreign trade; and firms advance their capacity to integrate these inputs more efficiently or at a larger scale. The production inputs that matter do not only include standard production factors (such as labor, land, physical and human capital) and public goods (including physical infrastructure and institutional frameworks), but also

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various less tangible inputs as leadership, trust, values, or work ethic. Over time, surviving firms, both large and small, are prompted to become more strongly integrated into larger production networks (without necessarily being aware of this) (Hausmann, et. al. 2013).

In order to recognize these two phenomena, the PS framework proposes a view of economic production that complements the standard neoclassical approach. Products and services are conceptualized, not only in terms of physical attributes or monetary values, but also in relation to knowledge: they are made of knowledge and they are also vehicles for knowledge. The underlying assumption is that the embedment of knowledge in products and services requires people who possess certain related capabilities. The standard economic view is that the stock of knowledge in a society is the sum of all capabilities that individuals possess meaning that the greater the set of capabilities of an individual, the larger the number of products and services that this individual can generate.[2] The complementary view of the PS approach is that the amount of knowledge embedded in a society does not mainly depend on how much knowledge each individual holds, but on the diversity of knowledge across individuals and on their ability to use and combine this knowledge through a complex web of interactions: markets and organizations allow the knowledge that is held by the few to reach the many –in other words, division of labor and difference in tastes and consumption patterns together generate and allow us to access a quantity of knowledge that none of us would be able to hold individually. Given this, the multiplicity of useful knowledge embedded in a society is not expressed in the amount of output (summarized by GDP) but in the diversity and composition of a country's productive capacity. The PS approach holds that the composition of produced goods and services mirrors the underlying structures that possess and combine this knowledge, and that this composition is not well captured by standard aggregate economic indicators.

The ease with which the knowledge embedded in available production inputs can be transferred and recombined is a major determinant of the ability of producers to offer a larger and more complex set of goods and services (associated with higher productivity levels). The ease with which an input can be moved between two products depends on their degree of commonality; for example, it is easier to move inputs from wheat to barley than from wheat to microchips, simply because of the presence of a larger set of commonalities between two agricultural products than between an agricultural product and an electronic manufacture. In a conceptual straight line that draws the distance between these three products, the distance between the two agricultural products (wheat and barley) is smaller (their proximity is larger) than the distance between either agricultural product and the electronic manufacture (microchip). It is possible to add more products to wheat's straight line of distances. The distance lines of barley and microchips can similarly

[2] In relationship to the literature on economic growth and development, the PS approached deviates from the class of models started by (Solow 1956) and (Romer 1986), and from the O-ring Model (Kremer 1993). The O-ring model assumes that products differ in the number of complementary steps that they require where each step is otherwise identical. In this model, countries with greater ability to perform any step successfully will find it more advantageous to specialize in products that require many steps. Yet, they will be unable to compete with less able countries that specialize in products requiring fewer steps, since wage differentials would make the production of these goods in the most able countries too costly. This model would not predict that high ability countries would be more diversified per se. Indeed, the O-ring model predicts that the matrix connecting countries to products would take a block diagonal rather than a triangular shape (Hausmann and Hidalgo 2011).

be generated, linking each product to all other products. The result of this complex web of production interactions can be represented in a network based on proximity data.

In this context, Hausmann and Klinger (2006) propose a measure of proximity that is based on observed patterns of diversification across countries. More specifically, they use the concept of conditional probabilities of co-exporting pairs of products as the building block in the construction of a square matrix of proximities for all products according to a comprehensive classification, in their case all 4-digit products in the Standard International Trade Classification (SITC Rev 2). Global trade data is used in the definition of proximities due to the lack of comparable global production statistics for goods (or services).[3] Hausmann and Klinger (2006) also propose concepts from network theory for the analysis of this matrix of proximities. Among other things, using a minimum-spanning tree algorithm with proximities across all 784 products in the global trade database, they construct a product-space map that clusters products into categories with similar production inputs. Moreover, they show that products exported by stagnant countries tend to be isolated, located in the sparsest and less connected parts of the PS map, while products exported by countries with higher long-run GDP growth rates tend to be in the densest part. In the PS framework, this provides initial support to the idea that producers in more dynamic economies have a larger set of capabilities, and that they can use their capabilities and knowledge more freely to recombine available production inputs.

The location of a country's export mix in PS matters for growth. For example, a country may be "stuck" in low value added industries or in products with declining world export markets, or both. Ideally, a country wants to be moving into higher value industries (moving up the value chain) and towards expanding export markets; however, this is difficult because it crucially depends on many factors, including unknown unknowns that influence the future developments of world exports and products. Hidalgo and Hausmann (2009) provide evidence that a country's position in PS is strongly correlated with its level of GDP per capita. Moreover, they show that there is a large heterogeneity in the distribution of capabilities across countries and that this distribution does not have linear consequences. For example, countries with very few capabilities will experience small diversification gains if just a small number of capabilities are added whereas a country that starts out with many capabilities will experience much larger gains if the same number of capabilities is added. The empirical evidence also suggests that the structure of the PS has important implications for technology spillovers across regions. To exemplify, the probability that a product is added to a country's export basket is, on average, 65 percent higher if a neighboring country is a successful exporter of that same product (Bahar, Hausmann, and Hidalgo 2012). Moreover, this technology diffusion is stronger at shorter geographical distances, weaker for more knowledge-intensive products, and accelerating over time.

[3] In recent years, technological upgrading is making exports of services more important as these become increasingly tradable. PS metrics based exclusively on merchandise trade data cannot capture this effect. In order to mitigate this shortcoming, our analysis includes a less detailed discussion of service exports, based on IMF Balance of Payment statistics.

3 Product Space Methodology and Concepts

The PS method is based on a set of empirical measures that are focused on the relatedness between different products and the income levels that are associated with exporters of individual products. Among these measures, the most central, proximity (with distance as its opposite) was discussed above. In country analyses based on PS concepts, alternative exports baskets may be evaluated. In this context, PS analysis suggests that a country that strives to use exports as a means of accelerating growth should take into account several key aspects. Among other things, such a strategy should consider the dynamics of revealed comparative advantage (*RCA*) to identify traditional, emerging, and sluggish exporting sectors. In addition, the country should strive to diversify, increasing competitiveness in product categories that are within reach and that offer higher scope for further diversification – using PS terminology, such categories have relatively high values for *density* and *PATH*, respectively. Lastly, when assessing different products, it is important to consider their income potential (*PRODY;* defined on the basis of GDP per capita and the shares of a product in the export baskets of countries with RCA>1 in the product); products with a high *PRODY* relative to the country's *EXPY* (defined on the basis of *PRODY* data and the product export shares for the country) promise to bring about stronger growth in the country's GDP per capita. (Definitions of key PS concepts are found in Annex 1.)[4]

In the following analysis of Morocco, the PS methodology is applied in a stepwise process. Drawing on previous World Bank applications, products are categorized according to structural shifts in *RCA* and ranked according to prospects for further diversification (*PATH*) and income potential (*PRODY*). Products with high *density*, high *PATH*, and high *PRODY* are usually the best candidates for diversification, as they combine strong production capability, large scope for further diversification, and high income potential. An increase in the share of products with high *PRODY* raises the income potential of the country's export basket (*EXPY*).

In general, there is a trade-off between products with high *density*, high *PATH*, and high *PRODY*, i.e. between products that are within reach ("low-hanging fruit," which often means doing things that are only slightly different; the case of high *density*), products that offer greater diversification potential (often new products that require non-marginal start-up investments; the high *PATH* category), and products that raise potential income (often those for which it is most difficult to become an efficient producer; products with high *PRODY*). Empirically, the relationships are often negative between *density* and *PRODY* and between *density* and *PATH*, but positive between *PRODY* and *PATH*. In other words, *PS* analysis often points to the difficulty of generating a successful development strategy as it

[4] Further developing the PS framework, Hausmann et al. (2013) propose two aggregate measures of embedded knowledge: for societies, the Economic Complexity Index (*ECI*) and, for products, the Product Complexity Index (*PCI*). These indexes are constructed using an iterative method that, from global trade data, gathers information contained in the number of products that a country can make (the diversity of the country) and the number of countries that can make a product (the ubiquity of the product). The authors find that, controlling for per capita income, countries with a higher *ECI* tend to grow faster in subsequent periods. While *ECI* and *PCI* have certain advantages, *EXPY* and *PRODY* are more transparent and fully adequate for our purposes. In fact, the correlation between ECI and *EXPY* is .61, between *PCI* and *PRODY* is 0.79, and between *PCI* and *PATH* is .48.

tends to show that products that are highly profitable and add to diversification are difficult to reach, while easily reachable products offer limited scope for diversification and growth.

A PS analysis does not provide answers to questions about future export winners for the focus country. However, on the basis of international experience (captured by detailed global trade data), PS analysis helps identify sectors that are attractive considering a country's capabilities and the potential contributions of different sectors to diversification and income potential. The approach manages to accomplish this at a finely disaggregated sector level thanks to the fact that it is designed to make good use of a rich database for merchandise trade, with annual data and global coverage at the country level. However, it is important to be aware that its design and data constraints together exclude a wide range of issues from the purview of PS analysis. Among other things, PS analysis explains changes in export structure on the basis of sectoral proximities without reference to other issues that clearly matter (for example sectoral policies and human capital) but for which matching global databases do not exist. As a result, it is often advisable to combine or integrate PS analysis with other approaches that address some of these other aspects, albeit with limitations of their own. Such approaches may include expanded historical analysis that highlights the roles of policy and factor endowments in sectoral trade and production growth. In general, when envisaging the future roles of different sectors, it is important to draw on insights from sector experts and policy makers in the context of broader development objectives.

Among the data-related shortcomings of most applications of PS analysis is that they do not address service sectors. In this paper, we try to mitigate this shortcoming by including a discussion of services, albeit not very detailed due to data limitations. Another shortcoming, which in practice probably is less serious, is related to the fact that the ability of different sector indicators to reflect country capabilities is hampered by the presence of high sector-level subsidies in some countries.

4 The Case of Morocco

In this section, the tools of PS analysis are applied to the case of Morocco. The analysis uses detailed export data starting in 1980 and examines patterns of changes in RCA and technology content (Section 4.1), and how the country's export structure has positioned Morocco in PS and prepared the country for future growth (Section 4.2). Based on the country's current capabilities, measured by the PS concept of *density*, we construct a *naïve* scenario of Morocco's aggregate exports up to 2025. Finally, we discuss some important sector priorities (Section 4.3) informed by PS metrics.

4.1 Evolution of Morocco's exports in recent decades

Figure 1 summarizes the evolution of Morocco's merchandise exports from 1980-2010, with observations in five-year intervals, according to patterns of RCA shifts.[5] As can be seen,

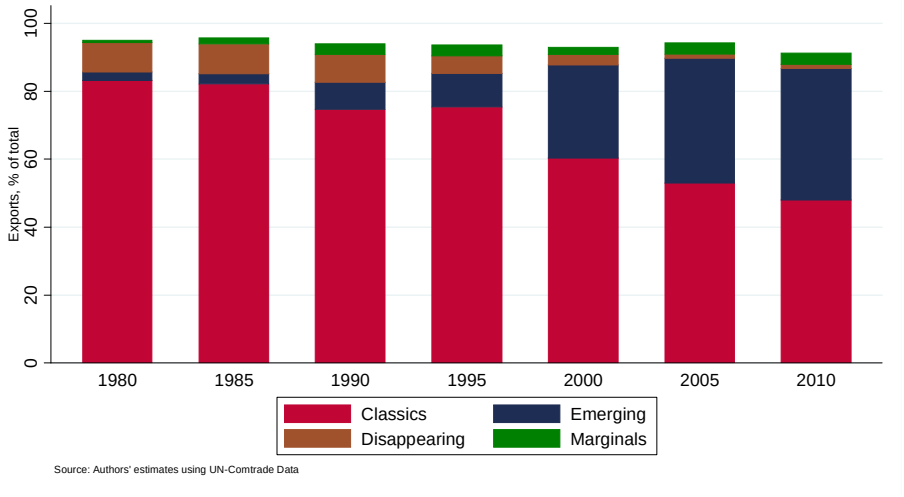
[5] Following previous World Bank applications, we classified Moroccan merchandise exports according to long-term shifts in revealed comparative advantage (RCA) using two distant five-year periods, 1980-1984 and 2006-2010, constructing a binary variable (D-RCA) that takes the value of 1 only if a product has an RCA value greater than unity during five consecutive years in each period. As a result of this classification, products can be grouped using a 2x2 matrix – with 2 time-periods and 2 values of the D-RCA variable. These

the most striking development is the growing share for emerging products, from 2 percent to almost 40 percent. This product category has also affected the technological composition of Morocco's export basket: a dominant and increasing share is manufactures (increasing from 60 to 90 percent of all emerging products); and, among the manufactures, the largest but only slowly growing share is med- or high-tech manufactures (increasing from 50 to 60 percent; Figure 2).

Growth in emerging exports has been rapid and, during the last fifteen years accelerating. However, it has been driven by a relatively small number of products. In fact, two product categories accounted for half of the observed growth between 1995 and 2010: the first is "Fertilizers, n. e. s." (SITC 5629) and the second "Insulated and electric wire, cable, bars, etc." (SITC 7731). One tenth of the observed export growth was due to various small exports, including "Diodes, transistors, photocells, etc." (SITC 7763) and various export discoveries in the textile industry.

Returning to Figure 1, among non-emerging products, the major change is a decline in classicals (from 83 to 48 percent); in terms of technology, Morocco's classical products are mostly primary and resource-based or low-tech manufactures. Among the remaining two product categories, disappearing products decline (by 7 percentage points) while marginals increase (by 3 percentage points).

Figure 1: Morocco's Merchandise Exports 1980-2010 by Pattern of RCA Shifts



product categories have commonly been named classical (if D-RCA=1 in the past and present), emerging (if D-RCA=1 only in the present), disappearing (if D-RCA=1 only in the past), and marginals (D-RCA=0 in the past and present).

Figure 2: Emerging Exports in Morocco by Technological Content

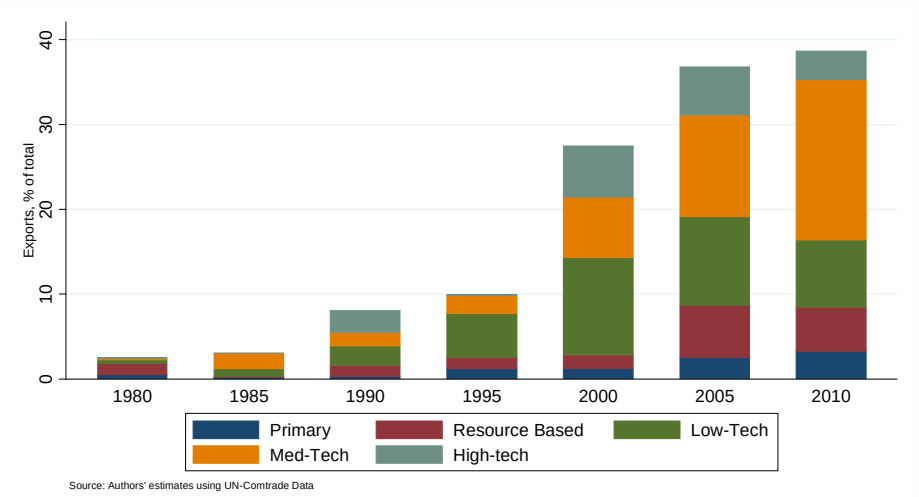
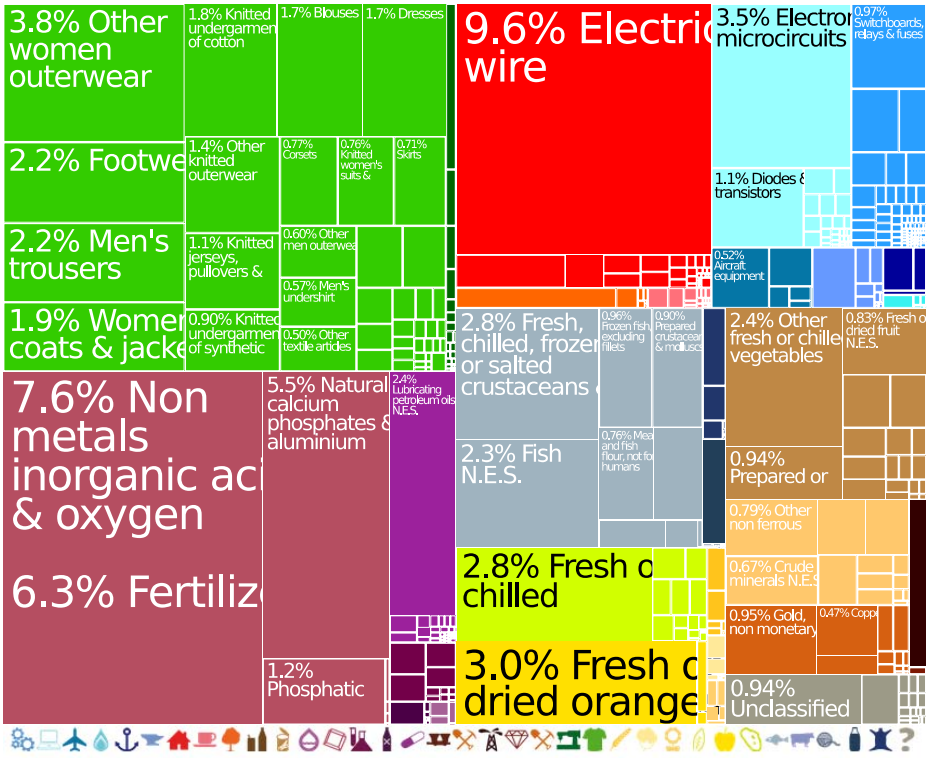


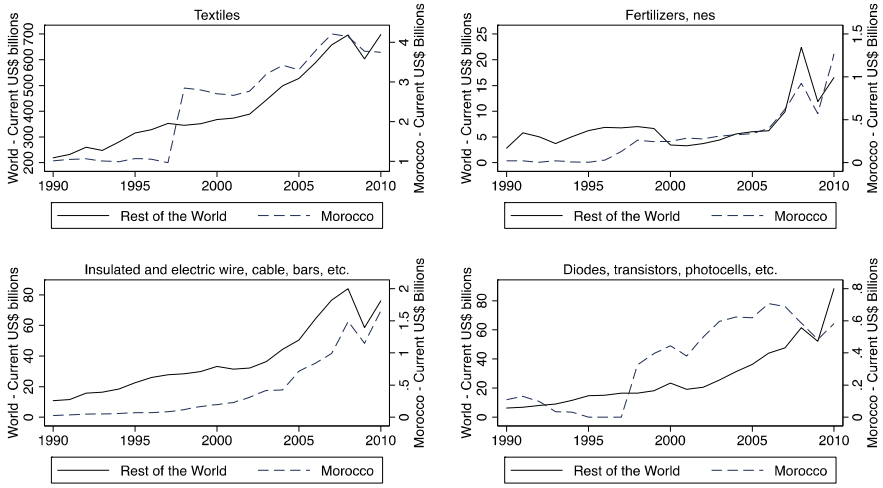
Figure 3 shows the composition of Morocco's merchandise exports in 2010 – its percent figures add up to 100. As shown, using rounded data, the main four items (accounting for 71 percent) were as follows: garments (25 percent); inorganic salts and acids (21 percent); vegetables, fruits, and fish (15 percent); and electric wire (SITC 7731; 10 percent). Among electronics, "Electronic microcircuits" (SITC 7764) and "Diodes and transistors" (SITC 7763) are the two most important items (a total of 5 percent). Figure 4 shows the evolution of export values 1990-2010 for the world (the global total) and for Morocco for a set of products that are among Morocco's emerging exports (with the scales for world and Moroccan values on the left and right vertical axes, respectively). In general, it suggests that Morocco's export growth for these products is not dramatically different from the growth in total world exports (or imports). It also suggests that, inside the Moroccan economy, different sectors are subject to common policy changes and constraints, as a result competing in markets for labor and other factors and responding to changes in exchange rates and other changes in incentives.

Figure 3: Morocc e Exports in 2010



Source: The Atlas of Economic Complexity http://atlas.media.mit.edu/explore/tree_map/export/mar/all/show/2010/

Figure 4: Trends for Selected Emerging Moroccan Exports for Morocco and the World, 1990-2010



Source: Authors' calculations using UN-Comtrade Data

4.2 Exports, GDP growth, and Morocco's position in the Product Space

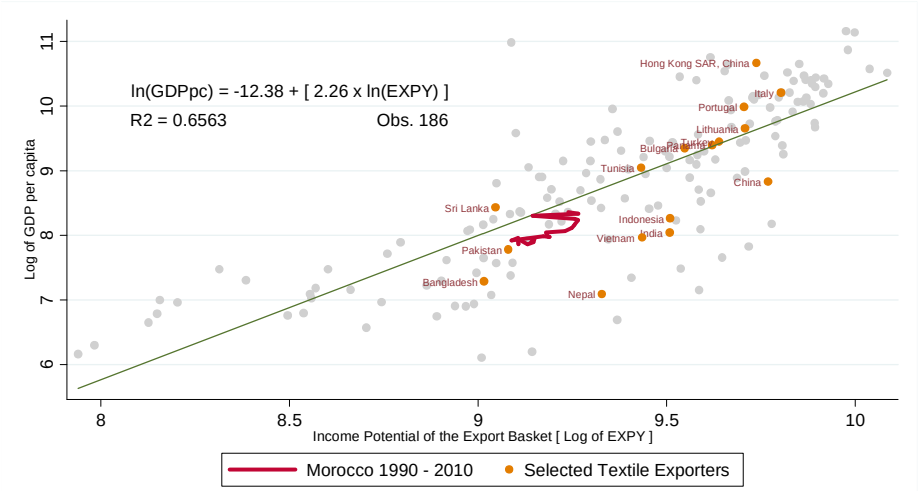
As noted in Section 3, global export data combined with country data on GDP per capita may be used to define *PRODY* (a global measure of the income potential of a product) and *EXPY* (a country-specific measure of income potential based on *PRODY* and country export data). These concepts are of interest since empirical cross-country analysis indicates that GDP per capita and *EXPY* are highly correlated – countries with a high GDP per capita tend to have a high *EXPY* and vice versa – and that increases in *EXPY* tend to lead to increases in subsequent GDP growth.[6] As an illustration of this relationship with reference to Morocco, Figure 5 shows an estimate of the cross-country relationship between country *EXPY* and GDP per capita in 2010, to make some relevant country detail visible highlighting the positions of Morocco and other textile exporting countries.

In addition, Figure 5 shows that movements of Morocco's *EXPY* across the GDP per capita space closely follow the estimated cross-country relationship throughout the period 1990-2010 – in other words, the evolution of GDP per capita is consistent with changes in the sophistication of the export basket (marked by an increasing merchandise export shares of products with higher *PRODY* values), supporting the validity of the PS approach to analyses of growth and trade for Morocco. The obvious implication that follows from this perspective is that, *ceteris paribus*, for Morocco (or any other country), accelerated growth in the income potential of its export basket would propel stronger GDP growth. A key strategic question is: Can the current structure of exports and its underpinning production structure provide the base for a future rapid structural transformation? In general terms,

[6] More specifically, Hausmann, Hwang, and Rodrik (2007) use Comtrade data to construct a panel of nearly 80 countries that start in 1962. Data is grouped into 5- and 10-year intervals and results from four different estimators (OLS, IV, OLS with fixed effects, and GMM) suggest that, on average, a 10% increase in *EXPY* in an earlier five-year period raises per capita growth by 0.14–0.19 percentage points in the subsequent five-year period.

this increased sophistication of the export basket has not been strong enough to propel GDP growth to rates that exceed those of other middle-income countries.

Figure 5: EXPY for Morocco and Selected Textile Exporters (1990 – 2010)

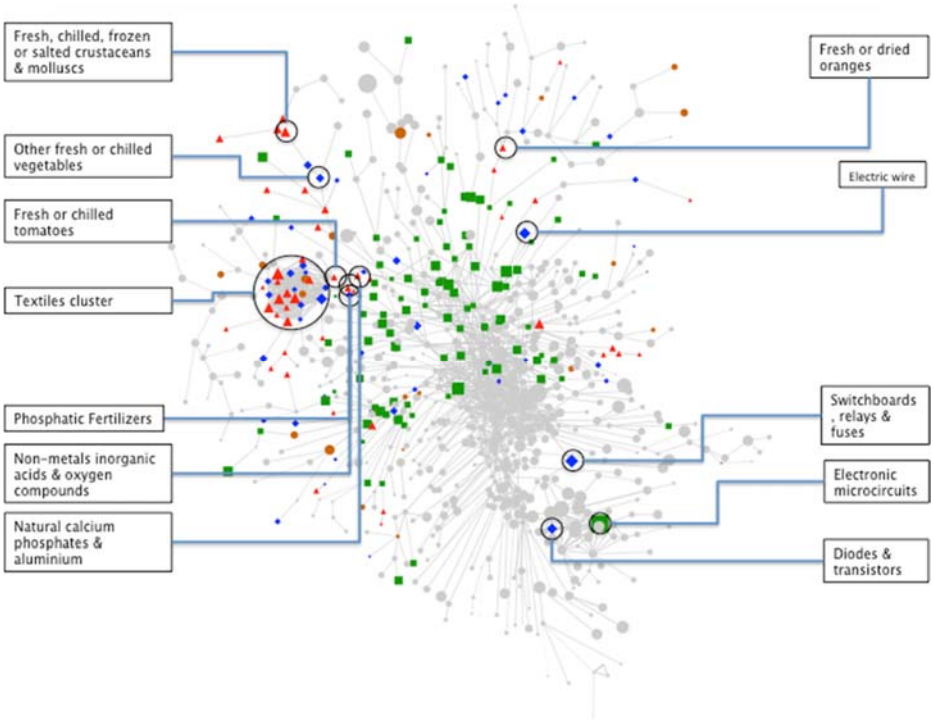


Note: Points for Selected Textile Exporters corresponds to year 2010
Source: Authors' calculations using Comtrade Data

Figure 6, a map of the PS in 2010 that reflects proximities between products, is relevant to a discussion of issues related to the income potential of country's exports and how it may change over time.[7] The map highlights the positions of Morocco's classical, emerging and marginal products, reflecting the data on long-term shifts in *RCA* for Morocco between 1980 and 2010, discussed in Section 4.1 It is evident that most classical exports (in red) and emerging exports (in blue) are located in the periphery of the PS, meaning that their underlying capabilities are not easily transferable to other, perhaps, more sophisticated products; given this, these products offer only a limited diversification potential. By contrast, marginal products (in green) are closer to the core of the PS, which is the densest part. This may mean that Morocco is building the capacities to export these products but that these capacities are not yet mature enough to permit exports in much larger quantities. A closer inspection is needed to evaluate the feasibility of marginal merchandise exports, among other things considering the extent to which they are affected by trade policies, favoring or disfavoring these sectors.

[7] It is important to emphasize that the PS network shown in Figure 6 represents the global map of the product space; it was constructed using global export data disaggregated by product and country, on the basis of which we computed conditional probabilities of co-exporting pairs of products with RCA>1 for both. Hence, the shape of the PS network is not country specific; however, in this global map, we highlight Morocco's classical, emerging, and marginal products.

Figure 6: Morocco's Position in the Product Space in 2010



Note: Classical products are red, emerging products blue, and marginal products green.
Source: Authors' diagram based on Hidalgo's Map in The Product Space and the Wealth of Nations. http://www.chidalgo.com/productspace

Data on *density* – a country-, time-, and product-specific measure – provides a perspective that complements that of the PS map by indicating the likelihood that a country will be able to develop an *RCA* > 1 in specific products. More specifically, *density* is defined on the basis of the proximities of the product to other products in which the country has an *RCA* > 1; i.e. on the basis of the country's current position in the network, it strives to capture the capability of the country to develop *RCA*s > 1 in other products. Crucially, Hausmann and Klinger (2006) show that products with high *density* are more likely to gain importance in the export basket, over time developing *RCA*s > 1.

Empirically, there is an overall positive relationship between the PS related measures of income potential (*PRODY*), and diversification potential (*PATH*) meaning that, as countries export new products with higher income potential (*PRODY*), they also develop products that offer larger sets of diversification opportunities in the future (*PATH*).[8] Nevertheless, the higher the income and diversification potential of a product, the more difficult it tends to be for a country to become competitive in that product, a phenomenon that is reflected in a lower value of *density*. The pattern that we observe for Morocco is similar to that observed in other developing countries: traditional exports, or classics, have less income potential (low *PRODY*) and offer lesser opportunities for further diversification (low *PATH*)

[8] The Product Complexity Index (*PCI*), is an alternative product indicator that is highly correlated with and plays a role similar to *PRODY*, but without reference to GDP per capita; see the annex for a definition.

than emerging and marginal products; however, the latter are more difficult to develop and scale-up, as reflected in their lower *density* values (Table 1).

Table 1: Product Space Measures for Merchandise Exports in Morocco

Product Classification	Number of Products	Exports, % of total	Average PRODY	Average Path	Average Density
Classics	46	51.7	9,641	114	0.263
Emerging	49	36.7	10,607	129	0.237
Marginal	22	1.1	8,684	110	0.215
Disappearing	93	3.4	16,060	150	0.183

Classics are products with RCA>1 in both periods 1980-1984 and 2005-09.
Emerging champions are products with RCA>1 from 2005-09, but not during the earlier period 1980-84
Disappearing products had RCA>1 during the period 1980-84, but RCA<1 by 2005-09
Marginals didn't have RCA >=1 either in the past or in the recent period, but they have relatively high PRODY and density.

Source: Authors' calculations using UN-Comtrade Data

The relationship between potential income gain (ln *PRODY* – ln *EXPY*) and lack of capability (1/*density*) for Morocco's goods exports in 2010 is shown in Figure 7 and Figure 8 below. Products above (below) the zero line on the vertical axis have a higher (lower) potential income than the average for Morocco's 2010 export basket of goods (measured by *EXPY*). The higher the value for a product along the horizontal axis, the lower the capability of Morocco to develop an RCA > 1 in the product. As expected, the upward-sloping relationship in both Figures indicates that the larger the potential income gain, the more severe the lack in the capabilities needed for competitive production. Interestingly, compared to classical and emerging products, marginal products show a stronger potential income gain and a more severe lack of capabilities (Figure 7). Figure 8, which scales the size of product bubbles by export values, shows that a subset of the emerging products and most marginal products have a *PRODY* well above Morocco's *EXPY* while the opposite holds for the bulk of classical products; as a result of small export values, the bubbles for the marginal products are indeed very small. In sum, Figures 7 and 8 both suggest that the marginal products offer payoffs that may be worth exploring.[9]

[9] Annex 2 presents average *PRODY*, density, and *PATH* for all Moroccan exports at the 3-digit level (SITC Rev. 2). Calculations at the 4-digit level are available upon request. Product Complexity Index can be downloaded from The Observatory of Economic Complexity.

Figure 7: *PRODY*. *EXPY*, *density*, and export goods for Morocco in 2010

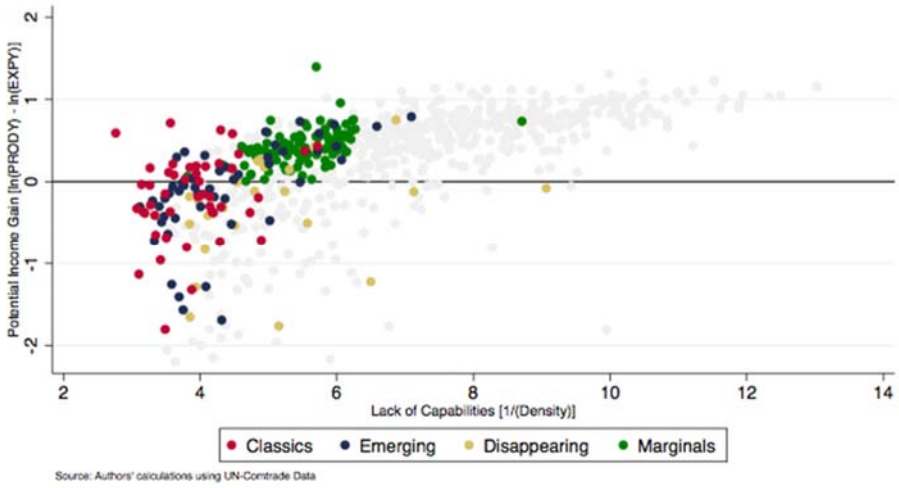
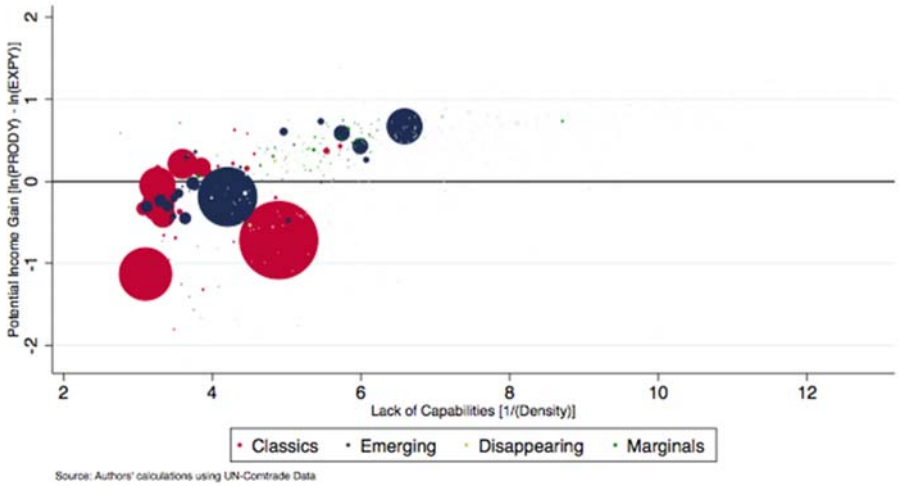


Figure 8: *PRODY*, *EXPY*, *density* and export values for Morocco, 2010



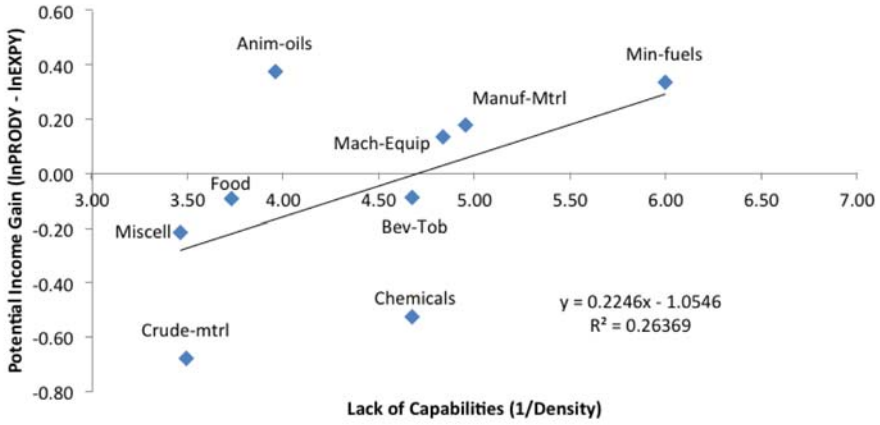
Note: The size of the colored dots reflects export volumes

Figure 9 is similar to Figure 7, except that the products are aggregated to the I-digit level, which may be viewed as representing industrial clusters. For some purposes, information at this higher level of aggregation may be more relevant for policy – discrimination in favor of sectors at a very fine level of disaggregation may be inefficient and require more knowledge than typically possessed by policy makers. Aggregation does not alter the positive relationship between potential income gain and lack of capabilities.

In addition to *PRODY*, *EXPY*, and *density*, it may be important to consider and bring the concept *PATH* into the analysis when possible options for diversification are considered. For example, for "Animal and vegetable oils, fats and waxes" (in Figure 9 labeled "Anim-oils"), Morocco's potential income gain is high relative to other products with a similar *density*. Under this heading, the main disaggregated products are "Fat and oils of fish and marine

mammals" (4111) and "Olive oil" (4235), both of which have relatively high *density* and *PRODY* values (like their aggregate). However, these two products have very low values for *PATH* (84 and 81, respectively), indicating that it is not likely that they will pave the way for further growth-promoting diversification.[10] By contrast, major exports under "Food" and "Miscellaneous manufactured articles" (including apparel and clothing) with comparable levels of *density* offer larger diversification potential but only moderate direct income gains (i.e., income gains in the absence of such diversification).[11] This suggests that countries may face (and policy makers may have to consider) trade-offs between more immediate and more distant gains in GDP and income growth.

Figure 9: *PRODY*, *EXPY*, and *density* in Morocco at the 1-digit level, 2010



Note. Explanations of abbreviations in Figure 7: Food = Food and live animals chiefly for food; Bev-Tob = Beverages and tobacco; Crude-mtrl = Crude materials, inedible, except fuels; Min-fuels = Mineral fuels, lubricants and related materials; Anim-oils = Animal and vegetable oils, fats and waxes; Chemicals = Chemicals and related products, nes; Manuf-Mtrl = Manufactured goods classified chiefly by materials; Mach-Equip = Machinery and transport equipment; Miscell = Miscellaneous manufactured articles.

Favorable PS measures do not implicate the absence of fierce competition in global markets. For instance, product 8424 "Men's jackets" has relatively high-*density*, high *PATH*, and one of the largest income potentials among Morocco's clothing and apparel export categories; however, Morocco has only a limited share (1.8%) of a global market that is dominated by China (37%) and Italy (11%).

4.3 Projecting export growth for Morocco up to 2025

In which sectors are Morocco's future exports likely to grow most rapidly? 30 years of detailed global export data reveal a high correlation between *density* and subsequent

[10] Morocco's world market shares for "Fat and oils of fish and marine mammals" and "Olive oil" are 3.6 and 0.9 percent, respectively. Like their aggregate ("Animal and vegetable oils, fats and waxes"), they have high values for density (0.233 and 0.265, respectively) and *PRODY* (19,266 and 14,756 respectively). Their *PCI* rankings, 674 and 596, respectively, are also very low.

[11] Under the "Food" heading, prepared or preserved categories tend to have larger income and diversification potentials than categories of food that are fresh or frozen, especially within "Fruits and vegetables" and "Fish, crustacean and mollusks, and preparations thereof." Among apparel and clothing, the income and diversification potential is more promising for the most technically sophisticated articles.

export growth. Table 2 presents results of panel regressions at the product level for annual export growth between *t* and *t+5* against *density* in *t* for *t*=1980..2005. The specification uses country-, year-, and industry-specific dummy variables. The panel regressions include results for linear, quadratic and cubic *density* terms.[12] In all cases, *density* is highly significant.[13]

In order to analyze the expected export growth that results for a change in *density*, we computed marginal export effects for the density values in the Moroccan sub-sample. Figure 10 shows average marginal export effects for the case of Morocco. As expected, low values are associated with negative export growth while, at above the median value (which is at the 60th percentile), *density* is associated with export growth of about 5 percent for products with *RCA*>1. Using these estimates, merchandise export growth is projected at the product level for Moroccan exports for three future points in time: 2015, 2020, and 2025. In this *naïve* scenario, we are allowing Morocco's *density* in products with RCA>1 to level up in 2015 with the average density for all countries that also have *RCA*>1 in that particular product. RCA is recalculated based on projected export growth for Morocco. In addition, we introduce small export discoveries for products with zero export values in 2010 if their density reaches above the 75th percentile in 2015 or a later year. Under this scenario, export discoveries happen for products above the 75th percentile of Morocco's *density*; the resulting combined value of all export discoveries is moderate, representing only 1.9 percent of total merchandise exports.

Table 2: Density as Predictor for Export Growth

Dependent Variable: 5-year Export Growth in time t, 1985-2010				
Independent Variable	**No Industry Dummies**		**With Industry Dummies**	
Density in t-5	190.129***	130.280***	257.177***	163.092***
(Density in t-5)^2	-209.524***		-316.180***	
(Density in t-5)^3		-191.941***		-280.333***
Dummy RCA t-5	0.386***	0.386**	1.109***	1.110***
i.Morocco	42.244***	43.461***	39.754***	41.916***
i.2005	18.816***	19.174***	17.359***	18.017***
constant	-92.503***	-89.521***	-97.695***	-92.603***
Obs.	1,361,725	1,361,725	1,361,725	1,361,725
Adj R-squared	0.1838	0.1834	0.1938	0.1930

note: *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' estimates

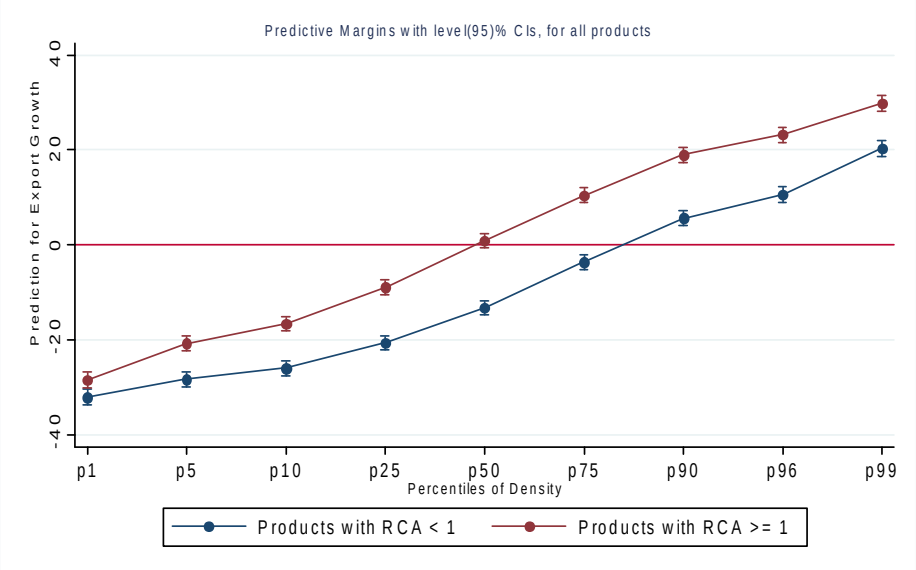
[12] Under the "Food" heading, prepared or preserved categories tend to have larger income and diversification potentials than categories of food that are fresh or frozen, especially within "Fruits and vegetables" and "Fish, crustacean and mollusks, and preparations thereof." Among apparel and clothing, the income and diversification potential is more promising for the most technically sophisticated articles.

[13] Estimated coefficients with linear and quadratic values for density, with positive and negative signs respectively, indicate that higher values of density would increase export growth at a decreasing rate. In this simple model no-policy variables have been incorporated, implicitly on the basis of the assumption that this unobservable information is captured exclusively by the set of categorical variables (industry-, country-, and time-specific); this may explain the relatively low R-squared of about 20 percent. Not shown in Table 2 are regressions with the initial level of exports as explanatory variable because, even though the estimated coefficient was positive and statistically significant, its size was negligible.

We project merchandise exports at the product level up to 2025 on the basis of Morocco's current export structure and global PS patterns. Figure 11 shows the projected evolution of total exports; Figure 12 disaggregates projected exports by technological content, showing results in five-year intervals. Total exports in Morocco follow the historical trend and the technological upgrading remains stagnant, which is consistent with the situation that prevailed during the last two decades.

In this partial analysis, the results do not support the notion that the current structure of Morocco's export will lead to a more pronounced technical upgrading in the future. In order to get technological upgrading, disaggregated product level export growth would have to be faster for products classified as high-tech, for instance, resulting from higher initial *densities* in high-tech products, with or without RCA>1. Projections are capable of changing the technological content, especially if *densities* are higher in emerging high-tech products.

Figure 10: Predictive Margins of Panel Regression (3) – Estimates for 1980 – 2005



Source: Authors' estimates

Figure 11: Exports in Morocco, historical and projected

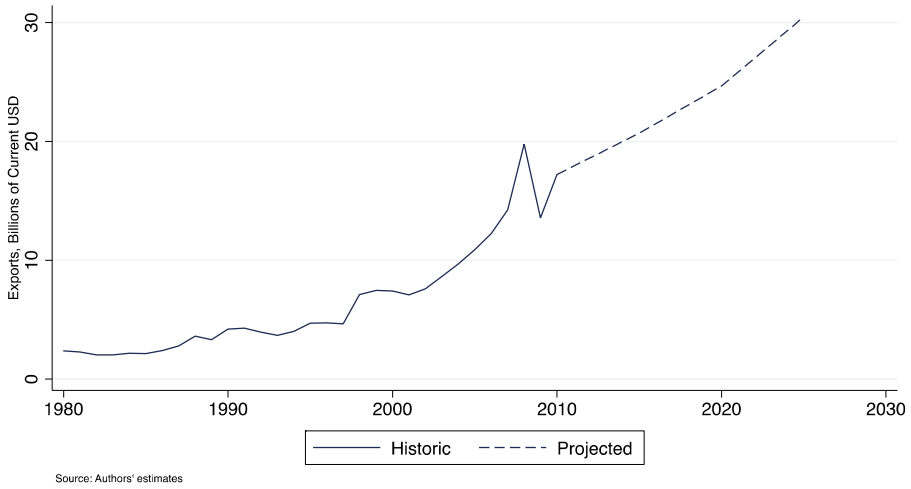
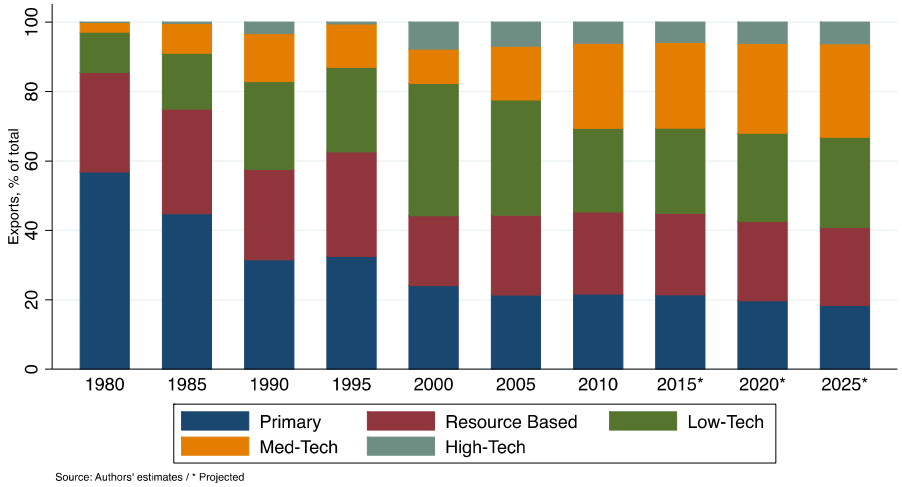


Figure 12: Historical and Projected Merchandise Exports by Technological Content



Note: * for projected values

4.4 Product-level diagnostic

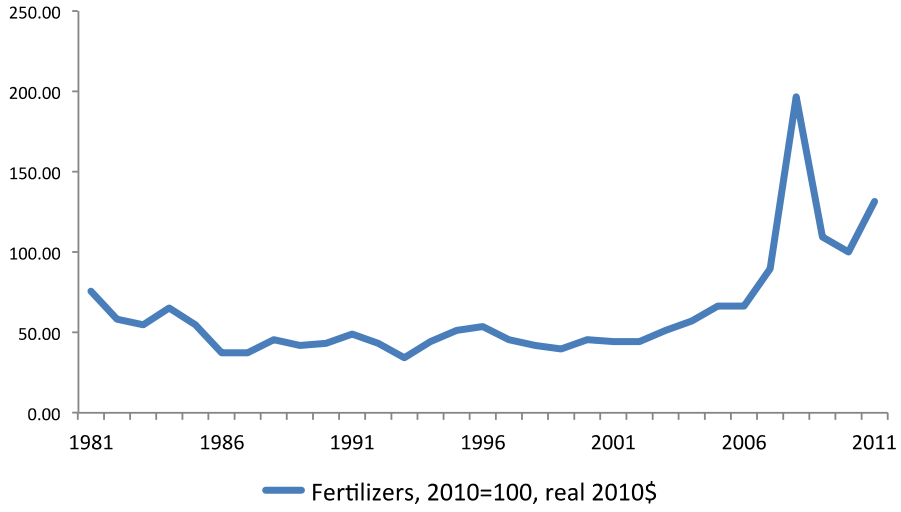
4.4.1 Phosphates

Some specific products may be important for Morocco's future export strategy, including phosphates, electronic components, and the auto-industry. Phosphate, used as fertilizer, is an irreplaceable input that powers modern agriculture, and its reserves are in decline almost everywhere except Morocco. According to estimates (Schröder et al. 2010), Morocco possesses 37 percent of the global economic phosphorus reserves, suggesting that its market may be a quasi-monopoly. A growing gap between phosphorus supply and demand in the coming decades is expected in the absence of large-scale implementation of

innovative phosphorus efficiency methods and recovery systems. In 2012, world prices of fertilizers were 250 percent above their 2005 level, reflecting these growing pressures (see Figure 13). Large windfalls of phosphate revenues might serve to alleviate many economic problems; however, Morocco needs to address the dangers of over-dependence and mismanagement of its mineral resources, not only because the well-known risk of Dutch disease, but also because of the risks of corruption and state capture.

In terms of the PS measures, "Fertilizers" and "Phosphatic Fertilizers" (SITC 5629 and 5622) have some of the lowest PCI values (rank 564 and 648 respectively), reflecting their extractive nature and the few forward-linkages that they can generate. *Density* is high but the *PRODY* values of these two products are low, suggesting that it is difficult for Morocco to aspire to become an upper-middle income country if it is focused on fertilizer extraction. (The *PATH* values are 137 for SITC 5629 and 97 for SITC 5622.)

Figure 13: World Price of Fertilizers, 2005 = 100



Source: World Bank, GEM Commodities

4.4.2 Electronics

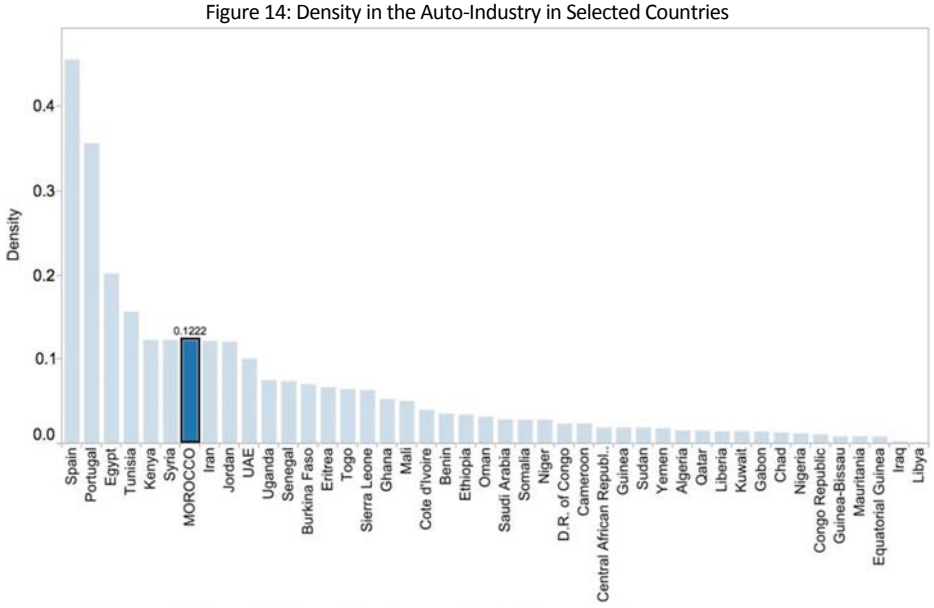
Some exports related to the assembly of electronic components have gained importance in Morocco. In "Diodes and transistors" (SITC 7763), "Switchboards and relays" (SITC 7721) "Electronic microcircuits" (SITC 7764), and "Electric wire" (SITC 7731) – with complexity-index rankings of 86, 120, 125, and 464 respectively – Morocco has attracted important R&D investments in the last decade: SQLI (France) set up an R&D platform in the country in 2003l Eolane Electronics Manufacturing Services (France) opened an R&D center in 2004 next to its manufacturing and distribution unit; STMicroelectronics has had a chip design Centre in Casablanca since 2000; and Gespac Maroc Usine Novatech, which is present in the city of Temara since 2001, manufactures electric wiring for aviation equipment. Nevertheless, Morocco is still considered an extension to Europe's industrial capacities and it is still an open question whether the country can be upgraded to become a significant manufacturing center, especially given fierce competition, both from large emerging economies (such as India, China, and Brazil) and regional competitors (such as

Egypt, Lebanon, and Tunisia). Moreover, Morocco's *density* in these export categories is not particularly high.

4.4.3 Auto industry

In the automotive industry, the Renault group is the largest firm on the Moroccan market, with a market share of 37 percent in 2011; among its brands, Dacia and Renault rank first and second, with market shares of 20 and 17 percent, respectively. In 2011, vehicle sales in Morocco topped the 112,000 mark. The number of cars on the road is estimated at 1.5 million, with an average age of 9-10 years. Although limited, the Moroccan automotive market is growing strongly. Morocco has only one car plant in Casablanca and seeks to develop its car industry further with the Renault Group, which is exempt from both corporate and export taxes up to 2017. The Renault mega project, which consists of a 1 billion euro investment in a 300-hectare plant located 30 kilometers from the new Tanger-Med port, will reach a production capacity of up to 170,000 vehicles per year at first and is expected to generate 6,000 direct jobs and some 30,000 indirect jobs in the northern region of Morocco. Moreover, in the automotive area, the country might serve as an important hub for the North-Africa corridor as well as Southern Europe. Nevertheless, Morocco's *density* in the auto-industry is still weak (*density* = 0.122) in comparison with other countries in the Middle East and North Africa Region, such as Egypt (*density*=0.202) or Tunisia (*density*=0.157) (Figure 14).

Figure 14: Density in the Auto-Industry in Selected Countries



Source: Authors' calculations using UN-Comtrade Data

4.4.4 Service sector

Finally, as noted earlier, service exports has gained importance in Morocco's total exports as their share has increased by an annual average of 0.55 percentage points since 1980. During the period 2006-2010, service exports accounted for 44 percent of total exports. Not only have they gained importance, but their composition has also become

more balanced. While "Personal travel services" is still the single most important service category – representing USD$6.7 billion in 2010 – their importance has diminished, passing from two thirds to one half of the total between 1995 and 2010. More recently, Air and Sea transport services have gained momentum, reflecting Morocco's increasing importance as a regional hub in North Africa for shipping logistics, assembly, production and sales. Similarly, "Miscellaneous business, professional, and technical services," and Telecom now add up to close to 20 percent of Morocco's service exports (Table 3). This shift in service exports is positioning Morocco with a more balance service export basket than the average country in Middle East and North Africa or compared to what is typical among lower-middle-income countries. In part, this outcome reflects successful efforts to attract foreign investments in key sectors.

Table 3: Service Exports in Morocco

	% of total service exports				Billions of Current USD			
	1995	2000	2005	2010	1995	2000	2005	2010
Personal Travel	66.9	66.5	56.3	52.2	1.3	2.0	4.6	6.7
Air Transport	8.9	8.0	9.7	11.1	0.2	0.2	0.8	1.4
Misc. business, prof., and tech.	11.8	5.3	15.2	15.0	0.2	0.2	1.2	1.9
Telecom Services	0.0	3.7	4.0	5.5	0.0	0.1	0.3	0.7
Sea Transport	11.5	6.8	5.2	3.3	0.2	0.2	0.4	0.4
Other Private Services	0.8	3.7	3.1	9.8	0.0	0.1	0.3	1.3
Government Services	0.0	5.9	6.5	3.2	0.0	0.2	0.5	0.4
Total	100.0	100.0	100.0	100.0	1.9	3.1	8.2	12.8

Source: Authors' calculations using IMF Balance of Payment Statistics

5 Conclusion

This paper analyzes the evolution of Morocco's structure of goods exports and its implications for future structural change. The conclusions of this paper are exclusively derived from empirical evidence from international trade patterns. In sum, the analysis finds that, in recent decades, Morocco has developed a revealed comparative advantage (RCA>1) for a set of rapidly growing medium- and high-tech products, in 2010 representing around 40 percent of total merchandise exports. While these developments are encouraging, a relatively small number of products accounts for most of the growth, making the country quite vulnerable to external shocks. Moreover, whatever its contribution may have been, this export transformation has not been sufficient to raise per capita growth to the average level for middle-income countries.

To date, Morocco's capabilities are primarily in products with a relatively low income potential. Morocco's GDP level and growth in the last decade closely match what would have been predicted in light of the evolution of the income potential of its merchandise export basket. In terms of the underlying network of production, Morocco's structure is such that diversification into more sophisticated products still remains difficult. Overall, there is a trade-off between sectors that are within reach and sectors that offer higher potential gains in income or diversification.

Our simple projections of Morocco's exports up to 2025 suggest a continued but slow shift toward higher technology content with an aggregate growth rate for merchandise exports that is similar to the record since 1990. Considering Morocco's natural resources and PS indicators based on its current exports, at a disaggregated level, phosphate-based

fertilizers are likely to grow rapidly. Considering their low income-potential (measured by their *PRODY*), their position in the periphery of the PS, and potential Dutch disease effects, strong reliance on fertilizers may have serious drawbacks unless the foreign exchange earnings that they generate are used in ways that promote growth in other sectors. Among other products, it may be important to consider electronics and the automotive industry; Morocco has established a foothold in both. However, the difficulties are greater – Morocco's capabilities are still fairly low and international competition is fierce.

At a more aggregate level, which may be viewed as representing industrial clusters, edible oil products (like olive oil) may offer relatively immediate income gains but limited diversification potential. However, in the long run, various other manufactured products, including both products that are related and unrelated to Morocco's primary sectors, may offer paths toward stronger diversification and income growth. Finally, it is important to note that, in recent times, Morocco's service exports have grown rapidly and become more diversified; they may offer attractive areas for future expansion.

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Annex 1: Product Space Indicators

PS analysis was pioneered in Hausmann, Hwang, and Rodrik (2007), Hausmann and Klinger (2006), and Hidalgo et al. (2007). This analysis is based on the country's current capabilities (or initial conditions) and on international evidence that arises from patterns of comparative advantage and path dependence in the basket of goods exports of a country, implicitly underpinned by similar path dependence in the production basket of the country. PS analysis provides detailed information about the income and diversification potential of different strategies, considering links between sectors. The key data source for the PS analysis is Comtrade's global trade records (the SITC Rev. 2 Classification at the 4-digit level, covering 784 products and 130 countries from 1980 to 2008);[14] this information is complemented by country-level data on GDP per capita. One significant shortcoming of PS analysis is that, as a response to limited export data for services, services have not been covered; this means that goods sectors have been viewed in isolation from services.[15] Since its inception, PS analysis has been applied to a wide range of countries, including numerous studies by the World Bank that have enriched its dialogue with clients. (See the reference section for a selection of studies).

Empirically, PS analysis involves the construction of set of export-related indicators, showing both the historical record of a country and indicative projections into the future. Some of these – including the Herfindahl index (HI), and revealed comparative advantage (*RCA*) are standard.[16] Other indicators, derived from network theory and validated empirically, have been pioneered more recently in the context of PS analysis.

More specifically, the standard indicators may be defined as follows, with the indices *c* (or *c'*), *i* (or *i'* or *i''*), and *t* referring to countries, goods (or products), and years, respectively:

- Using data on export values (*E*), *RCA* shows the degree of comparative advantage by country, product, and time. A country has an *RCA* in a product *i* if the following indicator has a value above unity:

$$RCA_{c,i,t} = \frac{\frac{E_{c,i,t}}{\sum_{i'} E_{c,i',t}}}{\frac{\sum_{c'} E_{c',i,t}}{\sum_{c'}\sum_{i'} E_{c',i',t}}} = \frac{\left[\begin{matrix}\text{shr of good in}\\ \text{country exports}\end{matrix}\right]}{\left[\begin{matrix}\text{shr of good in}\\ \text{world exports}\end{matrix}\right]} = \frac{\frac{E_{c,i,t}}{\sum_{c'} E_{c',i,t}}}{\frac{\sum_{i'} E_{c,i',t}}{\sum_{c'}\sum_{i'} E_{c',i',t}}} = \frac{\left[\begin{matrix}\text{shr of country in}\\ \text{exports of good}\end{matrix}\right]}{\left[\begin{matrix}\text{shr of country in}\\ \text{world exports}\end{matrix}\right]}$$

[14] Alternatively, PS analysis may be done using the much more finely disaggregated Comtrade Harmonized System database.

[15] In a recent pioneering analysis, Mishra, Lundstrom, & Anand (2011) address the role of service export sophistication in economic growth using the tools of PS analysis.

[16] Indicators of the technological content of exports are also frequently included in analyses of structural transformation as it is indicative of the sophistication of a country in a given product category. Technologically sophisticated products tend to be associated with a high *PRODY*. For example, Lall (2000) classifies products into primary, resource-based, low-, medium- or high-tech; see also Lall, Weiss, and Zhan (2006).

On the basis of the evolution of their *RCA*s, exported goods may be classified as classic, emerging, disappearing, or marginal. The classics may be understood as the traditional exports of a country, i.e., products in which the country has always had a comparative advantage. The emerging champions are products in which the country did not have a comparative advantage in the past but developed it in recent years. The time periods 'past' and 'present' can be specified by the analyst. The disappearing products are those in which the country had a comparative advantage in the past but does not have it anymore, and the marginal products are those in which the country never has had a comparative advantage.

PS analysis indicators include:

- The potential income level of a product *i* in *t*, $PRODY_{it}$, is defined on the basis of GDP per capita (*GDPPC*) of all exporting countries, with the weight of each country defined by how important *i* is in its exports (measure by the share of *i* in the total export value of country *c*):[17]

$$PRODY_{i,t} = \sum_{c} \left[\frac{\left(\frac{E_{c,i,t}}{\sum_{i'} E_{c,i',t}} \right)}{\sum_{c'} \left(\frac{E_{c',i,t}}{\sum_{i'} E_{c',i',t}} \right)} \cdot GDPPC_{c,t} \right]$$

Some evidence suggests that developing countries that start to produce and export a product over time may be able to raise the prices that they receive as quality improves over time, reducing the price gap vis-à-vis developed country producers (Hausmann, Hwang, & Rodrik, 2007, pp. 13-14).

- The potential income level of the export basket of a country, *EXPY*, defined using *PRODY* with each commodity *i* weighted by its share in the exports of the country:

$$EXPY_{c,t} = \sum_{i} \frac{E_{c,i,t}}{\sum_{i'} E_{c,i',t}} \cdot PRODY_{i,t}$$

Econometric cross-country time-series analysis indicates that *EXPY* is a strong and robust predictor of subsequent economic growth (Hausmann et al., 2007, p. 3).

- The proximity (φ) between two products, *i* and *i'*, in time *t,* a key building-block of all network indicators in the PS analysis, indicates the extent to which the simultaneous having an *RCA* in two products is related:

[17] The *PRODY* concept was developed by Hausmann, Hwang and Rodrik (2007) According to Schott (2008), *PRODY* may overestimate the income potential of complex manufactured products such as hi tech electronics if they are exported both by relatively poor countries like China and rich Western countries. However, Schott (2008) has also noted that for simpler products exported by most developing countries, especially low income ones, the *PRODY* is a reasonable representation of the income potential of the products exported.

$$\varphi_{i,i',t} = \min\left\{P\left(x_{i,t}\middle|x_{i',t}\right), P\left(x_{i',t}\middle|x_{i,t}\right)\right\}$$

where *P* (the conditional probability) is computed using all countries *c* in year *t,* and where

$$x_{c,i,t} = \begin{Bmatrix} 1 \text{ if } RCA_{c,i,t} > 1 \\ 0 \quad \text{otherwise} \end{Bmatrix}$$

- *PATH* is a measure of the relative position of each product *c* in the PS in time *t*. It is defined as the sum of all proximities between product *i* and all other products. A higher value indicates that a product is at the core of the PS, offering a better platform for further diversification; products at the periphery tend to have lower *PATH* values. Mathematically, the definition is as follows:

$$PATH_{i,t} = \sum_{i'} \varphi_{i,i',t}$$

However, it is important to note that the *PATH* indicator does not consider the characteristics of the products *i'* to which *i* is close, such as the income level of countries that tend to have an *RCA* > 1 in products *i'*.

- The *density* of a product *i,* here defined only for products for which *RCA* < 1, is scaled to vary from 0 to 1. It may be seen as a measure of the probability (or capability) of developing an *RCA* > 1 in product *i* in the future. For each product, it is the ratio between (a) the sum of all proximities between that particular product and all products in which the country has an *RCA* > 1; and (b) the sum of all proximities of the product (irrespective of whether or not the country has an *RCA* in the other product):

$$density_{c,i,t\left|RCA_{c,i,t}<1\right.} = \frac{\sum_{i'\left|i\neq i'\right.} \varphi_{i,i',t} \cdot x_{c,i',t}}{\sum_{i'\left|i\neq i'\right.} \varphi_{i,i',t}} = \frac{\sum_{i'\left|i\neq i' \text{ and } RCA_{c,i',t}>1\right.} \varphi_{i,i',t}}{\sum_{i'\left|i\neq i'\right.} \varphi_{i,i',t}}$$

Using historical data, it is possible analyze the determinants of the evolution of *RCA*s, including the role of *density* – has the country been able to develop an *RCA*>1 in goods for which it was well-positioned to do so given *density* values? Alternatively, *density* may be defined for all products, irrespective of their *RCA* value (if so, the domain condition on the left-hand side of the above equation is removed). For products with *RCA* > 1, it may be seen as a measure of the capability of the country to maintain this outcome.

- The product complexity index (*PCI*) and economic complexity index (*ECI*) are calculated using the method of reflections. This method 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 greater than 1. To make the method operational, diversification is defined as the number of products that a country exports and ubiquity as the number of countries that export the product (both with *RCA* > 1). The method assumes that a country that exports more goods is more complex than a country that exports fewer goods; additionally, that a product that is exported by fewer countries is more complex than a product that is exported by more countries. In other words, if a country can export a particular product it has the necessary and

specific capabilities hence more diversified countries have more capabilities. Similarly, a product that is less ubiquitous requires exclusive and more sophisticated capabilities. Diversification and ubiquity are computed as follows:

$$k_{c,0} = p = 1NpMcp \qquad (Diversification) \qquad (1)$$

$$k_{p,0} = \sum_{c=1}^{N_c} M_{cp} \qquad (Ubiquity) \qquad (2)$$

where *c* denotes the country, *p* the product, and M_{cp} =1 if country *c* exports product *p* with revealed comparative advantage greater than 1 and M_{cp}= 0, otherwise. The method of reflections to compute *PCI* and *ECI* consists in calculating jointly and iteratively the average value of the measure computed in the preceding iteration, starting with measures of a country's diversification and a product's ubiquity. The succeeding iterations refine the measures of complexity by taking into account the information from the previous iterations. These are given by:

$$k_{c,n} = \frac{1}{k_{c,0}} \sum_{p=1}^{N_p} M_{c,p}\, k_{p,n-1} \qquad (3)$$

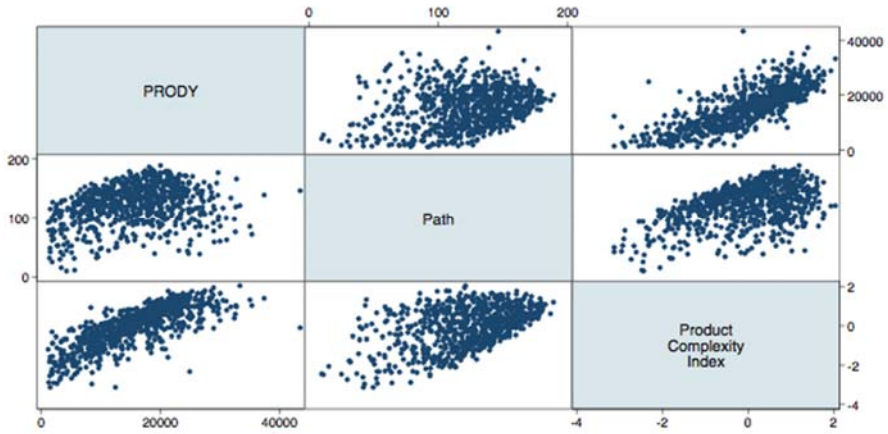
$$k_{p,n} = \frac{1}{k_{p,0}} \sum_{c=1}^{N_c} M_{cp}\, K_{c,n-1} \qquad (4)$$

where *n* corresponds to the number of iterations. These equations are iterated until no additional information can be derived from the previous iteration, and this happens at *n* when the relative rankings of the values estimated using (3) and (4) do not vary in iteration *n*+1 (for more details see Hidalgo and Hausmann, 2009).

The above PS concepts may be applied in a stepwise process to outline a country strategy for diversification and income growth in which exports play a crucial role. First, on the basis of a time series of *RCA* data, the products in the initial export basket of the country may be divided into four sets: classics, emerging champions, disappearing and marginals. Second, within each set, the concept of *density* can be used to rank products according to the country's capability to export each.[18] Third, the products can be ranked according to their *PRODY*s. The products with a high *density* and high *PRODY* are usually the best candidates for diversification as they reflect that the country has a high capability to export products with a high income potential. However, for some products, there might be a trade-off between the density and PRODY which the analyst can resolve by assuming that the current low-density products are viable only in the longer term when their density has increased, reflecting the development of an RCA > 1 in products in the proximity, underpinned by investments in factors that can foster their competitive production. Finally, the concept of proximity can be applied to a classic or emerging champion to explore which other products exist within close range that the country could diversify into.

[18] In terms of the above formal density definition, the product that is being ranked, which is referred to as i, may also be one in which the country has an RCA > 1.

Figure 15: PRODY, Path, and Product Complexity Index



Source: Authors' calculations

Annex 2: Product Space Metrics for Moroccan Exports

Table 4: Product Space Metrics for Moroccan Exports (SITC level 3) in 2010

Food and live animals chiefly for food

Heading	Classics	Emerging	Marginals	Exports, %	PRODY	Density	Path
Meat and preparations	0	1	2	0.01	17,805	0.17	146
Dairy products and birds' eggs	0	1	1	0.63	21,374	0.18	154
Fish, crustacean and molluscs, and preparations thereof	4	0	0	8.89	10,108	0.29	100
Cereals and cereal preparations	0	2	2	0.28	10,482	0.25	118
Vegetables and fruit	7	5	1	8.03	9,525	0.26	119
Sugar, sugar preparations and honey	1	0	2	0.12	9,943	0.23	138
Coffee, tea, cocoa, spices, and manufactures thereof	1	2	0	0.30	7,299	0.22	122
Feeding stuff for animals (not including unmilled cereals)	0	1	1	0.44	13,843	0.27	87
Miscellaneous edible products and preparations	0	0	2	0.20	13,812	0.21	142
	13	12	11	18.90	10,327	0.27	111

Beverages and tobacco

Heading	Classics	Emerging	Marginals	Exports, %	PRODY	Density	Path
Beverages	0	0	1	0.08	10,342	0.21	133

Crude materials, inedible, except fuels

Heading	Classics	Emerging	Marginals	Exports, %	PRODY	Density	Path
Crude rubber (including synthetic and reclaimed)	0	0	1	0.00	17,390	0.18	148
Cork and wood	1	0	0	0.04	18,573	0.36	33
Pulp and waste paper	1	0	1	0.46	15,865	0.17	108
Textile fibres (not wool tops) and their wastes (not in yarn)	0	2	2	0.05	12,399	0.21	145
Crude fertilizer and crude minerals	4	2	2	7.02	3,850	0.32	55
Metalliferous ores and metal scrap	2	1	0	2.07	8,227	0.23	109
Crude animal and vegetable materials, nes	3	0	0	0.83	8,824	0.25	118
	11	5	6	10.47	5,737	0.29	73

Mineral fuels, lubricants and related materials

Heading	Classics	Emerging	Marginals	Exports, %	PRODY	Density	Path
Petroleum, petroleum products and related materials	0	1	1	1.86	15,801	0.17	156

Animal and vegetable oils, fats and waxes

Heading	Classics	Emerging	Marginals	Exports, %	PRODY	Density	Path
Animal oils and fats	1	0	0	0.19	19,266	0.23	84
Fixed vegetable oils and fats	0	1	0	0.33	14,757	0.27	81
Animal and vegetable oils and fats, processed, and waxes	0	0	0	0.00	1,762	0.19	73
	1	1	0	0.52	16,431	0.25	82

Table 4: Product Space Metrics for Moroccan Exports (SITC level 3) – cont.

Chemicals and related products, nes

Heading	Classics	Emerging	Marginals	Exports, %	PRODY	Density	Path
Inorganic chemicals	1	1	3	9.86	5,158	0.20	123
Dyeing, tanning and colouring materials	0	0	1	0.04	15,266	0.17	169
Oils and perfume materials; toilet and cleansing preparations	1	0	2	0.53	12,283	0.20	143
Fertilizers, manufactured	1	1	0	6.27	8,404	0.23	125
Artificial resins and plastic materials, and cellulose esters etc	0	0	4	0.09	18,955	0.17	161
Chemical materials and products, nes	0	0	2	0.01	13,141	0.18	134
	3	2	12	16.79	6,699	0.21	125

Manufactured goods classified chiefly by materials

Heading	Classics	Emerging	Marginals	Exports, %	PRODY	Density	Path
Leather, leather manufactures, nes, and dressed furskins	1	4	1	0.72	7,078	0.24	144
Rubber manufactures, nes	0	0	2	0.01	24,756	0.17	154
Cork and wood, cork manufactures	1	0	2	0.14	16,950	0.23	106
Paper, paperboard, and articles of pulp, of paper or of paperboard	0	0	3	0.24	14,082	0.20	159
Textile yarn, fabrics, made-up articles, nes, and related products	2	4	12	1.53	10,863	0.22	136
Non-metallic mineral manufactures, nes	0	2	6	0.19	17,361	0.17	161
Iron and steel	0	1	6	0.88	18,604	0.20	146
Non-ferrous metals	2	1	2	1.74	12,468	0.20	118
Manufactures of metals, nes	0	0	11	0.38	16,662	0.18	164
	6	12	45	5.84	12,929	0.21	136

Machinery and transport equipment

Heading	Classics	Emerging	Marginals	Exports, %	PRODY	Density	Path
Power generating machinery and equipment	0	0	1	0.00	18,727	0.17	147
General industrial machinery and equipment, nes, and parts of, nes	0	0	1	0.00	19,620	0.17	169
Electric machinery, apparatus and appliances, nes, and parts, nes	0	3	4	14.03	13,486	0.20	138
	0	3	6	14.04	13,489	0.20	138

Miscellaneous manufactured articles

Heading	Classics	Emerging	Marginals	Exports, %	PRODY	Density	Path
Sanitary, plumbing, heating, lighting fixtures and fittings, nes	0	1	0	0.20	12,249	0.23	156
Furniture and parts thereof	0	0	3	0.33	15,159	0.19	161
Travel goods, handbags and similar containers	0	0	0	0.19	13,214	0.21	111
Articles of apparel and clothing accessories	11	12	0	21.68	8,700	0.30	131
Footwear	1	0	0	1.65	10,319	0.25	141
Professional, scientific, controlling instruments, apparatus, nes	0	0	1	0.01	14,877	0.17	162
Miscellaneous manufactured articles, nes	0	0	8	0.47	17,499	0.19	164
	12	13	12	24.54	9,131	0.29	133