# North African countries (NACs) production and export structure: Towards diversification and export sophistication strategy

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# North African countries (NACs) production and export structure: Towards diversification and export sophistication strategy

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## Abstract

The North African countries (NACs) production and export structure is suffering from double constraints: insufficient diversification along with excessively weak sophistication. This study establish a deeper link between diversification/sophistication on and growth in the NACs. The study assesses 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 consists in estimating a growth model as a Barro's regression (conditional -convergence model) using panel data. The paper 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 last part of this study proposes recommendations in terms of economic policies based on obtained results, highlighting the role of various stakeholders, and different policies.
*JEL classification numbers*: F15, F43, O14.
*Keywords*: Export diversification, sophistication, North Africa.

## Introduction

In North African Countries (NACs) the 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. Indeed, over the last decade 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 unemployment.

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 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 paper 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[1]. 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 last part of this report will offer recommendations in terms of economic policies based on results previously obtained.


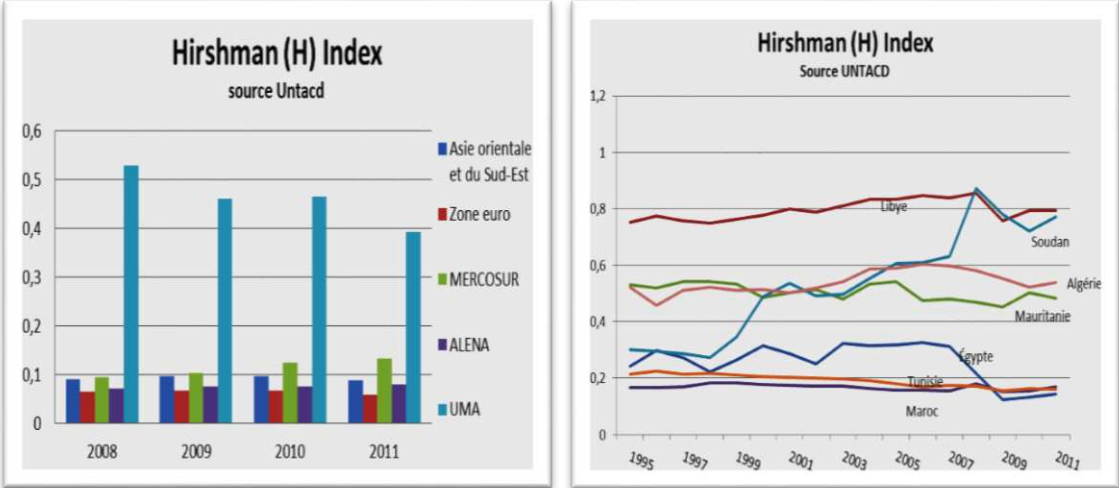**1 NACs Export diversification and sophistication**


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. 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.

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 blocs. 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 exports in these countries are specialized in subcontracting and imported inputs based products.

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[1] 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).

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).

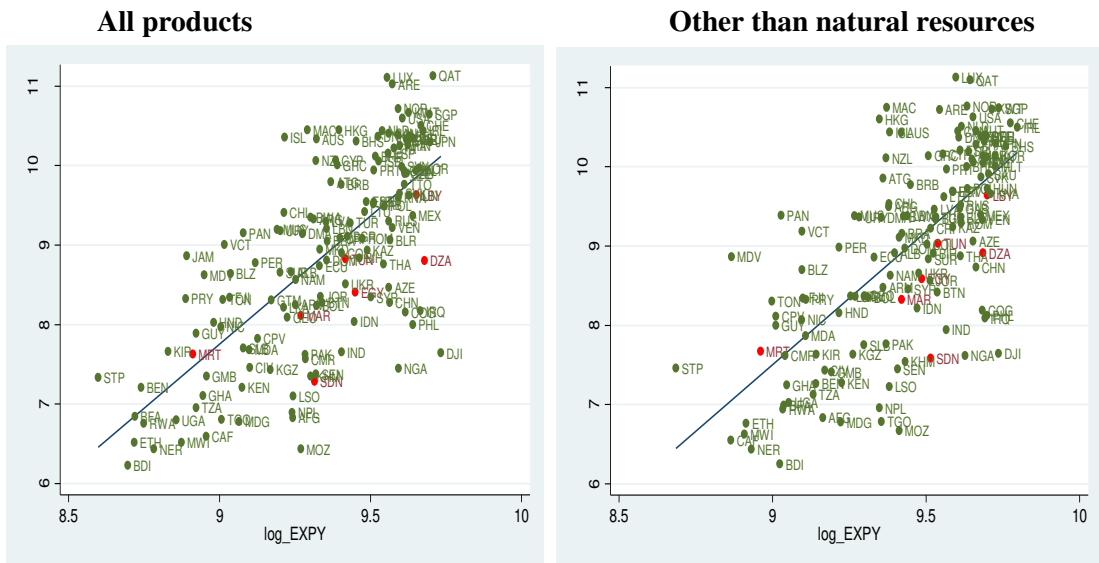**Figure 1: export concentration for NACs and some regional groupings**



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.

In this paper, the export sophistication index (EXPY) and the corresponding productivity index (PRODY) were calculated over the period 1995-2011 for the NACs.

The figure below shows that there is a positive relation between per capita income and the index of sophistication of products exported (EXPY) in 2009. 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.
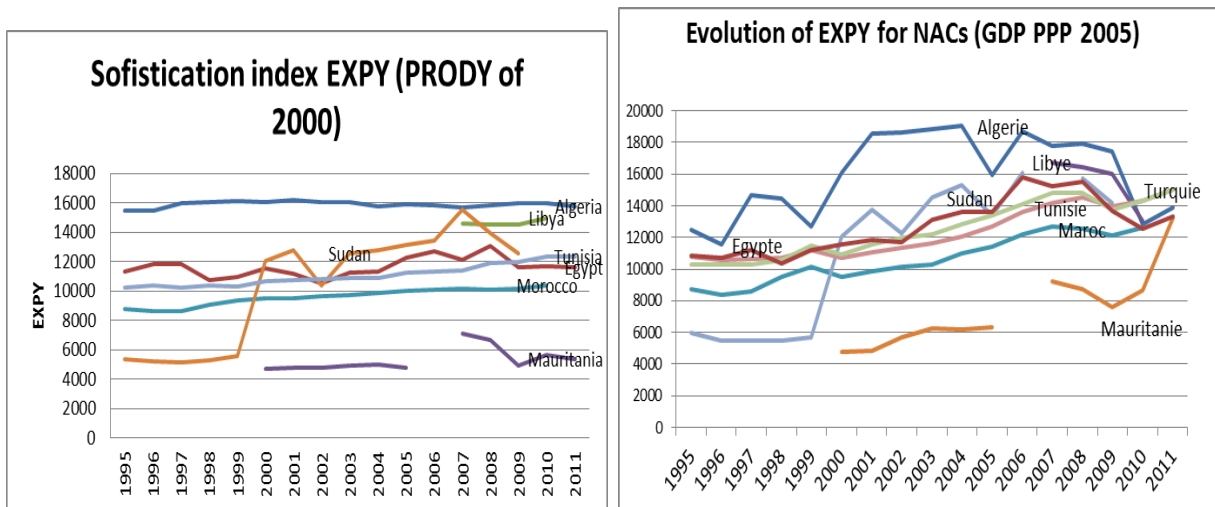
To analyse changes in the sophistication of the export basket, it is worth recalculating the value of EXPY with a fixed PRODY value. In this case, EXPY movements will be not attributed to changes in the income level of the other countries exporting the same product, but rather to the fact that the countries in question have increased the share of sophisticated products in their export baskets.

## Figure 2: relation between sophistication of exports and per capita GDP

| All products | Other than natural resources |
|:---:|:---:|



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 3: 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.

## 2 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

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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 FDI 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.

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:

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

$$(1)$$

$\Delta y_{it}$ 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 $\beta$ sign indicates a convergence of the economies toward their level of balanced growth[2]. $DIV_{it}$ represents the diversification of exports

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[2] 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)[3], 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. 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 FDI as percentage of GDP and share of primary exports as percentage of total exports[4]), 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[5]. 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[6]. The results of the estimates are presented in Table 1.

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[3] This index is defined as follows:

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

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.

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

[5] 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.

[6] 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

| Group of variables | Variable | EC2SLS | HWS | AR(1) |
|---|---|---|---|---|
| Diversification | Theil inter | -1.1415** | -1.1285** | -1.1415** |
| Complexity | Hidalgo-Hausmann (2009) | 0.6245** | 0.6523** | 0.7135** |
| Convergence | GDP/Capita lagged | -0.0002* | -0.0002* | -0.0002* |
| International trade | Openess (trade % of GDP) | 0.0146* | 0.0146* | 0.0151* |
| | FDI (entrants, % PIB) | 0.1825*** | 0.1838*** | 0.1773*** |
| | Exp. Primary (% of exp. tot.) | -0.0392** | -0.0305** | -0.0319** |
| Human capital | R&D | 1.7693** | 1.7775** | 1.7810** |
| Institutions | public spending | -0.1291** | -0.1279** | -0.1298** |
| | Gouvernance (corruption) | 0.2129 | 0.2481 | 0.2440 |
| infrastructures | paved roads (%) | 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[7]. 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.

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[7] 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.

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.[8]

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 FDI 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.

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[9]. But this study is based on a limited sample of countries, which

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[8] 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.

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

reduces the variance of these two variables and limit their significance unlike wider country samples, incorporating European countries in particular.

## 3 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 extends to the NACs the existing analyses , firstly modelling the determinants of diversification and sophistication in the NACs[10], 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[11] 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, FDI 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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[10] For the same reasons as previously, the sample of countries will be extended to the Mashrek countries and Turkey.
[11] 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 soon 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 FDI; *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 [12] 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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[12] 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 |
|---|---|---|---|---|---|---|---|
| International openess | Open.trade | -0.162** | -0.172** | -0.118* | -0.086 | -0.119** | |
| | Open.finance | -0.047(*) | -0.051(*) | -0.056(*) | -0.005 | -0.029 | |
| | fdi | -0.0270*** | -0.0270*** | -0.0240** | -0.0475** | -0.0071 | |
| Structural factors | 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*** | |
| institutional factors | pol. Indus (indice de prod | 0.5004*** | 0.4973*** | 0.5120*** | 0.4228*** | 0.3109*** | |
| | inv. Public (%) | 0.5104*** | 0.5036*** | 0.5402*** | 0.6214*** | 0.2577*** | |
| | Loans EIB | -0.0307** | -0.0307** | -0.0308** | -0.0408** | -0.0184** | |
| | Aid.development | 0.0685*** | 0.0658*** | 0.0611*** | 0.0837*** | 0.0278* | |
| | corruption | -0.0052 | -0.0077 | -0.0011 | -0.0783* | -0.0319 (*) | |
| Facteurs macroéconomiques | Terms of Trade | -0.0188 | -0.0194 | -0.0326 | -0.0561* | -0.0291 | |
| | Exchange rate | 0.0603 | 0.0609 | 0.0604 | 0.0804 | 0.0209 | |
| Other factors | infrastructure | | -0.1637*** | | | | |
| | Private investment (%) | | | -0.0847** | | | |
| | weight of oil export | | | | 0.0641** | | |
| | hystérèse (lag Theil) | | | | | 0.6493*** | |
| | GDP/capita | | | | | | -0.0001** |
| | (GDP/Capita)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 FDI 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 FDI would make it possible to continue the process of diversification[13].

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. 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.

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[13] 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.

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[14].

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)[15]. Lastly, estimates show 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[16]. 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).

## Conclusion

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

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[14] 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.

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

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

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[17] 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. 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 developed.

*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 these investments tend to be focussed on subcontracting activities directed toward Europe, with insufficient stimulation of effects of externalities on the rest of

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[17] www.lpi.worldbank.org

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[18], 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.

*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 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.

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.

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[18] 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.

## Annexe 1: 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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