Diversification and sophistication as a lever for the structural transformation of North African economies

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Preamble

The transition of the countries of North-Africa to the category of emerging countries will certainly take place through a major transformation of their economies; and this raises the issue of the processes to guide these structural changes. Moreover, insufficient growth results in these counties to face the challenges in the region and the subsequent relatively slow economic and social development, were in part attributed to the lack of diversification of these economies. North African countries are in general specialized in sluggish and low added value sectors or products. And even if some countries are more diversified that others, performances of most of the countries of the region are heavily dependent on raw materials prices or on climate hazards.

The high volatility of raw materials prices, coupled with the recent year's crises, had slowed down the economic growth and showed a high vulnerability of North African economies to shocks, despite their low level of integration into the global markets, stressing the need of a structural transformation.

Indeed, this relatively specialization of the production and exportations of the countries and its negative impact on the development confirm the need to consider the diversification as a priority of the economic post-crisis reforms. The question that may arise then is how to stimulate and strengthen the diversification process in order to support the growth and improve the competitiveness of the North African countries? and consequently, how to make this diversification be the driver of the structural change of the North African economies?

Experiences of both developed and emerging countries, especially Asian ones, show that these countries achieved a real development mainly through the structural and deep transformation of their economies. Similarly, studies show that the transition from low-income countries to medium-income countries depends on a strong transformation of the economies, and emphasize the role of the States in this process. Indeed, the status of the economies implies active public policies to bring the deep developments that the market is unable to trigger automatically through resources allocation.

The question is how to stimulate and strengthen the diversification process in order to support the growth and improve competitiveness of North African economies.

The strengthening of the process should take place in two directions. The first is related to the acceleration of the diversification pace; the second is a change in nature of the process through its reorientation towards more dynamic and new technology-intensive products. These processes, which will trigger a high added value, should be coupled with strategies encouraging exportations that allow for example, access to niche markets and the diversification of partners and markets. Modernization, sophistication and diversification of economic structures in these countries may be the new levers of the emergence of the region in the next years.

This report tries to shed light on some issues and challenges relating to the contribution of diversification and sophistication in the structural changes in North Africa. What is the status of diversification and sophistication in the region? What are the determinants thereof? What relation between sophistication, productivity and growth? What role the regional integration can play in the process of diversification and sophistication of economies? What lessons to be drawn from the specific experiences in Africa or in the emerging countries?

A better understanding of these challenges will open new prospects that will offer new bases for a sustainable and strong growth to achieve the sustainable improvement of the population well-being.

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1. Introduction

Over the last decade North African countries (NACs) have had moderate growth rates about 4% annually, whereas during the same period, East Asian and Pacific countries recorded annual growth of about 8.5% and 6.5% for South Asia countries. This growth in the NACs is still regarded as inadequate given the great challenges faced by these countries in terms of bringing down unemployment and of youth employment, including graduate employment.

This relatively slow pace of economic and social development increasingly raises the question of the suitability of the production apparatus and export structure of these countries. For example, a significant number of research studies show that specialising in raw materials, including oil products, is inimical to growth in the long term as such specialisation is productive resources consuming and hence these resources cannot be allowed to more diversified industrial activities (Sala-i-Martin, 2004, Sachs and Warner, 2001). Also with regard to non-oil-producing NACs, specialization often involves products with limited added value (textiles/clothing, agriculture) which have an impact on growth that is often considered as inadequate (Amable, 2000, Péridy and Roux, 2012).

The analysis of exports seems to be a good indicator of the production system given that exports make up that part of the production system that is entirely subject to international competition. In other words, exports, for which a country has comparative advantages in particular, are a genuine demonstration of a country's ability to raise the value of its production system on international markets. Moreover, from a practical viewpoint, export data is often more readily available and more coherent than production data and then it enables direct comparisons between countries.

In a more general way, the link between the structure of exports and economic development may be studied through two indicators: the diversification and sophistication of exports. With regard to the former, a number of channels allow us to understand how greater diversification of exports makes it possible to increase growth opportunities: this involves for example reducing dependence on some products whose prices and volumes are volatile and can lead to poorer trading terms. Greater diversification also makes it possible to create multiplier or spillover effects and raise productivity (Melitz, 2003). Consequently, greater diversification should favour growth in the long term via these productivity gains. From an empirical viewpoint, the work of Imbs and Wacziarg (2003) has shown that there is a quadratic relation between diversification of exports and economic development. Thus there is a positive correlation between increased diversification of exports and GDP per capita up to a certain development threshold. More recent work generally confirms this inverted U relationship between diversification and wealth creation (Hesse, 2009; Cadot et al. 2011, Naudé and Rossouw, 2011, Agosin et al., 2012). According to these studies therefore, a fairly advanced stage of development must be reached before seeing the positive relationship between diversification and wealth being reversed. It would therefore appear that NACs are far from having a sufficient level of diversification to reach the maximum growth for this level.

Likewise, some recent empirical studies highlight the role of sophistication of exports in the growth process (Hausman et al., 2007; Jarreau and Poncet, 2012). It would also appear that the low level of sophistication of exports of the South and East Mediterranean countries is a constraint to the economic growth. Thus, the NACs production and export structure is suffering from double constraints:

insufficient diversification along with excessively weak sophistication. In that there are few empirical studies on these countries (Ben Hammouda et al., 2009, Hausman et al. 2010, Lim and Saborowski, 2012), this report aims to establish a deeper link between diversification/sophistication on the one hand and growth on the other in the NACs.

As a first step, we shall propose a stylized analysis of the facts on the basis of various measurements of diversification and sophistication of exports. Among the indicators used, besides the standard measurements of concentration and diversification (Herfindahl-Hirschman), we shall use the recent approaches developed particularly by Cadot et al. (2011) who propose a decomposition of Theil's concentration index making it possible to distinguish the intensive and extensive margins of export diversification. With regard to measurements of sophistication, we shall use the indicator of Hausman et al. (2007) and Hidalgo and Hausman's economic complexity index (2009).

We shall then attempt to assess the impact of these variables on the growth of these countries so as to verify whether the current export structure is indeed a constraint to the economic development. The approach used will consist in estimating a growth model as a Barro's regression (conditional □-convergence model) using panel econometric techniques.

In a third stage we shall identify the factors determining diversification and sophistication of exports so as to find the various levers and actions which would firstly allow NACs to diversify their exports to higher added value products and secondly to take the existing products to a higher level of sophistication.

The role of the State will be highlighted in this process of structural transformation of the economy. In particular, what is the role of industrial policies, including policies addressed to encourage FDI and domestic investment? What are the effects of trade policies, and in particular opening up at an international level and regional integration policies? What role is played by institutional factors (governance in particular)? What is the impact of the other variables such as innovation and human capital, macroeconomic factors (exchange rates, public expenditure, and trading terms), natural factors (natural resources), outside aid, etc.?

The last part of this report will offer recommendations in terms of economic policies based on results previously obtained. The role of the various players in this economic transformation process (State, private sector, international community) will be underlined. Very specifically, we shall be looking to understand how the State may intervene through an effective industrial policy leading to a guided diversification, where imperfections and failings of the markets do not allow this result to be naturally achieved. Education and research policies will also be presented as a means of quickly taking products upmarket, through a better qualified population and more innovative production systems. Likewise, the role of institutional policies for improving the operation of the State will be underlined.

Finally, trade facilitation policies and vertical (with the EU) and horizontal (between NACs) deep integration processes will also be offered as the means of achieving a de-segmentation of national markets enabling for more efficient production and trade processes and making for greater attractiveness for FDI. In particular, it may be thought that the African dimension of regional integration has a growing role to play in the 10 coming years and beyond. Africa is the continent where growth of the workforce (estimated at 2.3% between 2010 and 2020) will be the greatest (McKinsey, 2012). This exceptional growth of the active population, along with a sharp rise in urbanization, should strongly boost private consumption (over 410 billion dollars from 2012 to 2020) and therefore the growth of the economy overall. With this in view, the NACs, by taking part in this process of regional integration with other non-African countries could take advantage of the economic explosion of this huge market. Moreover the gradual putting in place of the continental free trade area in Africa (CFTA) is a step in this direction.

2. Measurement of diversification and sophistication of exports from North African countries

Diversification of the production system is very often measured by the diversification of exports, because of the close link between these two concepts and the greater availability of data at international level. Measures used in most studies have taken their inspiration from the literature on inequalities and concentration of income. Export concentration indices make it possible to measure inequality between the various export shares for each destination. These shares may be defined under multiple levels of aggregation, with the understanding that the higher the level of disaggregation, the better the quality of the measurement. The most commonly used global concentration indices are those relating to the literature on income distribution such as the Herfindahl, Gini and Theil indices. Overall, the results obtained are not dependant on the index chosen.

Diversification of trade with the world

If we look at trade with all its partners in the world, the concentration of exports of the NACs remains high when compared with other regional groupings. For example, the average number of products exported by the Maghreb countries in 2004 was 100, half the number of products exported by other regional trading blocks. Attempts at diversification have made it possible to increase the number of products exported, reaching 252 products in 2011 for the Maghreb countries as against 260 for the NAFTA countries. The NACs that are rich in natural resources are those which have the highest concentration rates, continuing an upward trend. In these countries, fuel products form the highest export volume. The other countries keep the same concentration level between 1995 and 2011 with an average number of 235 products in 2011. Most exporte in these countries are specialized in subcontracting and imported inputs based products.

Heavy concentration on exported products is a source of vulnerability for the exports of the NACs and compromises future prospects for regional integration of trade in goods. However, some work has stressed that the preferential terms won for exporters through regional integration lead to diversification and development of exports of sophisticated products even among the products for which the country does not have a comparative advantage (Moncarzy, Olarreagaz and Vaillantx 2010). In Africa, the development of intra-regional trade remains a strategic alternative to promote diversification and structural transformation (Fortunato and Valensisi 2011).
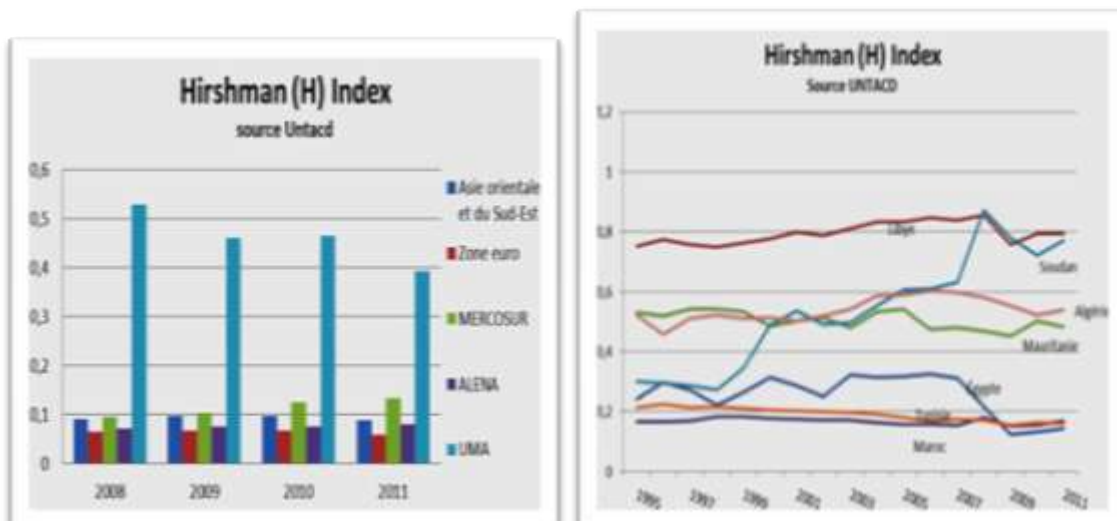
Diversification of intra-regional trade

To measure diversification of intra-regional trade, we focus on the Theil index for diversification on account of its decomposition properties[1] which make it possible to disaggregate overall diversification into intergroup – extensive – and intragroup – intensive – diversification. Thus the intensive margin of export diversification measures the inequality between the share of the active export branches. It leads to a convergence of the shares of the already active export branches over a period, expressing an increase in the volume but not the number of export branches. The extensive margin of diversification expresses an increase in the number of export branches or the number of new markets (see calculation method in Annex 2). Empirical studies on extensive and intensive diversification show a predominance of intensive diversification of the order of 60%, as compared with extensive diversification (Evenett and Venables 2002).

The database used here for calculating the diversification index includes the series of bilateral exports between 1995 and 2011 for the 7 countries of North Africa: Algeria, Egypt, Libya, Mauritania, Morocco, Sudan and Tunisia. This data is taken from the United Nations UNCTAD database. The product classification chosen is the SITC revision 3 with a three-digit disaggregation level.

The concept of intra-regional diversification (in North Africa), also developed in the context of this study, involves measuring the ability of the countries of North Africa to diversify their partners and/or their products going to the NACs. The overall Theil index shows mixed results depending on the countries, distinguishing two groups of countries: those that are relatively diversified (Tunisia, Morocco and Egypt) and countries with poor diversification (Algeria, Libya, Mauritania and Sudan). In terms of trends, the countries which are relatively diversified show an improved level of diversification after 2007. The situation worsens for the second group which has a low level of diversification and a trend towards being less and less diversified.

Figure 1: Trend in the total (extensive and intensive) intra-regional diversification index in the NACs
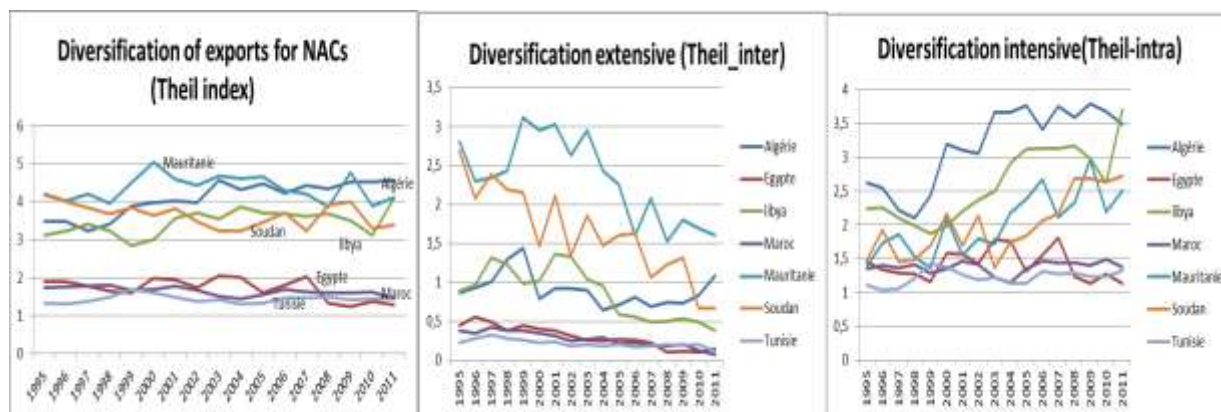
Breakdown of total diversification into extensive and intensive diversification shows that there has been an improvement in extensive diversification to the detriment of intensive diversification for all countries. With regard to extensive diversification, the less diversified countries are converging faster to the more diversified countries. So as to support their extensive diversification toward North Africa, the group of countries including Morocco, Egypt and Tunisia have succeeded in finding many more new destinations for their products rather than creating new export lines. The annual average for

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[1] With regard to the indices used in the decomposition, specialists use three types of indices namely the Theil index, the Brenton index and the Hummels and Klenow index.

creating new destinations, between 1995 and 2011, is 29 for Morocco, 25 for Egypt and 23 for Tunisia, occupying the first places in the region. However, the annual average for creating new export lines is no more than 3 categories for Egypt, 1 for Tunisia compared with 6 for Sudan and 4 for Libya.

Figure 2: Trends in the number of new export lines and destinations in the intra-regional trade of NACs:
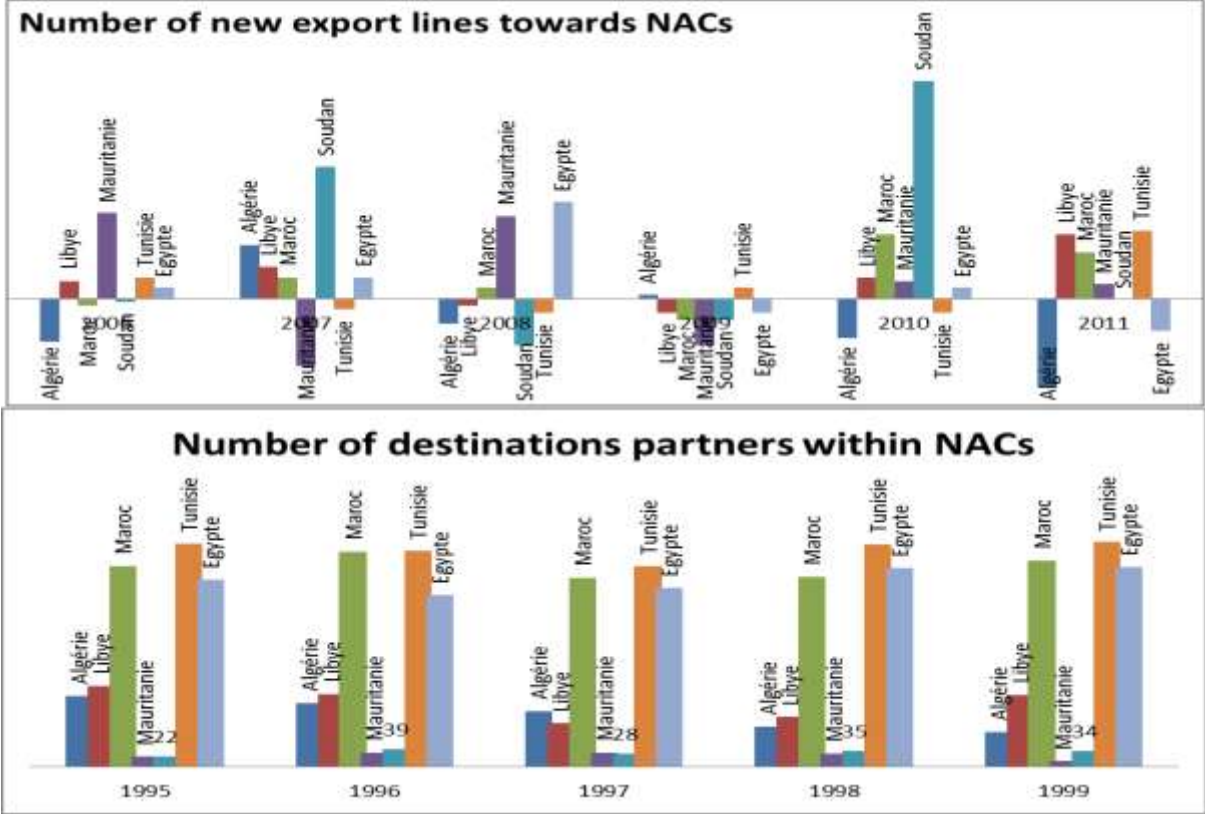
In terms of intensive diversification, reflected by trade in traditional export lines, the less diversified countries have lost greatly in terms of volume and trade intensity on these traditional export lines. For this group, the Theil intra index recorded the highest values between 1995 and 2011, up to 3.7 for Libya, 3.4 for Algeria, 2.7 for Sudan and 2.5 for Mauritania.
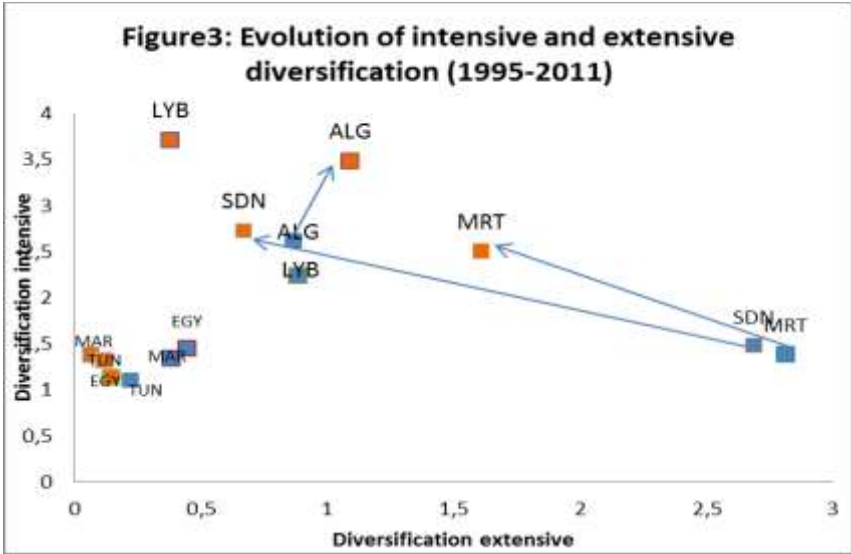
The table in Annex 1 shows that the composition of the basket of products exported in the North African countries has seen no significant change with the exception of Morocco and Egypt. For example, between 1995 and 2011, the countries that are rich in natural resources such as Algeria and Libya are continuing at the forefront to export the same mining and oil products. For Sudan, exports of agricultural products still come in first place and for Mauritania exports of sea products provide the main earnings. Likewise, Tunisia is continuing to export essentially low added-value agricultural products to the region.

For Morocco, however, the list of the five leading products exported to North African countries changed completely in 2011 as compared with the same list of products exported in 1995, as is shown in the table in Annex 1. In 2011, Morocco exported high added-value products to the countries of the region such as equipment for electricity distribution, public transport vehicles and processed agricultural products.

Likewise the 2011 list of exports in Egypt changed to higher added-value products like equipment for electricity distribution or manufactured metal items, whereas the 1995 list was based on the export of textile products, aluminium or agricultural products.

So as to properly understand the process of export diversification among NACs, it seems worthwhile to analyse the degree of complementarity between these economies given that diversification is highly dependent on this. The definition of the concept of complementarity between the economies of the region is the matching between the exports of a country with the imports of regional partners, showing the existence of a potential for a trading partnership. The test for complementarity (Finger and Kreinin, 1979) consists in assessing whether the main import criteria of the countries of the North are aligned on what is exported by their regional partners. The complementarity index varies from zero (when no goods exported by a country are imported by another) to 100 (when the structure of exports corresponds exactly to that of imports).

Figure 4: Intra-regional complementarity index for NACs
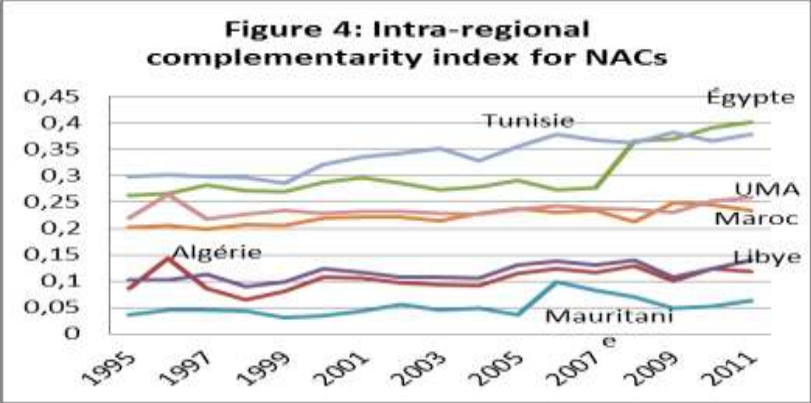
Lack of trade complementarity is one of the structural constraints with which attempts by NACs to integration have to cope. Exports of goods from the countries of North Africa have similar factorial intensities: the main exports of goods in Tunisia, Egypt and Morocco involve highly labour intensive production (clothing, textile thread, floor coverings) while the majority of Algeria's export products such as chemicals, plastics and aluminium are highly energy intensive. An analysis of product export dynamics (rapid growth) shows that in the case of Algeria, there is a high percentage of products which are manufactured using production methods that are highly energy and capital intensive. The most dynamic exports of Tunisia, Egypt and Morocco are highly labour intensive.

The complementarity index, as calculated by UNCTAD, defined as all the potential trading combinations between North African exporters and importers, also reveals the same groups categories, namely the diversified (Tunisia, Morocco, Egypt) and the non-diversified countries (Algeria, Libya, Mauritania, Sudan). Tunisia and Egypt show the highest levels of potential complementarities in the region, reaching a level of 0.4, more than double the North African average of 0.26. Morocco, in third position, shows an average performance with an index value of the order of 0.24. Algeria however shows a level of complementarity below the UMA average.

With regards to sophistication of exports, if reference is made to the new approach initiated by Hausman and Rodrik (2003) and Hausman et al. (2007), the structure of the basket of products exported affects the creation of new export lines, and so the dynamic of productivity as well as the countries' future growth potential. All other things being equal, the countries specialising in goods exported by rich countries are

likely to grow more quickly than countries specializing in other goods. In support of this hypothesis, Hausman et al. (2007) have developed a measurement of export sophistication (EXPY) based on the average per capita income of the countries exporting the same item of goods. They show that the countries having a more sophisticated export basket achieve faster growth. Thus a country's future development possibilities depend on the composition of its production. This measurement of sophistication is distinct from other traditional measurements of sophistication which attempt to measure the intensity of R&D or technological sophistication.

The concept of sophistication according HHR

The concept of the sophistication of the products used in the new trade theory to generate returns for each product a couple's income / productivity (called PRODY). In other words, this couple gives an idea of the level of productivity achieved by the product and its monetary value based on the average of export earnings. To calculate the level of sophistication by country, then we use the level of income / productivity is all a country's exports (what we call EXPY), by calculating the export-weighted average of the PRODY this country.

Beyond the technical characteristics, sophistication also reflects the level of product differentiation, the fragmentation of production, availability of resources and other factors, etc.. More sophistication of an exported product, the higher its average export revenue will be high. In general, sophisticated products exported by rich countries that pay higher wages. However, these products remain competitive given their content in technology, marketing, logistics and natural resources.

The advantage of this methodology is that it calculates a simple measure of sophistication for each product and for each sub-category of product for all existing classifications in international databases on trade. A decline in the index of sophistication does not mean that the production process takes less technology intensive or less skill. But simply reflects a diminished performance of industrial capacity to win market share in more complex activities.

In this study, the export sophistication index (EXPY) and the corresponding productivity index (PRODY) were calculated over the period 1995-2011 for the NACs (see detailed calculations in Annex 2)[2].

The figure below shows that there is a positive relation between per capita income and the index of sophistication of products exported (EXPY). The NACs have lower EXPY levels comparing to what would be expected according to their income. For example, the EXPY for Egypt, Morocco and Tunisia shows that these countries are unlikely to achieve rapid growth in the future, as their products are not very sophisticated as compared with their income levels. The same thing is true for the other countries in the sample, which are distinctly below the trend line. Also, the level of sophistication of the countries that are rich in natural resources appears to be even lower in relation to their per capita income, in comparison to the most diversified countries.

To analyse changes in the sophistication of the export basket, it is worth recalculating the value of EXPY with a fixed PRODY value. In this case, EXPY movements will be not attributed to changes in the income

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[2] Trade indicators between 1995-2011 are taken from the United Nations COMTRADE database and the GDP indicators are taken from the World Bank database. With regard to the calculation of the PRODY, the revealed comparative advantage index (RCA) by sector has been used from the COMTRADE database for the 175 countries of the world. The chosen product classification is the SITC revision 3 with a two-digit disaggregation level. Data on RCAs are lacking for some years for some countries. For example data is lacking between 1995-1999 for Mauritania and between 1995-2006 for Libya. GDP per head PPP (in USD base 2005) was used going on the World Bank database for the 246 countries. The common sample chosen for calculating PRODY between 1995-2011 comprises 175 countries. Thus the PRODY index includes missing values which correspond to the data on RCA). Using PRODY by sector and total exports per sector, the EXPY index was calculated for the NACs over the period for which the data on the PRODY is available.

level of the other countries exporting the same product, but rather to the fact that the countries in question have increased the share of sophisticated products in their export baskets.

Figure 5: relation between sophistication of exports and per capita GDP

All products (data for 2009)   **Other than natural resources (data for 2009)**
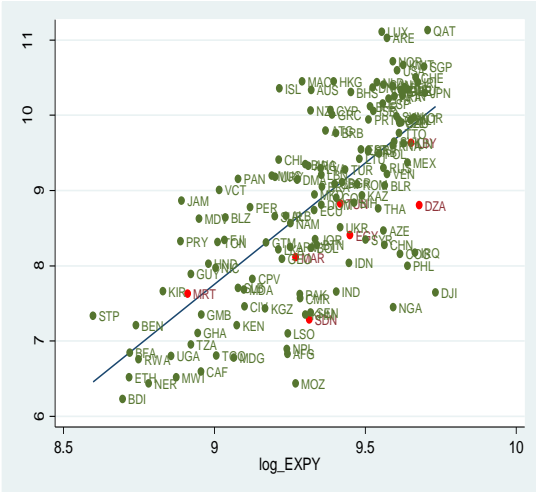
The figure below shows the trend in EXPY for the countries of North Africa, calculated on the basis of a PRODY of 2000. With the exception of Mauritania and Algeria, the sophistication indices of the countries of North Africa have had a weak upward trend, reflecting a poor sophistication dynamic in their exported products. Algeria and Mauritania have not seen any change in their export baskets in term of sophistication.

Figure 6: Trend in the EXPY sophistication index:
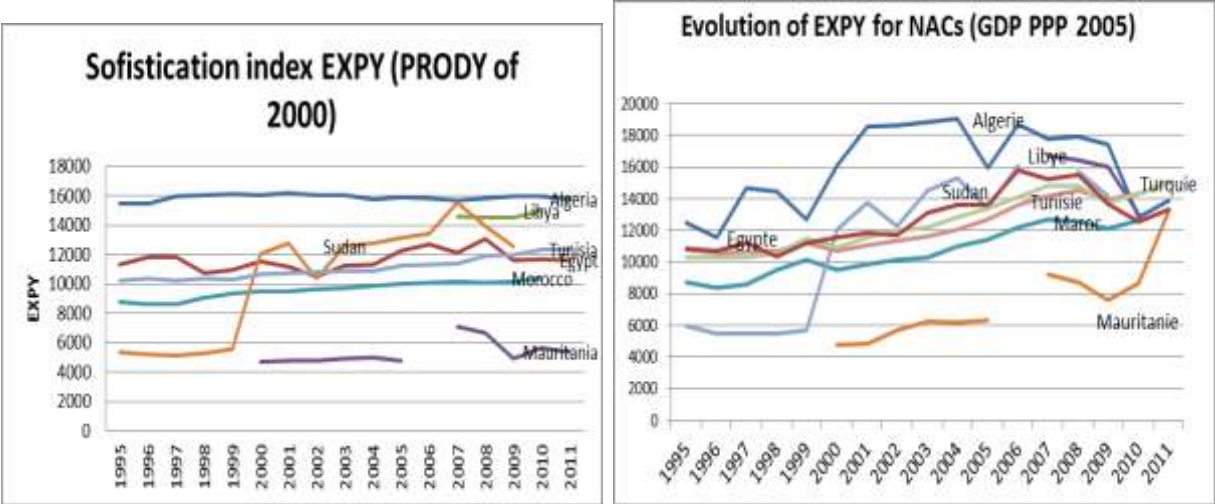
The case of Sudan shows a transformation of the structure of its products in terms of sophistication as in 1995 it had a far less sophisticated export structure than the other countries before catching up with the diversified countries of the region in the 2000s. The basket of exported products for Tunisia became more sophisticated than that of Egypt and deepened the gap as compared to the basket in Morocco. These results confirm weak structural transformation in the region and therefore raise doubts about the future growth potential of the region.

By way of sensitivity analysis, we also propose to use the index of economic complexity developed by Hausman and Hidalgo (2009). These authors introduced the idea that the productivity of the economy depends on the diversity of its productive capacity. They proposed an indirect measure of this productive capacity based on diversification within an economy and the ubiquity of a product. Diversification within an economy is closely linked to the diversification of productive capacity and is

defined as the capacity to produce a number of different products, while the ubiquity of a product is measured by the number of countries which produce the same product. Products with a low ubiquity rate are generally scarce products which require rare productive capacity. The complexity index which summarizes information on ubiquity and diversification (see Hausman and Hidalgo 2009 for a full description of the methodology) is calculated by the Economic Complexity Observatory (MIT, USA) from 1964 to 2008, for 128 countries.

Figure 7: Index of Economic Complexity - 2008

As with the sophistication index presented earlier, we can observe a positive relation between per capita income and the economic complexity index (ECI). The most diversified countries of the North African region (Egypt Morocco Tunisia) have ECI levels in line with what would be forecast according to their income.

In contrast to the results shown in the sophistication index, the ECI of Egypt and Tunisia shows that these countries may hope for rapid growth in the future, as their ECI is slightly above the complexity average (ubiquity and diversification) as compared with their income. This contradiction in the results gives a precise description of the situation of industry in these countries. The average productivity level associated with the export structure (measured by EXPY) is low and does not allow any hope for rapid growth in the future. In spite of low productivity, there have been attempts at diversification by these two countries (explaining an above-average ECI) reflected by the creation of new destinations for their products. In terms of strategy we may conclude that Tunisia and Egypt have favoured an approach making it possible export low-productivity products where they have failed to create new high added-value export lines. Over the long term and in order to increase their future growth potential, these two countries should change strategy and allocate resources to more productive export activities. For the other countries that are rich in natural resources, which are distinctly below the trend line, the relatively lack of complexity in their economies does not allow them to hope for rapid growth in the future, unless there is serious State intervention via an ambitious industrial policy that is part of a clear emergence vision.

3. Diversification and sophistication of trade: what impact on growth of NACs?

Since the work of Imbs and Wacziarg (2003), most of the most recent studies confirm that there is an inverted U relationship between diversification and wealth creation (Hesse, 2009; Cadot et al. 2011, Naudé and Rossouw, 2011, Agosin et al., 2012). So up to a certain relatively high level of income, the relation between diversification and per capita income is positive. Then, beyond this income level which generally corresponds to that of a developed country, this relationship is inverted. Applied to the NACs, this conclusion seems to indicate that greater diversification of their exports would allow them to achieve a higher level of development.

The most recent studies (Cadot et al. 2011) moreover make it possible to show a process whereby initially, the positive relation between per capita income and diversification is essentially due to the extensive margin effect (new products and new markets). At a second stage, after the turning point which comes somewhere around 22,000 USD, the reconcentration process is also due to an extensive margin effect, meaning that the more developed countries start to close down previously active export lines, in particular in declining sectors (textiles, agriculture, mining products, iron and steel, etc.).

From a political viewpoint, the State may play a role in the diversification process using at least two levers. Firstly by focussing its industrial policy on new sectors that drive growth (innovation sectors). Secondly by adopting a regional (African in particular) integration strategy making it possible to support diversification potential via targeted trade policy (lowering of tariff and non-tariff barriers).

Besides an analysis of the relation between diversification and development level, some recent empirical studies analyse the role of sophistication of exports in the growth process (Hausman et al., 2007, Caldeira and Veiga, 2010). These studies highlight the positive relation between sophistication of exports and growth, but Jarreau and Poncet (2012) show that in the case of China this relation is not unconditional. According to these authors, where the complexity of the products is achieved through DFI or by assembly work, effects on economic development are not significant. This is explained by the insufficient national benefits from the use of an imported technology. On the other hand, where domestic ownership is taken and it is possible to strengthen productive capacity and adopt new technologies, taking products upmarket helps sustain growth.

Box: DFI spillover effects

There has been serious renewed theoretical interest in the relation between DFI and growth in recent years. Beyond the direct impact of DFI on production, employment and trade (Navaretti et Venables, 2004), there are also indirect impacts related to the effect of DFI on the demand for inputs for multinational and domestic firms. This generates backward/forward linkages in a relation with local firms, allowing an increase in their productivity. These effects on productivity are of two kinds: horizontal and vertical.

Horizontal spillovers involve technological externalities linked to specific know-how such as more innovative production or management techniques. In that the productivity gains occur in the same branch, horizontal spillovers are often called intra-branch spillovers (Görg and Strobl (2002). Vertical spillovers involve pecuniary externalities linked to upstream/downstream effects on the input market, such as purchases by a multinational firm from the domestic firm, linked to a technology transfer which improves the quality of the intermediate products of the local firm (backward linkage), or contrariwise by the local firm purchasing more sophisticated intermediate products from the multinational, which increases its productivity (forward linkage). In that these vertical effects concern a number of branches, they are called inter-branch spillovers (Markusen and Venables (1999).

From an empirical viewpoint, a number of studies demonstrate the positive effects of DFI on productivity and hence on growth, thanks to these horizontal and vertical spillovers (Görg and Greenaway, 2004; Uttama and Péridy, 2010). At all events, technology plays a decisive role for maximizing the effects, as is also underlined by Jarreau and Poncet (2012).

The studies that are specific to the NACs with regard to the contribution of diversification and sophistication of exports to growth are still very limited where as there are far more analyses dealing with a wider sample of countries (Aditya and Rajat, 2012; Herzer and Nowk-Lehnman, 2006; Hesse, 2009). The aim of this section is therefore to analyse the specificities of the NACs with regard to the factors determining their growth and show up the particular role of diversification and specification of exports in the growth process of these countries.

The model put forward in the context of the neoclassical theory of growth is based on Barro's regression (1991). The difficulty in any estimation of a growth model is identifying the appropriate explanatory variables, in that the theory does not provide a sufficiently generalized framework to enable their identification. The risk is therefore that of using a purely empirical approach leading to a bias related to the variables omitted. This problem may be resolved at least in part by taking the approach used by Sala-i-Martin (2004) which uses a BACE method (Bayesian Averaging of Classical Estimates), which makes it possible to identify statistically the appropriate variables. They include education, international trade, geography as well as specific economic variables (share of government consumption in GDP, price of investment, etc....).

The model proposed here corresponds to an equation of conditional-convergence which takes this approach and includes in it two additional control variables: diversification and sophistication of exports. The equation to be estimated is therefore the following:

$$\Delta y_{it} = \alpha + \beta y_{it-1} + \gamma_1 DIV_{it} + \gamma_2 SOPH_{it} + \sum_k \gamma_k X_{kit} + \mu_i + \lambda_t + \varepsilon_{it}$$

(1)

Δy_{it} is the growth rate of per capita GDP in a country i in the course of year t, y_{it-1} represents the initial income in accordance with neoclassical theory: a negative β sign indicates a convergence of the economies toward their level of balanced growth[3]. DIV_{it} represents the diversification of exports

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[3] As with many empirical studies of this kind, the model specified above is not a log-log type on account of the presence of variables with a negative sign. However a sensitivity analysis including a log-log model without the negative variables gives us results very close to those presented below in terms of sign and significance of the parameters.

variable. To ensure the robustness of the results, several indicators are used: an index of diversification (measured by the Finger and Kreinin index (1979) of absolute deviation of the trading structure of a country as compared to the world structure)[4], the Herfindahl-Hirschman concentration index (HH), the Theil index, global and decomposed (intra and inter). The indicator will be particularly interesting in that it reflects the extensive margin. These indicators have been defined in the previous section.

$SOPH_{it}$ measures the sophistication of exports. Once again, several measures are proposed as sensitivity analysis: the Hausman et al. indicator (2007) and Hidalgo and Hausman's economic complexity index (2009).

X_{kit} corresponds to the vector of the k control variables used (see sources in Annex 3). They include human capital (share of R&D expenditure in GDP), opening up at an international level (trade as percentage of GDP, incoming DFI as percentage of GDP and share of primary exports as percentage of total exports[5]), infrastructures (percentage of metalled roads), and variables related to the role of the State (share of the State in consumption and indicator of corruption). As a sensitivity analysis, other variables have also been tested, such as enrolment rates in primary and secondary schooling (as alternative variables to human capital), the number of telephone lines per 1,000 inhabitants or the number of Internet users per 1,000 inhabitants (infrastructure), the share of oil exports (as an alternative to primary exports), the share of public investment (as an alternative to the share of the State in consumption). Other indicators of governance have also been tested such as political stability, the quality and efficiency of institutions, etc. Lastly the specific "country" and "time" effects of the equation (1) are intended to capture the impact of any variables omitted and to deal with problems of heterogeneity relating to the panel.

The equation (1) is estimated for NACs for the period 1995-2011[6]. Given the large number of variables and the complexity of some of them, it was not possible to test this model in the regions because this analysis assumes international regional data for all explanatory variables, this is not the case. The choice of 1995 as the starting year is the result of the availability of data. Two estimators are used so as to monitor endogeneity. The first is based on a random effects model with instrumental variables. This is the Hausman-Taylor Estimator, described in Egger (2004). The second is an error component two-stage least squares instrumental variable estimator, EC2SLQ IV developed by Baltagi (2005). Endogeneity is a crucial problem for this type of regression. In particular, diversification and sophistication of trade structures can explain growth but may also be the result of growth. These two variables will therefore be considered as endogenous for these two estimators.

Lastly, the estimators are also monitored in terms of cross-section heteroscedasticity and in terms of autocorrelation of residues using respectively the Huber-White Sandwich estimator and the AR1 (Cochrane-Orcutt) estimator[7]. The results of the estimates are presented in Table 1.

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[4] This index is defined as follows:

$$S_j = \frac{\sum_i |h_{ij} - h_i|}{2}$$

with hij = share of product i in total exports (or imports) of the country or group of countries j and hi = share of product i in total world exports (or imports). This index, between 0 and 1, shows if the structure by product of a country's or group of countries' exports diverges little or greatly from the structure by product of total exports in the world. The closer the index is to 1, the greater the divergence.

[5] This variable will be tested so as to verify in particular the "resource curse" hypothesis.

[6] The estimate of the model that is strictly limited to the 7 NACs was made in a preliminary approach. The results obtained are close to those presented following the study, particularly with regard to the sign of the parameters. However, the results are made less robust because we have only 7 in cross-sectional observations which considerably lowers the quality of the panel estimates. Thus, so as to ensure more robust results, the econometric analysis has also been to the Mashrek countries and Turkey, a total of 12 countries in all. This enlarged sample makes it possible to improve the quality of the estimates firstly on account of a larger number of observations, and secondly as it makes it possible to increase the variance between the countries of the variables used in the panel. The results do not differ from those obtained with the NACs alone on account of the great economic weight of these countries, but the parameters are more significant on account of a larger number of observations in particular cross-sectional observations.

[7] The results are also controlled in relation to multicollinearity using the vif test. This generally is in the neighbourhood of 5, a level below the generally tolerated threshold of 10.

Table 1a: Results of the estimates of the growth model: Hausman-Taylor estimator

Groupe de variables	Variable	HT(1)	HT(2)	HT(3)	HT(4)	HT(5)	HT(6)
Diversification	Finger	3.8246 (*)					3.9920**
	Hirschmann-Herfindhal		-0.966 (*)				
	Theil			-0.2585 (*)			
	Theil intra				0.7781		
	Theil inter					-0.9681**	
Complexité	Hidalgo-Hausmann (2009)	1.4504**	1.4420**	1.3792**	1.7581**	1.5921**	
	Hausmann et al. (2007)						0.0002**
Convergence	PIB/hab retardé	-0.0004*	-0.0004*	-0.0004*		-0.0004*	-0.0005**
Commerce international	Ouverture (échanges en % du PIB)	0.0178**	0.0165**	0.0171**		0.0147**	0.0104*
	IDE (entrants, % PIB)	0.2024***	0.2047***	0.2029***		0.2061***	0.2036***
	Exp. Primaires (% des exp. tot.)	-0.0244*	-0.0211*	-0.0214*		-0.0214*	-0.0295**
Capital humain	R&D	1.7945**	1.8878**	1.9737**		2.0180**	2.5931**
Institutions	Dépenses de l'Etat	-0.1982***	-0.2017***	-0.1923***		-0.1874***	-0.2217***
	Gouvernance (corruption)	0.1179	0.1253	0.2090		0.1998	0.2732
infrastructures	Routes asphaltées (%)	0.0004	0.0004	0.0003		0.0014	0.0004

Table 1b: Results of the estimates of the growth model: other estimators

Groupe de variables	Variable	EC2SLS	HWS	AR(1)
Diversification	Theil inter	-1.1415**	-1.1285**	-1.1415**
Complexité	Hidalgo-Hausmann (2009)	0.6245**	0.6523**	0.7135**
Convergence	PIB/hab retardé	-0.0002*	-0.0002*	-0.0002*
Commerce international	Ouverture (échanges en % du PIB)	0.0146*	0.0146*	0.0151*
	IDE (entrants, % PIB)	0.1825***	0.1838***	0.1773***
	Exp. Primaires (% des exp. tot.)	-0.0392**	-0.0305**	-0.0319**
Capital humain	R&D	1.7693**	1.7775**	1.7810**
Institutions	Dépenses de l'Etat	-0.1291**	-0.1279**	-0.1298**
	Gouvernance (corruption)	0.2129	0.2481	0.2440
infrastructures	Routes asphaltées (%)	0.0005	0.0003	0.0004

Notes: (*),*, **, ***: significant to a threshold of 20%, 10%, 5% and 1% respectively; HT: Hausman-Taylor (endogeneity control); EC2SLS: Error Component two-stage least squares instrumental variable estimator (Baltagi, 2005, endogeneity control); HWS: Huber-White Sandwich estimator (heteroscedasticity control); AR(1): Cochrane–Orcutt estimator for auto-regression (control for serial correlation of the residuals)

In a general way, all the aggregated concentration indices (Finger, Hirschman-Herfindhal and Theil) are not significant or only marginally so (often at a threshold of the order of 20%), which suggests that diversification in itself does not enable more growth in the NACs. On the other hand, decomposition of the Theil index very clearly gives a non significant parameter for the intra index while the inter index becomes negative and highly significant[8]. This indicates that only diversification linked to the extensive margin makes it possible to bring together conditions that favour growth. Diversification therefore only seems to fully play its role on growth in NACs if it is linked to an extension of exports to new markets or new goods.

The indicators of sophistication are significant in explaining the growth of per capita GDP in the NACs. This indicates that their current position, generally based on low added-value products, is not conducive to stimulation of growth.

These first results are truly interesting for the NAC economies. Every time these countries move toward a transformation of their economies in the direction of new products, new destinations, greater productivity and greater complexity of their industrial structures, this promotes higher growth. Future growth also depends on this, particularly on account of hysteresis phenomena, once this transformation of the productive structure has occurred.

These results tend to corroborate and more clearly set out recent conclusions on the analysis of diversification and sophistication, which show in particular that for even lower levels of per capita GDP, greater diversification is associated with higher levels of development (or growth), as we have seen in the introduction. With regard to NACs, these results also confirm hypotheses by some authors who have highlighted the insufficient level of diversification and sophistication as a potential barrier to growth (Péridy and Roux, 2012, Ben Hammouda et al. 2009). The results presented here therefore quantitatively confirm the positive link between diversification/sophistication in the NACs and their growth rates but make it clear that diversification must happen from the extensive margin, in other words towards new products or markets.[9]

Regardless of the sophistication and diversification variables, the results corresponding to the other growth determinants are the following. Firstly, the lagged per capita GDP variable, which measures beta-convergence, is indeed negative but very low and hard to see as being significant (10%). This reflects the fact that the convergence process of the NACs to their balanced growth level is extremely slow. This result moreover corroborates that previously obtained by Guétat and Serranito (2010) and Péridy and Bagoulla (2012) and who highlight the slow and very varied convergence processes according to countries. The fact of the diversification (extensive margin) and sophistication parameters being significant and having a positive effect while convergence is low means that diversification/sophistication may be considered as a means of accelerating growth and so in time promoting convergence, even if this model does not directly test the role of these variables on convergence.

The variables linked to international trade are also interesting. Thus, opening up to trade and attracting DFI are two variables where the parameters are positive and significant, which confirm that economic openness is a necessary, although not always sufficient, condition for generating growth. In this context, the process of regional integration also follows this trend, even if it has not been possible to test this variable directly, because of too small a sample of countries.

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[8] The non significance of the aggregated Theil index is explained by the fact that is for the most part made up of the (non significant) intra index.

[9] So as to test the specificity of the NACs in relation to other countries among those 12 ultimately chosen, the model was estimated with on the one hand a diversification and sophistication variable applied to all 12 countries and on the other hand an interaction variable consisting in the same variable multiplied by a dummy variable taking 1 as the value for the the NACs and 0 for the other countries. To the extent that the interaction variable is not significant, it may be concluded that the relation between diversification/sophistication and growth is not significantly different for North African countries from that of the 12 countries.

On the other hand, dependence with regard to primary products (oil, gas, agriculture, etc.) is a brake on growth in the NACs, as is attested by the negative and significant parameter corresponding to this variable. This last result confirms the resource curse hypothesis, advanced by some authors since Sachs and Warner (2001). The general causes of this curse are diverse, such as the worsening of trade terms, price and volume volatility, associated low productivity growth or the setting up of inappropriate support policies (see also Cadot et al. 2010 for further discussion). Be this as it may, it can only be noted that the NACs that are most dependent on primary products generally have more unfavourable growth dynamics.

With regard to human capital, this is unsurprisingly a key variable in growth processes. The role of research and development is thus clearly identified as one of the most significant factors for an explanation of growth in the NACs. Lastly, the role of the State is stressed by its share in consumption, where a negative parameter emerges. This result is relatively common in the literature and is generally explained by the fact that public consumption can be financed by taxes which create distortions and in reality bring down growth (Sala-i-Martin, 2004). However, state action is not always antagonistic to growth in that other studies have shown the role of the State and institutions in the growth process (Rodrik et al. 2004).

The other variables tested such as corruption or infrastructures are not significant and this is so whatever the specifications of the estimated models. This does not however mean that governance or infrastructures have no impact on the growth of the NACs. Moreover, some authors have recently shown their quantitative impact[10]. But this study is based on a limited sample of countries, which reduces the variance of these two variables and limit their significance unlike wider country samples, incorporating European countries in particular.

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[10] For example, the positive role of infrastructures in the NACs has been identified in Péridy and Bagoulla (2012).

4. Determinants of diversification and sophistication of exports

Existing analyses on determinants of diversification and sophistication of exports make it possible to highlight some key variables and the conditions linked to these variables, in particular opening up at an international level, lowering of trade costs, financial aid, human capital, appropriate investment and industrial policies (Agosin et al., 2012, Weldemicael, 2012, Klinger and Lederman, 2011, Munemo, 2011). There are still insufficient studies on the NACs especially as there are new indicators of diversification/sophistication which have still not been tested for these countries, in particular the decomposed Theil concentration index and the sophistication index developed by Hidalgo and Hausman (2009). Among existing studies, we may cite those of Ben Hammouda et al. (2009) concerning the determinants of diversification in North Africa (calculated from a Hirschman index), Dogruel and Teckce (2011) who specifically address the relation between trade liberalisation and diversification in the South and East of the Mediterranean and Gourdon (2010) and Hausman et al. (2010) who, in a report for the World Bank, propose analyses respectively for the case of Algeria and the role of industrial policies in the NACs. Lim and Saborowski (2012) for their part present a specific analysis of the case of Syria and the role of the State.

This section will extend existing analyses on the NACs, firstly modelling the determinants of diversification and sophistication in the NACs[11], secondly using several recent explained variables such as the Theil inter index (so as to identify the determinants of the extensive margin) or the Hidalgo-Hausman sophistication index (2009), and thirdly and lastly proposing explanatory variables covering opening up of trade, human capital, structural factors, macroeconomic factors, institutions and the level of development and the role of hysteresis.

The theoretical foundations behind the modelling of determinants of diversification (and sophistication) are both the traditional theories on factor endowments under perfect competition (HOS[12] framework) and more recently the "new new" international trade theory with heterogeneous firms, developed in particular by Mélitz (2003). Following these approaches, the determinants of diversification (and sophistication) of exports are based on several groups of variables:

- **Opening up at an international level.** For example, opening up at an international level is supposed to increase the number of exporters and varieties in Melitz-type monopolistic competition. A positive relation between opening up and diversification may be expected. However, in a traditional framework with factor endowments, opening up to trade may improve the profitability of the sectors for which a country is already specialized, thereby strengthening the existing concentration. With regard to financial liberalization, it may reduce liquidity constraints in a Melitz-type framework (see also Manova, 2008) and so lead to an increase in the number of exporters and varieties produced (positive effects on diversification). But here again, in an HOS framework with more homogeneous products, this relation between financial liberalization and diversification may be inverted. Lastly, DFI is supposed to increase diversification of exports.

- **Structural factors.** Increased human capital generally allows increased diversification, particularly if the accumulation of this human allows countries to change their specializations in the direction of more advanced products. Economic distance is another structural factor. An increase in this distance relating particularly to transport costs is supposed (in a Melitz-type framework) to reduce export opportunities (lowering of the number of varieties) and therefore reduce diversification. The level of development may also be considered as a structural factor showing an inverted U relationship with diversification, as mentioned in the introduction.

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[11] For the same reasons as previously, the sample of countries will be extended to the Mashrek countries and Turkey.
[12] HOS: Heckcher Ohlin and Samuelson.

- **Macroeconomic variables.** Still in the theoretical framework of Mélitz (2003), improved trade terms, increasing export profitability, should allow increased diversification. However, in an HOS framework, a rise on export prices may make resources toward these sectors more attractive and so reinforce the existing concentration. The role of the exchange rate is ambiguous from a theoretical point of view. Indeed, in a perfectly competitive, a depreciation of the exchange rate allows the entry of new exporters and therefore promotes diversification. In contrast, monopolistic competition, there is a nonzero probability that the input costs are too high. In this case, there will be no additional diversification. Thus, a depreciation of the exchange rate should theoretically encourage diversification unless the restrictions of competition generate significant costs or barriers to entry. Given this ambiguity, the empirical analysis is needed to clarify the relationship between exchange rates and diversification.

- **Institutional variables.** State investment may help improve diversification but some studies have advanced non-linearities (Ben Hammouda et al., 2009). Lastly, industrial policies, infrastructures, governance and state aid may contribute to greater diversification and sophistication of the productive processes if the policies pursued are appropriate.

Hysteresis. Insofar as export diversification and sophistication processes are very slow and depend to a great extent on past conditions, it is important to take into account these hysteresis phenomena in dynamic models. Production processes correspond to structural characteristics of the economies which can only change slowly. For example, a proactive industrial policy will only slowly have its effects on the diversification of an economy. The diversification and sophistication of a given economy in year t depends greatly on the levels observed in t-1.

In short, determinants of diversification and sophistication of exports are highly dependent on the theoretical framework used and so on the type of market environment found in the countries concerned (competitive with homogeneous products or monopolistic with highly differentiated products).

The following equations applied to the NACs will allow the variables identified earlier to be tested:

$$CONC_{it} = \alpha + \beta CONC_{it-1} + \sum_k \gamma_k OUV_{kit} + \sum_m \gamma_m STRUCT_{mit} + \sum_n \gamma_n INST_{nit} + \sum_l \gamma_l MACRO_{lit} + \mu_i + \lambda_t + \varepsilon_{it}$$

$$SOPH_{it} = \alpha + \beta SOPH_{it-1} + \sum_k \gamma_k OUV_{kit} + \sum_m \gamma_m STRUCT_{mit} + \sum_n \gamma_n INST_{nit} + \mu_i + \lambda_t + \varepsilon_{it}$$

Where $CONC_{it}$ and $SOPH_{it}$ correspond to the Theil concentration and Hidalgo-Hausman sophistication index (2009). As a sensitivity analysis, these two equations were also estimated with alternative indicators such as the Theil inter index, the Hirschman-Herfindahl index and the Hausman et al. sophistication index (2007).

The *OUV* group of variables corresponds to variables of economic openness, such as openness to trade, financial openness and DFI; *STRUCT* corresponds to structural variables such as education, distance and facilitation of trade; *INST* includes institutional variables such as industrial policy, public investment, international aid, loans from financial institutions [13] and governance (corruption): macro variables (MACRO) include trade terms and exchange rates. Other variables have also been tested in alternative specifications such as infrastructure, private investment, the share of oil exports and the level of development (per capita GDP and per capita GDP squared). Determinants of trade sophistication are relatively similar, apart from macroeconomic variables which a priori appear less important. A complete description of the variables is found in Annex 3. The estimators used are Hausman-Taylor (HT) in the static version of the model and the GMM in the dynamic version (Arellano et Bond, 1998). The results of the estimates are presented in Tables 3 and 4. The period of estimation covers 1995 to 2011 for the countries set out earlier.

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[13] Taking account of problems of data availability with regard to loans from financial institutions, the variable tested here is limited to EIB loans.

Table 3: Determinants of export concentration

(variable explained: Theil index)

Groupe de variables	Variables	HT(1)	HT(2)	HT(3)	HT(4)	GMM	Effets fixes
Ouverture internationale	ouv. Commerciale	-0.162**	-0.172**	-0.118*	-0.086	-0.119**	
	ouv. Financière	-0.047(*)	-0.051(*)	-0.056(*)	-0.005	-0.029	
	fdi	-0.0270***	-0.0270***	-0.0240**	-0.0475**	-0.0071	
Facteurs structurels	education	-0.2770**	-0.2951**	-0.2705**	-0.2362*	-0.0590	
	distance	-0.1741	-0.1651	-0.1520	-0.0275	-0.0137	
	facilitation	0.4020***	0.4061***	0.3718***	0.3584***	0.1706***	
Facteurs institutionnels	pol. Indus (indice de prod. In	0.5004***	0.4973***	0.5120***	0.4228***	0.3109***	
	inv. Public (%)	0.5104***	0.5036***	0.5402***	0.6214***	0.2577***	
	prêts EIB	-0.0307**	-0.0307**	-0.0308**	-0.0408**	-0.0184**	
	aide	0.0685***	0.0658***	0.0611***	0.0837***	0.0278*	
	corruption	-0.0052	-0.0077	-0.0011	-0.0783*	-0.0319 (*)	
Facteurs macroéconomiques	termes de l'échange	-0.0188	-0.0194	-0.0326	-0.0561*	-0.0291	
	taux de change	0.0603	0.0609	0.0604	0.0804	0.0209	
Autres	infrastructures		-0.1637***				
	investissement privé (%)			-0.0847**			
	part des exp. pétrolières				0.0641**		
	hystérèse (Theil retardé)					0.6493***	
	PIB/hab						-0.0001**
	(PIB/hab)2						0.00003

Notes: (*),*, **, ***: significant to a threshold of 20%, 10%, 5% and 1% respectively; HT: Hausman-Taylor

With regard to the determinants of concentration (diversification), Table 3 highlights the positive effects of opening up on diversification, which corresponds to negative parameters as the variable explained in the Theil concentration index. Thus a greater openness in trade and finance and DFI enable greater diversification of exports. This suggests that the policy of openness put in place by some NACs over the last 20 years in a multilateral framework (GATT membership) or on a regional basis (Barcelona and Agadir agreements) allowed more diversification of the economies concerned. Pursuing this policy of openness, particularly by lowering of NTBs or by attracting more DFI would make it possible to continue the process of diversification[14].

Oil-producing countries are however an exception. The additional tests aimed at studying any specificity of the oil-producing countries with regard to the relation between openness and diversification reveal that this relation becomes non-significant. Greater openness on the part of oil-producing countries does not enable greater diversification of their trade. This result is in line with the theoretical expectations in a context of factor endowments with homogeneous products. Economic openness in these countries makes it possible to make even greater use of their comparative advantages in their natural resources, which does not make it possible to achieve greater diversification. Consequently, these countries must put in place proactive industrial policies so as to successfully achieve greater diversification (incentives for the development of renewable energies, etc.). This result does not mean that the oil countries are questioning the process of liberalization.

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[14] With regard to financial liberalization, the variable used (share of domestic credit to the private sector as a percentage of GDP) is very general and does not directly address the finer sub-variables such as guarantees for export, the rate NPLs of the banking and rationing. However, the variable can be used to explain the positive effects of financial liberalization on the diversification of the economies of the North African country. These results are also consistent with the approach Mélitz explains this positive relationship with the entry of new exporters due to the easing of liquidity constraints related to financial liberalization.

Instead, they must use their industrial policies to encourage the emergence of new comparative advantages in the context of opening. For example, the development of alternative energy sources (solar and wind) would reduce the dominance of oil and gas as well as developing new skills in growth sectors. On this point, the use of FDI and PPP seems particularly appropriate to achieve the diversification of these countries.

Among the structural factors, human capital, measured here by the rate of enrolment in secondary schooling is also an important driver of diversification. Education and research policies must therefore be strengthened so as to allow faster diversification of economies, particularly towards more innovative products. While transport costs, measured here by distance do not appear to influence diversification, facilitation of trade on the other hand plays a very significant role. Any reduction of the time required for export helps increase diversification of exports, thanks to improved trade efficiency. Consequently, the NACs must improve trade facilitation, particularly by strengthening logistic performance in trade (effective customs bodies, control procedures, efficiency at ports, etc..)

Institutional factors also play a major role in diversification processes. Results show that the industrial policy of the NACs (measured by an industrial production index) and public investment tend to strengthen trade concentration, which suggest that investment is essentially focussed on industries that are already in existence and not innovative enough. Private investment however enables greater diversification of exports, perhaps because it involves newer and so more risk-laden activities. Aid to NACs also favours concentration of activities, apart from loans by financial institutions. On this point, the type of loans granted seems to favour new products, favouring export diversification.

These results have vital implications in terms of economic policies as they suggest that industrial policy and public investment in NACs must be refocused on newer activities so as to promote trade diversification. International aid must be better used so as to be of greater benefit to diversification activities. Lastly, private investment must be supported as it is directly involved in the diversification process[15].

Among the other variables which play a significant role on the level of diversification, we may cite infrastructures, which have a positive role. Hysteresis is also very significant, which suggests that diversification phenomena are extremely slow processes, being therefore highly dependent on past values. A policy aimed at greater diversification is therefore a long-term policy. The level of development is also significant. The higher per capita GDP, the more diversification there is. We may note that the country sample does not make it possible to obtain a quadratic inverted U relationship, which indicates that the NACs have GDP levels that are still too low not allowing the achievement of a "maximum" level of diversification, in line with earlier work on this issue since Imbs and Wacziarg (2003)[16]. Lastly, estimates shows that oil-producing NACs are logically penalized in that this endowment mechanically reduces the diversification index. However, macroeconomic variables and indicators of governance (corruption, quality of institutions, etc…) remain non-significant, whatever specification is made[17]. The non-significance of the exchange rate can be explained in two ways. Or as mentioned above, we consider that the entry costs prevent diversification following a depreciation of the exchange rate in the context of insufficient competition. Another explanation is related to the quality of data because exchange rates are calculated index (with a common base for all 100 countries in the same year). Thus, this variable captures the temporal variations of the exchange rate but not the differences in rates between countries (this constraint is common to all analyzes panel).

Similarly, the insignificant nature of governance indicators can be bound to data. Indeed, the range of countries considered together fairly homogenous countries in terms of governance. Thus, the estimator can hardly capture the differences in governance between countries, since these differences are too small. To address this problem, it should work on a much larger sample of countries, including in particular in developed countries (with very different levels of governance).

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[15] As in Ben Hammouda et al. (2009), we have tested the existence of non-linearities relating to investment. We confirm some results relating to public investment, which raises diversification up to a certain threshold before lowering it. However, the results highlighted here suffer from problems of multicollinearity, making them less robust.

[16] There was a specific estimate done for these variables on account of the serious problems of multicollinearity.

[17] The indicator of legal rules gives slightly better results than that concerning corruption but is barely significant at a level below 20%.

The results obtained earlier underwent sensitivity tests using alternative estimators (Hausman-Taylor, GMM, fixed effects and estimators with correction for heteroscedasticity and autocorrelation), alternative explained variables (Hirschman-Herfindhal index and Theil inter index), and alternative explanatory variables (use of various proxies for human capital, investment, industrial policy, governance, etc.). These tests show how robust the results presented are. In particular, there is no major difference between the explanation of the aggregated Theil index and the inter index.

Other tests were done so as to identify any specificities in oil-producing countries (or North African countries as such) relating to the role of investment or industrial policies. However, the results do not show any major difference as to the role of these two variables for these groups of specific countries.

An analysis of determinants of sophistication shows that the variables relating to openness are far less significant for explaining diversification. In particular, DFI and financial openness do not appear to have an effect on the sophistication of the exports of the NACs[18]. As to trade openness, it only has a positive effect on sophistication with the Hidalgo-Hausman index. These results suggest that while trade openness allows diversification of exports by attracting more exporters and varieties, it does not necessarily allow greater trade sophistication.

However, structural variables play an important role, like education and human, trade facilitation and the initial level of development. Institutional variables are also generally significant with loans from external financial institutions promoting innovative activities having a positive effect, as do, to a lesser extent, industrial policy and public investment but the latter tend to play a negative role by focussing on less innovative products. International aid also seems focussed on less innovative sectors.

As with diversification, for the same reasons, governance does not seem to affect the level of sophistication of trade. Lastly, the quality of infrastructure fosters sophistication of the production processes. But in a general way, hysteresis phenomena are also very much present, indicating that the sophistication of exports corresponds to a very slow process dependent on choices made in the past[19].

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18 Again, a more detailed analysis could be considered in order to better explain the role of these variables on the sophistication. In particular, the use of more accurate financial variables would deepen the understanding of the financial mechanisms of the processes of sophistication.

19 Alternative estimators and explanatory variables were used to test how robust these results were. The results are however a little more sensitive to problems of multicollinearity than in diversification models (the vif level reaches 10).

Table 4: Determinants of export sophistication

Variable explicative: Indice de complexité économique (Hidalgo et Hausmann, 2009)

Groupe de variables	Variables	HT(1)	HT(2)	HT(3)	GMM
Ouverture internationale	ouv. Commerciale	0.0089	0.0091	0.0080	0.0034
	ouv. Financière	0.0009	0.0010	0.0004	0.0015
	fdi	0.0021	0.0016	0.0020 (*)	0.0002
Facteurs structurels	education	0.0244***	0.0279***	0.0200***	0.0117***
	développement (PIB/hab)	0.0001***	0.0001***	0.0001***	0.0001***
	distance	0.0001	0.0002	0.0002	0.0001
	facilitation	-0.0047**	-0.0044**	-0.0045**	-0.0047*
Facteurs institutionnels	pol. Indus (indice de prod. Inc	-0.0010***	-0.0010***	-0.0011***	-0.0004**
	inv. Public (%)	0.0268*	0.0237*	0.0075	0.0080
	prêts EIB	0.0001***	0.0001***	0.0001***	0.0001***
	aide	-0.0001***	-0.0001***	-0.0001*	-0.0001*
	corruption	0.0183	0.0247	0.0077	0.0063
Autres	infrastructures	0.0081**			
	investissement privé (%)		0.0079**		
	part des exp. pétrolières			-0.0112***	
	hystérèse				0.5417***

Variable explicative: Indice de sophistication (Hausmann et al. 2007, 2009)

Groupe de variables	Variables	HT(1)	HT(2)	HT(3)	GMM
Ouverture internationale	ouv. Commerciale	0.3901***	0.4038***	0.5027***	0.2533***
	ouv. Financière	-0.0046	-0.0102	-0.0131	-0.0380
	fdi	0.0002	0.0011	0.0017	0.0020
Facteurs structurels	education	0.1121***	0.0671**	0.1829***	0.0272
	développement (PIB/hab)	0.4930**	0.2594*	0.5455*	0.2391 (*)
	distance	-0.2470*	-0.2455*	-0.2330*	-0.0393*
	facilitation	-0.1950***	-0.2077***	-0.1782**	-0.1335*
Facteurs institutionnels	pol. Indus (indice de prod. Inc	0.2786	0.2804	0.1820	0.0159
	inv. Public (%)	-0.1362	-0.1232	-0.0701	-0.0501
	prêts EIB	0.0207***	0.0207***	0.0159**	0.0155**
	aide	0.0279	0.0241	0.0263	0.0112
	corruption	-0.0570	-0.0748	-0.0717	-0.0347
Autres	infrastructures	0.0923***			
	investissement privé (%)		-0.0283		
	part des exp. pétrolières			0.0347	
	hystérèse				0.6465***

Notes: (*),*, **, ***: significant to a threshold of 20%, 10%, 5% and 1% respectively; HT: Hausman-Taylor (endogeneity control).

5. Implications in terms of economic policies

An analysis of the determinants of diversification and sophistication of exports in NACs allowed us to identify the constraints limiting the ability of these countries to add value to their exports by means of a transformation of their production apparatus. These results suggest that specific targeted reforms should be instigated so as to free up the potential of the most productive industries and consequently exports and growth.

Promoting human capital

The transformation of the industrial structures of the economies of the region requires parallel development of the human capital. Results have shown that human capital, despite its limits, has a positive effect both on diversification, sophistication and growth in the region. Low growth of labour productivity as well as the availability of a qualified labour are the main constraints on the countries of the region. Creation of new high added-value activities and the export of sophisticated products require an improved training, education and research policies. Moreover, the countries of the region with a more advanced education system such as Tunisia suffer from problems of matching training and market needs. Consequently, a long-term strategy should be put in place to ensure that potential in terms of qualified and productive workforce so as to meet the needs of new industrial strategies and deal with high growth of the active population.

Developing logistics chains and trade facilitation

Logistics chains play a central role in promoting exports by lowering costs and the time required to deliver goods and in a more general way to the efficiency of the export process. For example, when the Logistics Performance Index (LPI) developed by the World Bank is considered, Tunisia, Morocco and Egypt, despite having an index value above the NAC average, are still far behind the average of the developed and emerging countries. The other NACs are in an even more unfavourable situation, suffering in particular from a lack of efficiency in customs clearance procedures and infrastructure quality. Moreover, transport costs remain high even though 6 of the 7 in the region are coastal countries. For example road transport is often in the hands of fragmented small businesses providing high-cost, low-quality services while at the same time, there are restrictions on international transport companies. Maritime transport has been consolidated by investment in ports and port logistics but even so, there are still great problems over transhipment costs, transit times and harmonization of regulations. On this point, public-private partnership initiatives (PPP) adopted in some North African countries, such as the Port of Enfidha in Tunisia or the Port of Tangiers-Mediterranean in Morocco, must be supported.

Table 5: Logistics Performance Index 2012 (World Bank)

Indicators	Tunisia	Morocco	Egypt	Algeria	Mauritania	Libya	Sudan	MENA	South Asia	World
LPI ranking	41	50	57	125	127	137	148			
Global index LPI (1=faible, 5=élévé)	3.17	3.03	2.98	2.41	2.40	2.28	2.10	2.58	2.58	3
Customs (1=faible, 5=élévé)	3.12	2.64	2.60	2.26	2.33	2.08	2.14	2.29	2.47	3
Infrastructure (1=faible, 5=élévé)	2.88	3.14	3.07	2.02	2.34	1.75	2.01	2.40	2.39	3
International shipments (1=faible, 5=élévé)	2.88	3.01	3.00	2.68	2.52	2.62	1.93	2.68	2.59	3
Logistics competence (1=faible, 5=élévé)	3.12	2.89	2.95	2.13	2.28	2.25	2.33	2.49	2.58	3
Tracking & tracing (1=faible, 5=élévé)	3.25	3.01	2.86	2.46	2.28	2.38	1.89	2.56	2.49	3
Timeliness (1=faible, 5=élévé)	3.75	3.51	3.39	2.85	2.60	2.51	2.31	3.02	2.93	3

Promoting investment in high added-value activities:

In the light of the results found for private investment, this would allow greater diversification of exports development of sophisticated activities. To achieve this, the countries of North Africa must attract private initiatives in particular in new high added-value activities. For its part the State should make an effort to limit the risk of macroeconomic instability so as to allow, to the private sector, room for manoeuvre to manage the inherent risk in creating new activities. Lastly, grants of tax benefits and subsidies can be used to support creation of innovative activities for the private sector to have an incentive to invest in high-risk activities.

Paradoxically, the results also show that industrial policy and public investment in North African countries are associated with a concentration of non-sophisticated activities. They would therefore be supporting traditional low added-value activities. Such activities have not succeeded in meeting the challenge of high sustainable growth. The State should therefore refocus its industrial policy on investment in newer activities. This can be done in the context of a policy of transformation of the industrial structures and by PPP strategies that can support the private sector toward higher added-value activities. On this point, regional partnerships, in particular in the Euro-Mediterranean context, where there are suitable financial instruments, could act as levers to help the development of these innovative activities.

With regard to FDI, the results show that there are no sufficient effects in particular on sophistication of exports. This confirms the idea that thiese investments tend to be focussed on subcontracting activities directed toward Europe, with insufficient stimulation of effects of externalities on the rest of the economy. The way through which FDI is attracted and received must be revised to favour higher added-value activities and above all with a taking of ownership at domestic level of technical capacities and technology transfer. For example, in Turkey, foreign investors have the same advantages as a local investor. There was even a list of strategic sectors identified giving entitlement to incentives and loans at preferential rates[20], even if they are located in non-priority regions. Moreover, other loans and customs exemptions are on offer to support purchases of materials, the import of intermediate products to support export activities.

Economic openness and export finance mechanisms

Financing trade and supporting exporters is one of the major problems affecting facilitation of international trading transaction (see LPI 2012 World Bank). This problem is particularly important in the countries of North Africa given the fragility of financial system both at a structural and institutional level.

Morocco, followed by Tunisia and Egypt are thus in first place in terms of financial development (credit in percentage of GDP). However, the share of gross non-performing loans and poor bank supervision are the main problems leading to a rationing of credit especially for SMEs. The financial market in these countries remains limited with low market capitalisation for supporting investment. The problem of convertibility of the local currency also adds a further constraint slowing down trade in products between the countries of the region. In Algeria, the consolidation of some state banks has not made it possible to remove financing constraints faced by international trading transactions (major transactions are managed by the State). Moreover, the banking system of Mauritania and Sudan is very limited and plays little part in the financing of economic activity.

So as to promote diversification of exports of products among the NACs, it is important to bring down the barriers existing between different banking systems in these countries and developing an inter-regional information system allowing banks to manage the risks of transborder transactions. In this context, an action Agenda has been devised by the ECA (Economic Commission for Africa) to set up a regional payment system to achieve efficient transfers, updating of regional payment statistics,

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[20] Loans are offered at 50% of investment cost up to a maximum of TL 4.5 trillion for regional development investments and TL 500 billion for others, at subsidized rates (20-30%) over terms from 1 to 3 years.

harnessing of regional resources, etc. (chapter 8, <u>State of regional integration in Africa</u> 4, 2010). Moreover, Member States must support the setting up of a Maghreb Bank for Investment and benefit from regional payment mechanisms already in place in neighbouring African sub-regions in Central[21] or West Africa[22]. Specifically, in order to facilitate regional trade transactions and FDI, it is important to speed up the gradual elimination of capital-account controls, setting up more flexible exchange systems and to improve currency convertibility in North African countries. In the same context, the ECA report[23] on financial integration and regional governance also underlines the need to produce an agenda to support the implementation of financial integration, the creation of a system to encourage North African banks supplying regional payment services and the setting up of the necessary reforms to interconnect the North African stock markets.

Regional integration strategy

Given the importance of trade openness, it seems that the process of regional integration, along with appropriate industrial policies and by exploiting comparative advantages and complementarities, will promote diversification and growth of NACs.

The table below shows the list of the 10 first categories of products exported to North Africa, classified by their level of sophistication (measured by the PRODY indicator), their level of complementarity with imports from the various North African partners (measured by the sectoral complementarity index) and lastly by the comparative advantage which they have (measured by the RCA index). The results for the sample show that the trade between the countries of North Africa are not in line with the criteria for optimal sophistication, complementarity and comparative advantage.

For example, for Algeria, the list of products exported to North Africa contains **only one** product on the list of the 10 most sophisticated products exported by Algeria (see the full list in Annex 1), **only one** product belongs to the list of the 10 most complementary products exported by Algeria (Annex 1). Morocco **exports no** complementary product to the region. For Tunisia and Egypt, no category of product exported to NACs appears on the list of most sophisticated products which they are able to export and only one highly complementary product is traded between these two countries and the rest of the NACs.

So the regional integration strategy of NACs should be refocused toward trade in higher added-value products which would make it possible to raise the productivity level of the production system of these economies. Identifying the list of products likely to meet this criterion is possible using a composite index calculated on the basis of normalized and weighted indices of the sophistication index (PRODY), the comparative advantage index (RCA) and lastly the complementarity index (COMPL) given that the products should be traded on the basis of trading complementarity within the region.

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[21] For more information, see the following page: https://www.beac.int/index.php/systemes-de-paiement

[22] For more information, see the following page: http://www.bceao.int/-Systemes-de-Paiement-.html

[23] "Rapport sur l'integration financière et la gouvernance regionale en Afrique du Nord", ECA December 2012.

Table 6: The list of the 10 most exported products to the North Africa region (2010)

Country	product description tr	RCA	PRODY	COMPL	Country	product description tr	RCA	PRODY	COMPL
	Sectors exported to NACs					Sectors exported to NACs			
Algeria	Gas natural/manufactured	green		blue	Egypt	Metal manufactures nes			
Algeria	Sugar/sugar prep/honey	green			Egypt	Electrical equipment			
Algeria	Iron and steel				Egypt	Cereals/cereal preparatn			
Algeria	Non-ferrous metals				Egypt	Non-metal mineral manuf.			
Algeria	Inorganic chemicals	green			Egypt	Sugar/sugar prep/honey	green		
Algeria	Non-metal mineral manuf.				Egypt	Non-ferrous metals			
Algeria	Organic chemicals		red		Egypt	Vegetables and fruit	green		
Algeria	Electric current				Egypt	Paper/paperboard/article			blue
Algeria	Perfume/cosmetic/cleansr				Egypt	Iron and steel			
Algeria	Misc manufactures nes				Egypt	Dairy products & eggs	green		
Morocco	Electrical equipment				Libya	Gas natural/manufactured	green		
Morocco	Road vehicles				Libya	Iron and steel	green		
Morocco	Perfume/cosmetic/cleansr				Libya	Petroleum and products			
Morocco	Iron and steel				Libya	Organic chemicals	green	red	blue
Morocco	Pulp and waste paper		red		Libya	Plastics in primary form	green	red	
Morocco	Coffee/tea/cocoa/spices				Libya	Inorganic chemicals	green		blue
Morocco	Vegetables and fruit	green			Libya	Dairy products & eggs		red	blue
Morocco	Fish/shellfish/etc.	green			Libya	Cereals/cereal preparatn			
Morocco	Crude fertilizer/mineral	green			Libya	Travel goods/handbag/etc		red	
Morocco	Inorganic chemicals	green			Libya	Textile fibres	green		blue
Mauritania	Fish/shellfish/etc.	green			Tunisia	Metal manufactures nes			
Mauritania	Animal feed ex unml cer.	green		blue	Tunisia	Paper/paperboard/article			
Mauritania	Animal oil/fat	green		blue	Tunisia	Non-metal mineral manuf.			blue
Mauritania	Hide/skin/fur, raw	green		blue	Tunisia	Electrical equipment	green		
Mauritania	Metal ores/metal scrap	green			Tunisia	Vegetables and fruit			
Mauritania	Crude fertilizer/mineral	green		blue	Tunisia	Fixed veg oils/fats			
Mauritania	Fish/shellfish/etc.	green			Tunisia	Inorganic chemicals	green		
Mauritania	Fish/shellfish/etc.	green			Tunisia	Industry special machine			
Mauritania	Fish/shellfish/etc.	green			Tunisia	Iron and steel			
Mauritania	Fish/shellfish/etc.	green			Tunisia	Road vehicles			

However, weightings may change according to the desired strategy of the countries of North Africa so as to identify each time a list of strategic products. For example a strategy giving the same importance to comparative advantage as to sophistication and complementarity might be expressed as follows:

INDEX= =(0.35*rca_norm) +(0.35*prody_norm)+(0.3*(1-compl_norm))[24]

Taking this chosen configuration of weighting, the results relating to the pattern of specialization of each country are given in the table below. For example, for Algeria, the regional integration strategy would be better suited and more optimal than the current strategy if the country were to move toward exporting products such as organic chemical derivatives, pharmaceuticals, electricity generating equipment… etc. Although the revealed comparative advantage in these products is low, Algeria should make efforts to increase its competitiveness and move in the direction of more sophisticated products.

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[24] The normalization of a variable is calculated using the following formula X_norm=X-min(X)/max(X)-min(X)

Table 7: Specialization strategy by product for the countries of North Africa

country	productdescription	COMPL	RCA	PRODY	Country	productdescription	COMPL	RCA	PRODY
Algeria	Organic chemicals	.0050354	.0459	23606.63	Morocco	Animal oil/fat	.00122	7.3389	21603.63
Algeria	Photographic equ/clocks	.0013961	.0022	21922.41	Morocco	Organic chemicals	.00485	.0156	23606.63
Algeria	Pulp and waste paper	.0013137	.0285	21076.64	Morocco	Pulp and waste paper	.00192	2.2058	21076.64
Algeria	Pharmaceutical products	.0091923	.0008	21589.06	Morocco	Photographic equ/clocks	.00123	.0188	21922.41
Algeria	Metalworking machinery	.0025298	.0002	20725.8	Morocco	Metalworking machinery	.00228	.0248	20725.8
Algeria	Plastics in primary form	.0116329	.0007	21166.06	Morocco	Pharmaceutical products	.00973	.1303	21589.06
Algeria	Power generating equipmt	.0073672	.0016	20259.45	Morocco	Plastics non-primry form	.00321	.198	19928.3
Algeria	Scientific/etc instrumnt	.0060854	.002	20147.4	Morocco	Office/dat proc machines	.00537	.0552	20190.97
Algeria	Office/dat proc machines	.0067391	0	20190.97	Morocco	Scientific/etc instrumnt	.00534	.0895	20147.4
Algeria	Plastics non-primry form	.0038825	.0019	19928.3	Morocco	Plastics in primary form	.01123	.046	21166.06
Egypt	Animal oil/fat	.000237	1.5543	21603.63	Mauritania	Animal oil/fat	.00059	3.861	21603.63
Egypt	Organic chemicals	.0013239	.1874	23606.63	Mauritania	Metal manufactures nes	.01651	.0004	16039.62
Egypt	Dairy products & eggs	.0036684	4.0872	17968.29	Mauritania	Hide/skin/fur, raw	.00010	.8986	13131.92
Egypt	Plastics in primary form	.0018397	.9722	21166.06	Mauritania	Non-ferrous metals	.00796	.0024	13968.16
Egypt	Photographic equ/clocks	.0012873	.0104	21922.41	Mauritania	Animal feed ex unml cer.	.00944	6.964	10408.84
Egypt	Paper/paperboard/article	.0006741	1.3703	19294.63	Mauritania	Meat & preparations	.00479	.0034	12264.99
Egypt	Manufactured fertilizers	.0202667	12.4834	10279.42	Mauritania	Fish/shellfish/etc.	.17542	52.554	7588.691
Egypt	Plastics non-primry form	.0010029	.8383	19928.3	Mauritania	Petroleum and products	.05562	.0001	13007.37
Egypt	Pulp and waste paper	.0006915	.0058	21076.64	Mauritania	Vegetables and fruit	.00501	0	7710.47
Egypt	Chem material/prods nes	.0039247	1.6606	19646.75	Mauritania	Crude anim/veg mater nes	.00117	.0214	6680.237
Libya	Gas natural/manufactured	.0534899	8.0811	12263.89	Tunisia	Manufactured fertilizers	.02315	14.121	10279.42
Libya	Organic chemicals	.0005366	.5369	23606.63	Tunisia	Organic chemicals	.00491	.0235	23606.63
Libya	Plastics in primary form	.0108448	.1493	21166.06	Tunisia	Photographic equ/clocks	.00041	.2322	21922.41
Libya	Chem material/prods nes	.0058658	.0046	19646.75	Tunisia	Animal oil/fat	4.85e-	.0002	21603.63
Libya	Rubber manufactures nes	.0049834	.0001	19120.73	Tunisia	Pulp and waste paper	.00080	.1115	21076.64
Libya	Travel goods/handbag/etc	.00029	.0006	16314.96	Tunisia	Plastics non-primry form	.00077	.8081	19928.3
Libya	Petroleum and products	.3646623	7.7129	13007.37	Tunisia	Power generating equipmt	.00294	.8661	20259.45
Libya	Misc manufactures nes	.0094088	.0001	14664.46	Tunisia	Scientific/etc instrumnt	.00052	.5644	20147.4
Libya	Miscellaneous manuf arts	.0043373	0	13362.13	Tunisia	Paper/paperboard/article	.00151	1.1551	19294.63
Libya	Hide/skin/fur, raw	.0003017	.0002	13131.92	Tunisia	Metalworking machinery	.00238	.0477	20725.8

Moreover, regional integration should be based on the creation and coordination of regional value chains in activities with high added value. For example, the decomposition of an activity in the aviation industry into two complementary sub-activities between Tunisia and Morocco that promote the exchange of knowledge, qualified labour, bargaining power visa vis the parent company and encourages cooperation in other related activities.

Naturally, this regional integration strategy should be complementary in nature with a multilateral opening enabling a lowering in particular of non-tariff barriers, which are still at a high level in NACs. It should also be based on raising the quality of institutions, particularly through gradual improvement of governance and the fight against corruption.

Annex 1: Lists of exported products:

Table A1: The 10 most exported products according to the RCA, PRODY, Complementarity criteria (2010)

Pays	secteurs avec RCA le plus élevé Catégorie de produit	Secteurs les plus sophistiqués Catégorie de produit	Secteurs les plus complémentaires Catégorie de produit
Algérie	Gas natural/manufactured	Organic chemicals	Animal/veg oils procesd
Algérie	Mineral fuel/lubricants	Photographic equ/clocks	Beverages
Algérie	Petroleum and products	Industrial equipment nes	Travel goods/handbag/etc
Algérie	Sugar/sugar prep/honey	Pharmaceutical products	Dairy products & eggs
Algérie	Inorganic chemicals	Plastics in primary form	Hide/skin/fur, raw
Algérie	Crude fertilizer/mineral	Pulp and waste paper	Misc food products
Algérie	Leather manufactures	Metalworking machinery	Building fixtures etc
Algérie	Beverages	Power generating equipmt	Crude/synthet/rec rubber
Algérie	Hide/skin/fur, raw	Office/dat proc machines	Leather manufactures
Algérie	Food & live animals	Scientific/etc instrumnt	Photographic equ/clocks
Egypte	Manufactured fertilizers	Organic chemicals	Hide/skin/fur, raw
Egypte	Crude fertilizer/mineral	Photographic equ/clocks	Beverages
Egypte	Vegetables and fruit	Industrial equipment nes	Animal oil/fat
Egypte	Sugar/sugar prep/honey	Animal oil/fat	Animal/veg oils procesd
Egypte	Crude anim/veg mater nes	Pharmaceutical products	Travel goods/handbag/etc
Egypte	Gas natural/manufactured	Plastics in primary form	Electric current
Egypte	Textile fibres	Pulp and waste paper	Coffee/tea/cocoa/spices
Egypte	Dairy products & eggs	UN Special Code	Paper/paperboard/article
Egypte	Gold non-monetary ex ore	Metalworking machinery	Pulp and waste paper
Egypte	Inorganic chemicals	Power generating equipmt	Building fixtures etc
Libye	Gas natural/manufactured	Organic chemicals	Hide/skin/fur, raw
Libye	Petroleum and products	Plastics in primary form	Travel goods/handbag/etc
Libye	Mineral fuel/lubricants	Chem material/prods nes	Organic chemicals
Libye	Organic chemicals	Rubber manufactures nes	Dairy products & eggs
Libye	Iron and steel	Chemicals/products n.e.s	Textile fibres
Libye	Plastics in primary form	Dairy products & eggs	Inorganic chemicals
Libye	Chemicals/products n.e.s	Travel goods/handbag/etc	Crude fertilizer/mineral
Libye	Inorganic chemicals	Misc manufactures nes	Vegetables and fruit
Libye	Manufactured goods	Manufactured goods	Animal feed ex unml cer.
Libye	Textile fibres	Miscellaneous manuf arts	Rubber manufactures nes

	secteurs avec RCA le plus é	Secteurs les plus sophistiq	Secteurs les plus complémentaires	
Pays	**Catégorie de produit**	**Catégorie de produit**	**Catégorie de produit**	
Maroc	Inorganic chemical	Industrial equipment nes	Animal/veg oils procesd	
Maroc	Fish/shellfish/etc	Animal oil/fat	Beverages	
Maroc	Animal oil/fa	Pharmaceutical products	Misc food products	
Maroc	Apparel/clothing/acces	Plastics in primary form	Leather manufactures	
Maroc	Vegetables and frui	Pulp and waste paper	Travel goods/handbag/etc	
Maroc	Crude anim/veg mater ne	UN Special Code	Building fixtures etc	
Maroc	Food & live animal	Metalworking machinery	Hide/skin/fur, raw	
Maroc	Footwea	Power generating equipmt	Dairy products & eggs	
Mauritani	Fish/shellfish/etc	Animal oil/fat	Hide/skin/fur, raw	
Mauritani	Gold non-monetary ex or	UN Special Code	Animal oil/fat	
Mauritani	Metal ores/metal scra	Metal manufactures nes	Crude anim/veg mater nes	
Mauritani	Commodities ne	Non-ferrous metals	Crude fertilizer/mineral	
Mauritani	Animal feed ex unml cer	Manufactured goods	Vegetables and fruit	
Mauritani	Food & live animal	Hide/skin/fur, raw	Meat & preparations	
Mauritani	Crude mater.ex food/fue	Petroleum and products	Non-ferrous metals	
Mauritani	Animal oil/fa	Mineral fuel/lubricants	Animal feed ex unml cer.	
Mauritani	UN Special Cod	Commodities nes	Metal manufactures nes	
Mauritani	Hide/skin/fur, ra	Meat & preparations	Petroleum and products	
Tunisie	Manufactured fertilizer	Organic chemicals	Animal oil/fat	
Tunisie	Apparel/clothing/acces	Photographic equ/clocks	Crude anim/veg mater nes	
Tunisie	Inorganic chemical	Industrial equipment nes	Animal/veg oils procesd	
Tunisie	Fixed veg oils/fat	Animal oil/fat	Building fixtures etc	
Tunisie	Footwea	Pharmaceutical products	Scientific/etc instrumnt	
Tunisie	Animal/veg oil/fat/wa	Plastics in primary form	Hide/skin/fur, raw	
Tunisie	Crude fertilizer/minera	Pulp and waste paper	Gold non-monetary ex ore	
Tunisie	Miscellaneous manuf art	UN Special Code	Photographic equ/clocks	
Tunisie	Electrical equipmen	Metalworking machinery	Misc manufactures nes	
Tunisie	Vegetables and frui	Power generating equipmt	Non-metal mineral manuf.	

List by country of the 5 most exported products to North Africa 1995-2011

Pays	description du produit	Cumul des exportations	RCA	description du produit	Cumul des exportations	RCA
	Liste des cinq premiers produits exportés au Nord Afrique en 1995			**Liste des cinq premiers produits exportés au Nord Afrique en 2011**		
Algérie	Gaz naturel, même liquéfié	87343.01	64.2684	Propane et butane liquéfiés	1271181	40.4485
Algérie	Propane et butane liquéfiés	50094.52	52.2668	Gaz naturel, même liquéfié	300107.4	23.976
Algérie	Huiles brutes de pétrole ou minéraux bitumineux	19583.42	17.1479	Sucres, mélasses et miel	93444.06	1.7147
Algérie	Produits laminés plats, en fer ou aciers non alliés	13830.75	.4569	Produits laminés plats, en fer ou aciers non alliés	14386.17	.074
Algérie	Énergie électrique	12419.1	.9081	Zinc	14110.93	1.3696
Maroc	Engrais (autres que ceux du groupe 272)	32092.38	25.9058	Équipement pour distribution d'électricité, n.d.a.	50048.02	14.8524
Maroc	Pâtes à papier et déchets de papier	30848.57	2.5336	Véhicules automobiles pour transport de personnes	41847.79	.0964
Maroc	areils de chauffage et de réfrigération, n.d.a.	23138.8	.53	Savons, produits d'entretien et détersifs	26458.59	.8756
Maroc	Chaussures	20290.21	1.7484	Pâtes à papier et déchets de papier	24677.08	2.2058
Maroc	Huiles de pétrole ou minéraux bitumineux > 70%	14240.11	1.386	Café et succédanés du café	24509.41	.7905
Mauritanie	Poissons frais, vivants ou morts, réfrigérés ou congel	1281.161	..	Poissons frais, vivants ou morts, réfrigérés ou congel	3110.247	55.0025
Mauritanie	Huiles de pétrole ou minéraux bitumineux > 70%	1045.921	..	Nourriture pour animaux (sauf céréales non moulues	1129.993	6.964
Mauritanie	Minerais de fer et leurs concentrés	920.499	..	Huiles et graisses d'origine animale	388.794	3.861
Mauritanie	Cuirs et peaux (sauf pelleteries), bruts	129.977	..	Crustacés, mollusques et invertébrés aquatiques	294.256	96.2125
Mauritanie	Véhicules automobiles pour transport de personnes	18.252	..	Cuirs et peaux (sauf pelleteries), bruts	142.221	1.439
Soudan	Graines et fruits oléagineux (sauf farines)	8583.962	44.946	Graines et fruits oléagineux (sauf farines)	40582.52	..
Soudan	Cuirs et peaux préparés	2416.308	18.7714	Coton	27445.53	..
Soudan	Animaux vivants autres que ceux aquatiques	1886.631	38.5381	Cuivre	16963.55	..
Soudan	Graines et fruits oléagineux (dont farines, n.d.a.)	1536.06	66.9673	Animaux vivants autres que ceux aquatiques	11955.3	..
Soudan	Légumes, frais, réfrigérés, conservés, séchés	663.254	.0099	Légumes, frais, réfrigérés, conservés, séchés	3984.34	..
Tunisie	Chaux, matériaux de construction fabriqués (sauf arg	43690.55	6.3091	Papiers et cartons découpés	112494.1	3.016
Tunisie	Sels et persels métalliques des acides inorganiques	34342.18	8.1719	Graisses et huiles végétales douces	87452.52	13.0324
Tunisie	Pneumatiques en caoutchouc	17625.44	1.1291	Chaux, matériaux de construction fabriqués (sauf arg	85541.16	4.1621
Tunisie	Semoules	15559.91	5.2924	Sels et persels métalliques des acides inorganiques	79652.84	14.8701
Tunisie	Animaux vivants autres que ceux aquatiques	12689.03	1.3259	Fruits (sauf oléagineux), frais ou secs	78358.7	3.1592
Égypte	Aluminium	20215.33	..	Riz	183267.3	..
Égypte	Riz	13392.2	..	Équipement pour distribution d'électricité, n.d.a.	156326.2	..
Égypte	Barres, profilés en fer ou acier (dont palplanches)	11485.76	..	Sucres, mélasses et miel	127714.3	..
Égypte	Cokes et semi-cokes de houille, lignite ou tourbe	10516.99	..	Articles manufacturés en métaux communs, n.d.a.	118523	..
Égypte	Fils textiles	6515.939	..	Cuivre	103266.7	..
Libye	Barres, profilés en fer ou acier (dont palplanches)	154627.7	..	Huiles brutes de pétrole ou minéraux bitumineux	367695.6	..
Libye	Huiles de pétrole ou minéraux bitumineux > 70%	90718.65	..	Gaz de pétrole et autres hydrocarbures gazeux, n.d.a	109223.5	..
Libye	Huiles brutes de pétrole ou minéraux bitumineux	84799.93	..	Propane et butane liquéfiés	103918.8	..
Libye	Produits laminés plats, en fer ou aciers non alliés	36389.25	..	Huiles de pétrole ou minéraux bitumineux > 70%	85870.27	..
Libye	Fils de fer ou d'acier	24418.21	..	Hydrocarbures, n.d.a. et dérivés halogènes, nitrosés	76813.8	..

Annex 2: Technical Appendix

Encadré 1 : Calcul de l'indice de diversification de THEIL

Pour un pays donné et pour une année donnée l'indice de Theil de diversification des exportations est donné par :

$$T = \frac{1}{n} \sum_{k=1}^{n} \frac{x_k}{\mu} \ln(\frac{x_k}{\mu}) \qquad \text{où} \qquad \mu = \frac{\sum_{k=1}^{n} x_k}{n}$$

n est le nombre total des produits exportés

Décomposition de l'indice de Theil : diversification-intra versus diversification-inter

Si n est le nombre total des produits exportés (par exemple les 256 produits enregistrés dans la base de donnée de l'UNTACD dans la classification type pour le commerce international (CTCI), Révision 3 pour le niveau le plus détaillé (la position à 3 chiffres)). Si on divise le nombre de produits exportés en lignes d'exportation actives[25] et lignes d'exportation non actives, soit nj est le nombre de produits exportés dans le groupe j = 0,1. μ est la valeur moyenne des exportations en dollars, μ_j est la valeur moyenne des exportations du groupe j, et x_k est la valeur des exportations du produit k dans le groupe j. la diversification inter-groupe est définit par :

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

La diversification intra-groupe est définit par :

$$T^W = \sum_{j=0}^{1} \frac{n_j}{n} \frac{\mu_j}{\mu} T^j)$$

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

T^j est la valeur de l'indice de Theil pour les sous-groupes j=0,1. Il est facile de vérifier que la variabilité intragroupe T^W plus la variabilité intergroupe T^B est égale à la variabilité totale mesurée par Theil total $T = T^B + T^W$

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[25] Une ligne d'exportation est assimilée dans cet exercice à une catégorie de produit selon la classification adoptée.

Encadré 2 : Calcul de l'indice de Sophistication

L'indice de sophistication EXPY pour un pays j est définit comme une mesure qui utilise les flux de commerce mondiaux et les niveaux de PIB par tête des pays exportateurs afin de déduire le niveau de productivité moyen associé à la structure des exportations d'un pays. Le calcul de l'indice EXPY est basé sur le calcul du niveau de sophistication de chaque produit PRODY définit comme l'avantage comparatif révélé (RCA)-pondérée du PIB par habitant de chaque pays qui exporte le même bien. Ainsi le

$$PRODY_{i,t} = \sum_c \frac{\left(xval_{i,c,t} / X_c\right)}{\sum_j \left(xval_{i,c,t} / X_c\right)} Y_c = \sum_c \frac{RCA_{i,c,t}}{\sum_c RCA_{i,c,t}} Y_c$$

où $xval_{i,c,t}$, est la valeur des exportations du bien i effectué par le pays c dans l'année t, Xc est le total des exportations par pays c, et Yc est le PIB par habitant du pays c.

Comme le montre la formule ci-dessus, le calcul du PRODY peut se faire sur la base de l'indice de Balassa de l'avantage comparatif révélé (RCA) normalisé par rapport aux autres pays qui exportent le même produit.

Par la suite le PRODY sera utilisé comme une mesure pondérée pour calculer la sophistication de la structure des exportations au niveau du pays EXPY où la pondération est la part du secteur i dans la valeur totale des exportations du pays c.

$$EXPY_{c,t} = \sum_i \left(\frac{xval_{c,i,t}}{X_{c,t}}\right) PRODY_{i,t}$$

Cette valeur indique une moyenne pondérée du PIB par tête de tous les pays qui exportent les même produits que le pays c. En d'autres termes, elle mesure le niveau de productivité associé au panier de produits exportés, ou encore au modèle de spécialisation du pays.

Annexe 3: Indicators and sources:

INDICATEURS	SOURCES
DIVERSIFICATION:	
Indice de diversification des exportations	calculs des auteurs à partir de l'indice de Finger et Kreinin (1979) (données UNCTAD)
Hirschman-Herfindhal	calcul des auteurs, données UNCTAD
Theil: total, inter et intra	calcul des auteurs, données UNCTAD
SOPHISTICATION:	
Indice de complexité économique (Hidalgo et Hausmann (2009)	The observary of economic complexity of MIT (http://atlas.media.mit.edu/about/team/)
Indice de sophistication: Hausmann et al. (2007)	Calcul des auteurs à partir des données UNCTAD
OUVERTURE INTERNATIONALE:	
IDE: entrées en % du PIB	WDI
Ouverture commerciale: exportations + importations en % du PIB	WDI
Ouverture financière: crédit domestique au secteur privé (% PIB)	WDI
CAPITAL HUMAIN ET AUTRES FACTEURS STRUCTURELS:	
Part de la population avec enseignement primaire	WDI and Unesco institute for statistics
Part de la population avec enseignement secondaire	WDI and Unesco institute for statistics
R et D en % du PIB	WDI
Distance pondérée	CEPII géographie
Facilitation des échanges: nombres de jours nécessaires pour exporter	Doing Business World Bank
FACTEURS INSTITUTIONNELS:	
Politique industrielle: production industrielle, US$ constants 2000, 1995=100	WDI
Politique industrielle: production industrielle, US$ constants 2000, (par habitant)	WDI
Investissement public en % du PIB	Heston et al. 2006
Part de l'Etat dans les dépenses de consommation totale (% du PIB)	WDI
Investissement privé: FBCF, secteur privé (% du PIB)	WDI
Aide et assistance au développement (US$ constant, 2010)	WDI
Prêt cumulés de la BEI	European Bank of Investment
Gouvernance:	
Corruption	WGI World Bank
Vote	WGI World Bank
Absence de violence/stabilité politique	WGI World Bank
Efficacité de l'Etat	WGI World Bank
Qualités de la régulation	WGI World Bank
règles de droit	WGI World Bank
FACTEURS MACROECONOMIQUES:	
Termes de l'échange	WDI
Taux de change effectif réel, 1995=100	WDI et Darvas, 2012
Exportations de produits pétroliers (en % des exportations de biens))	WDI
AUTRES:	
Exportations primaires: SITC 0+1+2 % en % des exportations totales	UNCTAD 2012
Part des exportations pétrolières dans les exportations totales de biens	WDI
PIB par habitant (US$ constant, 2000)	WDI
Infrastructures:	
Routes asphaltées (% du total)	WDI
Utilisateurs internets pour 100 habitants	WDI
Nombre de lignes téléphoniques pour 100 habitants	WDI

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