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MANUFACTURING SECTOR, NATURAL RESOURCES AND ECONOMIC GROWTH IN AFRICA: A DYNAMIC PANEL APPROACH

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ABSTRACT

The objective of this paper is to establish the relationship between manufacturing and growth in African countries taking into account their natural resource endowments. To do this, we estimate models using dynamic panel data from 40 African countries.

We note that the concentration of exports in manufactured goods has a positive impact on growth if and only if the value of the share of minerals and fuels in total exports is less than a certain critical value. We identify 37 countries where the share of manufactures in exports increases the per capita product (*natres*[1]*<50%*) and 13 countries where this relationship is not significant (*natres>= 50%*). The growth of manufacturing value added has a positive and significant impact on the growth of GDP per capita. The high share of exports in natural as well as rents of resources has significant adverse effects on growth. The added value of the agricultural sector is still low, with a significant negative effect on growth. Moreover, education, infrastructure investment and trade openness for manufactured goods have positive and significant effects on the level of output per capita in Africa.

Keywords: Economic Growth, Manufacturing, Natural Resources, Dynamic Panel, GMM system.

[1] *The share of fuels (fuel_ex) and minerals (me_ex) in total merchandise exports (natres=fuel_ex+me_ex)*

1. INTRODUCTION

Over the past fifty years, the issue of industrialization in Africa has become a concern at the heart of economic debates (Altenburg, 2011). This issue is particularly important because most African economies are based on agriculture with low added value. Exports of commodities cannot get to African countries a strong and sustainable economic growth. The industrialization of Africa will therefore accelerate the transition of African economy based on agriculture and the export of raw materials to a modern economy and job creation, ensuring self-sufficiency and improving incomes and standards of living (UNCTAD, 2011). Indeed, in a modern economy, rapid and sustainable economic growth, almost always involved a process of industrialization and in particular the development of manufacturing (Szirmai, 2009). It is therefore necessary for African countries to make a structural change to significantly reduce poverty, provide jobs to its youth estimated between 7 to 10 million every year who enter the workforce (UNCTAD, 2011). This change will then promote the growth of agricultural productivity on the one hand, and the development of opportunities other than in agriculture, so in the processing of raw materials and services, other. That means to pass to sector of low productivity to the sector with higher productivity and in these sectors make more productive activities.

In addition, several empirical studies highlight the potential of industrialization especially manufacturing in sustainable growth, employment and poverty reduction. Indeed, manufacturing activities are sources of technological progress, innovation in a modern economy (Gault and Zhang, 2010). Then, the manufacturing industry is a very important mean of dissemination of new technologies in other sectors of the economy (Shen, 2007). Finally, synergy and training (demand[2] growth, export) on other sectors (agriculture, services) by manufacturing activities are very important. The manufacturing sector is a source of technological change, but also has a higher potential for creating jobs than agriculture (Tybout, 2000).

With several natural resources, Africa has experienced several industrialization policies. Indeed, after the oil shocks of 1970, industrialization by import substitution (early 1960-end 1970) was

[2] *According to Engel's law, as and as per capita income increases, the share of agriculture in total household expenditure decreases and the share of manufactures rose*

no longer viable[3]. Then in 1980 with the advent of the Structural Adjustment Programs (SAPs), we notice that the elimination of the barriers to exports and the specification of countries to the products making comparative advantage. Finally, under the weight of foreign debt most African countries adopted the Poverty Reduction Strategy Paper which has completely changed the industrialization policies of African countries.

The share of manufactured exports for all products PVD rose from 25% to nearly 85% between 1980 and 2005 (Martin, 2010). In Sub-Saharan Africa (SSA), the share of commodity exports in total exports had a downward trend over the period 1998-2010. The share of manufactures in exports remained stagnant at about 32% while the export of gold and other metals has been an upward trend over the same period. The African continent is rich in natural and human resources, wealth that could support an expansion of agricultural production and trade. With 733 million hectares of arable land, Africa has about 27% of the world total, while Asia has only 628 million hectares and Latin America 570 million (Juma, 2011).

Despite these different phases of industrialization, relations that bind the manufacturing sector growth are not yet established by high charges or not African natural resources. Therefore, it became essential to ask: ***how do the manufacturing and agricultural sectors influence economic growth in African countries according to their natural resource endowments?*** The answer to this question is all the more necessary as it will better appreciate the impact of the manufacturing sector on economic growth in Africa.

This paper addresses several questions:

(i) Does the level of development of manufacturing influence economic growth in Africa?

(ii) The relationship between manufacturing and economic growth depend on the natural resource base of African countries?

(iii) Between agriculture and the manufacturing sector, which contributes most to the GDP per capita?

To do this, inspired by the writings of Szirmai (2011), models panels that take into account the problems of endogeneity can existed between variables of interest were exploited. And the most

[3] *The industrial policy of import substitution implemented by African countries was primarily oriented towards the needs of the domestic market rather than to the external market*

appropriate method used in this study to ensure the robustness of the estimated elasticities is the GMM system, proposed by Blundell and Bond (1998).

The results suggest that the relationship between the manufacturing sector and economic growth depends on the natural resource base of the country. Indeed, the concentration of exports in manufactured goods has a positive and significant impact on the level of per capita product if and only if the value of the share of minerals and fuels in total exports is less than a certain critical value (*that is to say, from the sum of minerals and fuel in total exports is less than 50 %*). We identify 37 countries where the share of manufactures in exports increases the per capita product (*group 1: natres <50%)* and 13 countries where this relationship is not significant (*group 2: natres >=50%*). There is a positive and significant relationship between economic growth and the manufacturing value added growth. But the high share of exports in natural as well as rents has significant adverse effects on growth in Africa resources. Moreover, the level of manufacturing value added in GDP has not reached a critical threshold to significantly make the product level per capita in Africa. The added value of the agricultural sector is still low, a negative and significant effect on growth.

Moreover, higher education, investment in infrastructure (public and private investment, development and use of ICT) and trade liberalization for manufactured goods have positive and significant effects on the level of per capita product. However, the strong growth of the African population is an obstacle for growth in African countries. So they have an interest in developing their manufacturing and strengthen export in the sector, improve their agricultural value added; increase their investment in infrastructure and master population growth in order to stimulate growth.

The remainder of this paper is structured as follows. MATERIALS (Data and study variables) as well as the theoretical and empirical journals are presented in Section 2, which is also dedicated to the presentation of the METHODS of the study (baseline model and estimation strategy). In Section 3, we analyze the RESULTS that emerge from the estimates and tests described in the previous section. We derive different results measures to help boost the manufacturing sector in African countries as well as the optimal use of annuities (good governance, transparency in the management of rents) from natural resources to better focus their influence on growth and employment. The last section concludes the paper.

2. MATERIALS and METHODS

At first, this section presents the data and variables used in this study and their sources. The second part is dedicated to the methodology implementation. Variables are presented highlighting the empirical work on studies on manufacturing, natural resources and economic growth.

2.1. MATERIALS: Data, the study variables and sources

The data concern the variables of interest relating to economic growth, manufacturing and natural resources. Variables that are served as controls and are very important in explaining the dynamics of growth are also presented.

2.1.2. Manufacturing sector

Manufacturing is the physical or chemical transformation of materials into new products, substances or components (UN[4]). According to the SCIAN[5], manufacturing sector or manufacturing industry comprises establishments primarily engaged in the transformation of materials or substances into new products by mechanical or other physical chemical processes. It can be finished product ie own use or consumption, or semi-finished products, that is to say, to be used as raw materials in a facility that use them to produce something else.

Several authors have demonstrated that the manufacturing sector is an engine of growth (Szirmai, 2008, 2009, 2011); (Rodrik, 2009) (Fagerberg and Verspagen 1999) (Sukti and Ilo, 2006) (Gebreeyesus and Lizuka, 2009) (Ruled 2007) (Katuria and Raj, 2009) (Thomas, 2009) (Dasgupta and Singh, 2006) (Chakravarty and Mitra, 2009) (Timmer and de Vries, 2009). These authors showed that the manufacturing sector is the branch of industrial activity that offers the greatest opportunities in terms of sustainable growth, employment and poverty reduction in Africa. Also, these authors highlight the positive relationship between manufacturing and GDP growth (high productivity, innovation, intensive ICT).

In the same vein, some authors show that technology and innovation are vital to economic development and the modern economy (Lall, 2005; Gault and Zhang, 2010). The research and

[4] *Department of Economic and Social Affairs (DESA).*
[5] *Classification System industries of North America.*

development activities of manufacturing companies were the key technological developments in the world economy (Dunn and Shen, 2007). The manufacturing industry is a very important means of dissemination of new technologies in other sectors of the economy.

Moreover, according to the 2012 report of the United Nations Conference on Trade and Development, Africa represents only one percent of global manufacturing and must boost emergency economic sector in hope of reducing poverty. This is especially important because Africa continues to be marginalized in the production and global trade of manufactured goods. Indeed, the share of the region in world manufacturing value added fell from 1.2% in 2000 to 1.1 % in 2008 (UNCTAD). However, in parallel, the developing countries of Asia are rising from 13% to 25 % over the same period. While the share of Africa in world exports of manufactures only slightly increased from 1% in 2000 to 1.3% in 2008, that of low-income countries and middle-income Asia Eastern and Pacific surged , reaching 16% in 2008 , against 9.5% in 2000. Research and development, Africa is still lagging behind. Spending on research and development in SSA in 2007 was 0.6% against 2.7% in the North American states and 1.8% in the countries of the European Union (**Table 1**).

Africa also lost ground in manufacturing intensive labor, which constitute the first stage of industrial development and is very essential in rapidly growing cities (UN, 2011). The share of manufacturing intensive labor in manufacturing value added (MVA) fell from 23% in 2000 to 20 % in 2008. That is why according to the UN, Africa cannot reasonably hope to reduce widespread poverty if governments do not take effective measures to increase the vital manufacturing sector for the economies of the continent.

We use in this study of manufacturing value added in GDP and the share of manufactures in exports. These variables are chosen because of their availability for a large number of countries and also because they are the most used in the studies. We also include in our estimates of the value added in GDP in other sectors such as agriculture, industry and services. These sectors contribute to industrialization. For example, the agricultural sector must provide consumer goods that make domestic firms more competitive in world export markets (Rattso and Torvik, 2003). In addition, the development of agriculture can contribute to creating a competitive advantage in the industry to the extent that the short and medium term, the sector remains an important source of foreign exchange to import intermediate inputs whose local industries need. Also, the

competitiveness of the manufacturing sector also depends on producer services (Janvry and Sadoulet, 2010).

2.1.3. Natural resources

Based on studies Poelhekke and Ploeg (2010), Asiedu and Lien (2011), Asiedu (2013), we use four variables to capture the natural endowments of African countries: (*i*) the proportion of fuel (fuel) of total merchandise exports, *fuel_ex* (*ii*) the rents from oil exports in GDP, *oilrent*[6] (*iii*) the share of minerals in total exports of goods, *me_ex*, (*iv*) share of fuels (*fuel_ex*) and minerals (*me_ex*) in total exports of goods, *natres*, with *natres* = *me_ex* + *fuel_ex*. We use these variables for several reasons. These variables indicate the type of IDE oriented countries according to their staffing and the importance of these grants net oil exporters will save such a high concentration of FDI in the oil sector. Also, these variables are used in several studies and data are available for most African countries over long period. Our hypothesis that there is a negative relationship between natural resources and economic growth for the country is justified. Indeed, the prices of natural resources especially oil are sensitive to the volatility of the exchange rate (Sachs and Warner, 1995). Also, a significant proportion of exports of fuels and minerals in exports implies that these economies are less diversified and therefore more exposed to external shocks (adverse effects of exogenous shocks) and therefore difficult to maintain sustained economic growth and sustainable in the country. All these factors can generate macroeconomic instability savings and acts negatively on growth.

We will use *natres* in the initial model and *oilrent or nat*res to test the robustness of the initial estimates. This choice is justified by the fact that *natres* variable provides more information on natural resource endowments of countries (Asiedu, 2013). It measures the dependence of the countries natural resources and the composition of the foreign trade of the countries most endowed with natural resources. Data are available for 45 countries. The data come from the World Development Indicators of the World Bank (WDI, 2013). They cover the period from 1980 to 2010.

[6] *Oil rents are the value of oil exports net of production costs. Poelhekke and Ploeg (2010) employed oilrent as a measure of natural resources dependence.*

2.1.1. Economic growth

The growth rate of GDP per capita, constant 2005US$ and GDP per capita, constant 2005US$ are used as a proxy for economic growth. As Durlauf et al. (2005), the growth equation including the traditional determinant (see Solow, 1956; Mankiw et al 1992) and endogenous variables of growth (see Romer, 1986; Barro, 1991). The data are from WDI (2013). They cover the period from 1980 to 2010.

2.1.4. Control variables

Inspired by the writings on the theory of growth, other variables were used as control variables in this study. These are the determinants of growth commonly used in the empirical literature (Mankiw, Romer and Weil (1992), Barro and Sala-i-Martin (1995), Barro (1991)).

The initial value of the product as a proxy the initial value of per capita GDP of country *i* at the beginning of each (initial per capita GDP) period. Under the assumption of conditional convergence, according to neoclassical theory, the coefficient associated with it must be negative and significant (Solow, 1956; Barro and Salai-Martin, 1995). All things being equal, countries with levels of GDP per head lower have a high probability to grow to a greater rate than rich countries.

The accumulation of physical capital is an important determinant of growth (Romer, 1986 and Solow 1956). The investment is a powerful effect on growth through its impact on production. As a proxy, we use gross fixed capital formation in GDP (*fbcf_pib*).

The impact of population growth rate is apprehended through the natural logarithm of the population size (*lnPOP*). Growth of the total population tends to slow down or accelerate the growth of the product. This variable is assumed to have a negative effect on economic growth in Africa.

The stock of human capital is proxied by enrollment at the secondary level (*school*). According to the augmented Solow model (Mankiw et al., 1992), human capital positively influences growth. It is allows workers to be more efficient and productive (Lucas, 1988). As assumed by the neoclassical and endogenous theories, we assume that human capital has a positive effect on economic growth in African countries.

Infrastructure: the existence of adequate infrastructure (roads, ICT) is favorable for economic growth (Démurger 2001; Egert et al, 2009.). Quality infrastructure stimulates growth by promoting the rapid movement of goods and services, labor and information. We use to capture the level of infrastructure development *fbcf_pib* addition, the number of telephones per 100 (*phone*) inhabitants.

The opening rate is an important determinant of economic growth. It provides information on the competitiveness of economies. This indicator is measured by the ratio to GDP of the sum of exports and imports (*Trade/GDP*). Trade openness can be favorable or unfavorable to growth. The expected sign of this variable is uncertain.

All data variables are derived from the World Development Indicators of the World Bank (WDI, 2013). They cover the period from 1980 to 2010. Quantitative variables are expressed in logarithms in order to interpret the results in terms of elasticity.

2.2. METHODS

The basic model of growth as a reference to the study and the estimation procedure are presented in this section.

2.2.1. Reference Model

To understand the impact of manufacturing growth in a group of countries, the most commonly used approaches are models in panel data (Szirmai and Verspagen, 2011). In this article, a panel model is implemented. However, individual country effects (fixed effects or random effects) should reflect the specificities of each country group formed because of the disparities between their respective economies.

We start from a Cobb Douglas production function argument, having physical capital (K), human capital (H), work (W) and technological progress (A).

$$Y_t = A_t \left(K_t\right)^{\alpha} \left(H_t\right)^{\beta} \left(L_t\right)^{1-\alpha-\beta} \quad \textbf{(1)}$$

with Y is Gross Domestic Product (GDP), K the stock of fixed capital H, the stock of human capital, L labor input, A, the level of technology. We assume that $\alpha+\beta=1$ that is to say, the factors of production are paid their marginal productivity.

Reasoning per capita capital, equation (**1**) can be rewritten as follows:

$$y_t = A_t(k_t)^{\alpha}(h_t)^{\beta} \quad \textbf{(2)}$$

with $y=\frac{Y}{L}$, $k=\frac{K}{L}$, $h=\frac{H}{L}$

After linearization, equation (**2**) is as follows:

$$\log(y_t) = \log(A_t) + \alpha\log(k_t) + \beta\log(h_t) \quad \textbf{(3)}$$

Physical capital per capita (*k*) is represented by the share of investment in GDP (*fbcf_pib*) while the gross enrollment rate in secondary school (*school*) is used as a proxy for human capital (*h*). Technical progress can be enjoyed through human capital and its quality is apprehended by the population effect emerges through the indicator of economic growth (economic growth rate of GDP per capita (*txgdp*)) and quality education (*school*). The inclusion of these variables in the model (**3**) gives the model (**4**) written as:

$$Log(GDP\ \ per\ capita_t) = \alpha_0 + \alpha\log(\ fbcf\ \_\ pib_t) + \beta\log(school_t) \quad \textbf{(4)}$$

The variables included in the model (**4)** are not the only influence on economic growth, it is very important to introduce more variables characterizing the manufacturing, control variables presented above. The model equation increased growth arising from the introduction of these variables is as follows:

$$\begin{aligned}&\Delta Log(GDP\ \ per\ capita_{i,t}) = \alpha_0 + \beta_1 Log(GDP\ \ per\ capita_{i,t-1}) + \beta_2 L\,\text{og}(\ fbcf\ \_\ pib_{i,t}) + \\ &\beta_3 Log(school_{i,t}) + \beta_4(manu_{i,t}) + \beta_5 Log(natres_{i,t}) + \beta_6 Log(\ pop_{i,t}) + \beta_7 Log(\ phone_{i,t}) + \\ &\beta_8 Log(trade\_pib_{i,t}) + \varepsilon_{i,t}\end{aligned} \quad \textbf{(5)}$$

In this specification, $Log(GDP\ per\ capita_{i,t})$ is the growth rate of GDP per capita which depends on the logarithm of its former value $Log(GDP\ per\ capita_{i,t-1})$ which verifies the assumption of convergence theory of the growth model of Barro (1990).

Further growth depends on investment (*fbcf_pib*) and education (*school*) indicators of the manufacturing sector (*man*), the natural resource endowment of countries (*natres*) vectors of economic and financial variables (growth rate population (*Log(pop)*), open rates (*trade_pib*), infrastructure (*phone*) and finally the error term $\varepsilon_{i,t} = \eta_i + \lambda_t + \nu_{i,t} \sim IID(0, \sigma_\nu^2)$ with unobservable components such as country specific component (η_i),a time-specific components (λ_t) and the residual term ($\nu_{i,t}$).

As a dynamic panel model, equation (**5**) can be rewritten as follows:

$$Log(GDP\ per\ capita_{i,t}) = \alpha_0 + (1+\beta_1)Log(GDP\ per\ capita_{i,t-1}) + \beta_2 Log(fbcf\_pib_{i,t}) + \beta_3 Log(school_{i,t}) + \beta_4(manu_{i,t}) + \beta_5 Log(natres_{i,t}) + \beta_6 Log(pop_{i,t}) + \beta_7 Log(phone_{i,t}) + \beta_8 Log(trade\_pib_{i,t}) + \varepsilon_{i,t}$$

$$i=1,\ldots,N\ ;\ t=1,\ldots,T \qquad \textbf{(6)}$$

The hypothesis of convergence between the economies studied suggests that the coefficient (β_1) of $Log(GDP\ per\ capita_{i,t-1})$ is negative and significant in the model increased growth, ie $0 < 1+\beta_1 < 1$. As Bailliu et al (2001) Aloui and Sassi (2005), Asiedu and Lien (2011), to reduce the variability and irregularities in the data especially the lack of data, we chose clusters of five years. Such a choice can eliminate the effects of economic cycles but is short enough to reflect important changes in a given country. The data cover the period 1980-2010[7] and thus T = 6.

2.2.2. Estimation strategy

The increased growth model (**6**) is a linear dynamic panel model. The estimation of this model by OLS leads to biased estimators and do not converge when the number of periods is low or

[7] The last period is a grouping of six years.

when the lagged dependent variable $Log(GDP\ per\ capita_{i,t-1})$ is correlated with the individual effects (η_i):

Individual and intra estimator[8] in first differences are negatively biased and not convergent (Matyas and Sevestre, 2008). Also, in case of reverse causality or omission of relevant variables, the OLS estimator is biased and inconsistent (Mickell, 1981). GMM estimator (GMM) proposed by Arellano and Bond (1991) allows consistent estimators of the model than the one proposed by Anderson and Hsiao. The estimator proposed by these authors refers to the GMM in first differences to remove individual specific effects and use lagged values of the dependent variable as instruments. Equation (**6**) can be rewritten as follows:

$$lpibtppa_{i,t} - lpibtppa_{i,t-1} = (1+\beta_1)(lpibtppa_{i,t-1} - lpibtppa_{i,t-2}) + \sum_j \beta_j (x_{i,t}^j - x_{i,t-1}^j) + (\lambda_t - \lambda_{t-1}) + (\nu_{i,t} - \nu_{i,t-1})$$

$$i=1,\ldots,N\ ;\ t=1,\ldots,\ T$$

(7)

Indeed, by construction, ($lpibtppa_{i,t} - lpibtppa_{i,t-1}$)is correlated with the error term $(\nu_{i,t} - \nu_{i,t-1})$ so Arellano and Bond propose to use lagged values of the dependent variable as instruments for the term $(lpibtppa_{i,t-1} - lpibtppa_{i,t-2})$, and lagged values of the explanatory variables x_i^j as instruments of term $(x_{i,t}^j - x_{i,t-1}^j)$. However, the frequently lack of robustness of the obtained estimates led to wonder about the reasons for this fragility. As Arellano and Bover (1995) shows, the lagged dependent variables are weak instruments in the model and the first difference estimator is biased in small sample. Blundell and Bond (1998) show that this weakness is the lack of correlation between $lpibtppa_{i,t-2}$ with variables written in first differences model (weak instruments).

Blundell and Bond (1998) then propose a more efficient estimator, the system GMM estimator (GMM estimator "stacked"). This estimator is obtained by: (*i*) combining the first difference in equation (7) with instruments presented above, and (*ii*) the level equation linking $lpibtppa_{i,t-1}$ and x_i^j and their first differences as instruments (Arellano and Bover proposal (1995)

[8] The estimator intra individual unlike the first difference of the coefficient associated with the lagged dependent variable $Log(PIB\ per\ capita_{i,t-1})$ *is convergent when N and T tend to infinity.*

complements of instruments in first differences). The use of this double set of instruments significantly improves the quality of the estimates (Hayakawa, 2007).

We use this method to estimate the model (**6**). The GMM two-step approach is asymptotically efficient and robust to the inclusion of heteroscedasticity. However, in the case of small sample sizes or finishes, the GMM is biased in two steps. To eliminate this bias, Windmeijer (2005) proposed a correction of the variance-covariance matrix when the estimator is used in finite sample.

In addition, the system GMM estimator is based on two assumptions. **1**. The instruments are valid, that is to say non-correlated to the error term ($\nu_{i,t}$). This hypothesis is tested using the Sargan/Hansen test on identification. **2**. The absence of autocorrelation of order 2 (AR (2)) in the residues and negative autocorrelation of order 1 (AR (1)). This is the Arellano-Bond test that is used to test this hypothesis. Thus, for each estimation, we test this hypothesis and verify the relevance of the instruments. We report the p-values associated with autocorrelation tests and the Hansen J test for the validity of instruments. The different results obtained confirm the absence of autocorrelation and validated instruments. However, this test loses its power and leads to biased results when the number of instruments *i* is relatively more important than the number of individuals (in this country) N. The ratio of the number of instruments the number of individuals (*i*) (**r=** N/i) must be greater than unity (Roodman, 2007; Stata, 2009). For this, we take as instruments lagged variables of order 1.

Our estimation procedure is then to estimate the model by GMM in two-step[9] method, with Windmeijer correction, which is as mentioned above asymptotically efficient and robust in the presence of heteroscedasticity. We treat variables as strictly exogenous independent variables except models robustness or some variables that are considered endogenous. We use lagged independent variables and the dependent variable as instruments variables. Difference estimators and system use the first difference of all exogenous variables as standard instruments and delayed values of the endogenous variable to generate the instruments proposed by Arellano and Bond (1991). In addition, unlike the approach difference estimates in system content; including lagged values of the difference of the endogenous variable as instruments.

[9] *The two-step method allows the inclusion of heteroscedastic between individuals, the autocorrelation of the error terms and the simultaneity bias and measurement errors.*

3. RESULTS and DISCUSSION

This section presents some descriptive statistics of the variables of interest and the results of initial estimates and their implications for economic policy.

3.1. Descriptive statistics

Erreur ! Source du renvoi introuvable. shows the relationship between the growth of GDP per capita and the share of manufactured exports in exports (*manex*). The data considered are the medians of two variables over the period from 1980 to 2010.

1. Is there a positive correlation between growth and the export of manufactured goods? Does this relationship depend on the resource endowment of the country?

The growth rate of per capita GDP is positively and significantly correlated with the share of manufactured goods in exports. OLS regression of the second variable on the first gives $\hat{y} = 0.87 + 0.22 \times man\_ex$ with *p-value=0.021* (robust). As the empirical literature shows, the increase in the share of manufactured goods in exports while promoting economic growth in Africa.

INSERT FIGURE 1 HERE

This relationship depends on the resource endowment (*natres*)[10] African countries. For countries with (13 countries)[11], the above relation is not significant. The valid relation is as follows $\hat{y} = 0.08 + 0.67 \times man\_ex$ with *p-value= 0.885* (robust) and $R^2 = 0.0009$. In the complementary group, that is to say where (37 countries), this relationship is positive and significant but the 10% threshold; $\hat{y} = 1.05 + 0.02 \times man\_ex$ with *p-value= 0.089* (robust). The results of the estimation countries show a positive and significant relationship between manufacturing exports and GDP growth per capita for South Africa (ZAF). The estimated relationship is as follows: $\hat{y}_{ZAF} = \underset{(2.46)^{**}}{-7.01} + \underset{(2.90)^{**}}{0.16} \times man\_ex_{ZAF}$; (*median value: ZAF=51.9%*). A 1% increase in the share of exports of manufactures in exports of South Africa increases the growth with 0.16%.

[10] Natres=*Fuel exports (% of merchandise exports) + Ores and metals exports (% of merchandise exports).*
[11] *Algeria, Angola, Cameroon, Congo, Rep., Gabon, Guinea, Liberia, Lybia, Mauritania, Mozambique, Niger, Nigeria, Zambia.*

However, for other countries with more than 50% median values, this relationship is not significant.

INSERT TABLE 1 HERE

With low variability, the export share of manufactures in total exports in Africa (SSA and North Africa) is low compared to other regions. For example, over the period 1996-2010, as regards exports, manufactured goods account for about 27% in SSA and 18% in the MENA total merchandise exports compared to about 84% in East Asia and the Pacific and 50% on the same period in Latin America and the Caribbean.

In addition, African products represent only 1% of value added and global manufacturing exports (Report UNCTAD, UNIDO, 2011). The decrease in the export of manufactured goods from African countries especially those in the North are mainly due to weaker demand in Europe and political instability in some countries of the region (Egypt, Libya, and Tunisia).

The Table 2 shows the relationship between GDP per capita and growth of manufactured value added (*the first law of Kaldor*) and the growth of value added in other sectors (industry, services and agriculture). Data are means and medians of the variables over the period 1980-2010 and for forty countries for which data are available.

Estimates show an association between manufacturing growth and growth of GDP per capita. Diagnostic tests on the model are inconclusive. The estimated beta coefficient varies between 0.1 and 0.3, well below unity, which means that the marginal propensity of growth compared to manufacturing growth is about 0.2. This confirms that the manufacturing sector is an engine of growth in Africa. Other sectors give conclusive results except agriculture where the relationship is not significant. Marginal propensities estimated for the service and industry sectors are more important than the manufacturing sector and are above 0.3.

INSERT TABLE 2 HERE

2. The share of manufacturing value added in GDP is it big enough to positively influence growth in Africa?

The median values of the growth of GDP per capita and the share of value added in GDP over the period 1980-2010 are shown in the **Erreur ! Source du renvoi introuvable.** below. The

relationship between growth and manufacturing value added (*mav_gdp*) reveals a lack of correlation; $\hat{y} = 1.12 + 0.015 \times mav\_gdp$ with *p-value= 0.680* (robust).

INSERT FIGURE 2 HERE

Taking into account the natural resource endowment of countries provides no meaningful response. Coefficients associated with *mav_gdp* for both groups of countries are not significant.

3. The large share of natural resources in African exports she promotes economic growth?

There is a negative but not significant correlation between the growths of output per capita and African natural resource endowment. The OLS estimation gives the following results: $\hat{y} = 1.61 - 0.096 \times natres$ with *p-value= 0.125* (robust). The analysis following the two groups (*group 1: natres<50 vs. group 2: natres>= 50%*) countries does not allow to conclude that there is a significant correlation between the two variables.

INSERT FIGURE 3 HERE

4. The countries most endowed with natural resources have low values of the share of exports of manufactures in total exports.

The relationship between manufactured exports and natural resource endowments is negative and significant. The equation gives $\hat{y} = 28.67 - 0.26 \times natres$ with *p-value=0.001* (robust). High concentrations of natural resource exports are associated with low shares of manufactured goods in exports in the countries concerned.

INSERT FIGURE 4 HERE

3.2. Estimation results and statistical tests

The variables listed below are progressively integrated into the model of economic growth increased to test the robustness of coefficients. The first models (1-8) estimates include only the variables of interest (*manex, vam, fuel_ex, nat, ind, agr, ser*). Other models (9-21) integrate important determinants of growth. The different results obtained are shown in Tables 3, 4 and 5.

3.2.1. Direct effects of manufacturing and natural resource endowments on growth

The Hansen test shows that we cannot reject the null hypothesis which states that the error terms are uncorrelated with the instruments for models (1) – (8) (**Table 4**). In these models, the validity is confirmed instruments. The eight models successfully pass tests Arellano-Bond and therefore the validity of the null hypothesis of no autocorrelation of order 1 and 2. Furthermore, different models are estimated globally significant in terms of the Fisher statistic (*p-value<5 %*). More explanatory variables are statistically significant.

First, Model 1 shows that the share of manufactured exports in a positive and significant effect on growth but low GDP per capita product. The estimated elasticity is 0.01. This means that a difference of 1 point in the manufacturing value added per capita product increased by 0.01. In contrast, the concentration of natural resources in exports has a negative and significant impact on growth. The coefficient is positive; confirming the idea that manufactured goods export is beneficial to growth for the manufacturing sector more than other sectors comparative advantage. These results confirm those obtained by Szirmai (2011).

With regard to the added value of agriculture in GDP, it has a negative and significant effect on per capita product. Indeed, the elasticity associated with this variable is -0.18. This result highlights the need to invest in the growth sector that represents the manufacturing source of innovation and create jobs.

Rents from natural resources (energy and mining), the export of natural resources are unfavorable for the growth of African countries. This situation shows the adverse effect of the export of raw materials source of low added value. The main reason is that the mineral and petroleum resources from extractive industries are still not handled in transparent contracts.

The share of value added in other sectors (industry, services) in GDP of African countries has a positive and significant impact on growth. This result shows the importance of service activities in African economies.

The following section presents the results of different models (9-21) with further variables of interest, important determinants of economic growth presented above.

INSERT TABLE 3 HERE

3.2.1. Taking into account important determinants of growth

Different models of growth increased estimated successfully pass tests Hansen and Arellano-Bond. Models (9-21) shown in **Tables 3** and **4** are globally significant in terms of the Fisher statistic (p-value<5%). In addition, several significant determinants of economic growth are statistically significant.

Factors supporting growth in Africa

A high concentration of exports in manufactured exports has a positive and significant impact on economic growth (estimated 9, 13 and 21). The elasticity associated with this variable varies between 0.031 and 0.055. This sector is dominated by activities that have a high productivity and are sources of positive externalities for other sectors. As shown (Rodrik, 2009; Szirmai Verpagen, 2011), manufacturing activities increase the potential growth of the economy and therefore the growth itself.

As mentioned in several publications of UNCTAD, a structural transformation that aims to promote the development of the manufacturing sector and to further diversify the economy may result in larger gains for Africa in terms of development, including gains from the strengthening of intra-African trade (2009 UNCTAD, 2012a, UNCTAD and UNIDO, 2011). The manufacturing sector has a significant multiplier on employment, which has the potential to create jobs for young Africans and affect the whole economy, and strengthen the links between the major activities mining and manufacturing in Africa.

INSERT TABLE 4 HERE

Infrastructure development (*fbcf_pib, ICT*) is a powerful engine of economic growth in Africa. The investment is the engine of economic growth in the countries considered. The estimated elasticities for the share of investment in GDP for all estimated models are significant at 1% and vary between 0.12 and 0.22 points.

The coefficient representing capital expenditure is also positive and statistically significant for all equations, according to the predictions of economic theory which states that capital accumulation is supposed to foster the growth of real GDP per capita. The accumulation of physical capital is then a fundamental determinant of output growth per head over the period 1980-2010. For example, for model 3, a 1% increase in the investment ratio is associated with increased growth of 0.21%.

Similarly, the development and use of ICT is favorable for economic growth in Africa. Elasticities associated with the phone variable are positive and significant and between 0.1 and 0.2.

Moreover, trade openness is a growth factor for African economies to export manufactured goods. The degree of openness (Trade / GDP) of countries considered to have a positive impact on the growth of per capita product. The elasticity of this variable is estimated at +0.4.

However, it becomes unfavorable for growth when looking at agricultural products that are less competitive and thus having an adverse effect on growth.

Also, increasing the number of learners in higher levels of education has a positive effect on growth in Africa (5% or 1%). The elasticity associated with this variable varies between 0.04 and 0.3. This result is consistent and consistent with that found by Barro (1990) suggests that increased investment in education is a factor boosting growth and thus contributes to the reduction of disparities between countries.

INSERT TABLE 5 HERE

Unfavorable to growth factors in Africa

The increase in the population of African countries is unfavorable for growth. The population growth reduces the amount of capital per head and therefore the per capita product. The population growth has a negative and significant effect on the growth of output per head in accordance with the theory of Solow (1956).

The high concentration of natural resource exports is unfavorable for growth. The coefficient on this variable is negative and significant in models (**6**), (**10**), (**11**), (**12**). A high concentration of

natural resource exports reduces the manufactured products. But natural resources have low competitiveness because they depend on the volatility of international financial markets.

The added value of the agricultural sector has a negative and significant effect on output per capita. Indeed, the elasticity associated with this variable is -0.4 to -0.23 depending on the model considered. As Muehlberger 2007 shows exports of most African countries especially those in SSA are dominated by primary products. The nature of the goods produced and exported by African firms affects growth.

3.3. Policy implications of the results

The previous section was used to study the impact of the manufacturing sector on economic growth in African countries according to their natural resource endowments. This study concludes that the indicators of the manufacturing sector have an impact which is differentiated by the endowments in natural resources. Thus, this study proposes as a measure boosting the African manufacturing sector. These countries should place particular emphasis on industrial development for sustained economic growth and sustainable their economies. Policy recommendations arising from the results are as follows:

1. Put questions to promote the manufacturing sector at the heart of government strategies and therefore make it a priority: Diversifying the industrial fabric of African countries beyond the food and textile industries that dominate the industrial sector to work the creation of new export-oriented and exploitation of local raw materials industrial units, rehabilitate and create new industrial zones. By its vocation processing, manufacturing can radically change the structures of economies and accelerate growth;

2. Increase exports of manufactured products by conquering the African sub-regional markets, increasing trade sub-regional and regional;

3. Work to strengthen the technological capabilities of local enterprises to make them more able to produce goods of medium and high technology;

4. Establish bodies' quality standards and testing, support for research and development and delivery of services to improve productivity in the manufacturing sector;

5. The implementation of a policy in order to increase the technological absorption capacity in agriculture and in the manufacturing sector which requires the promotion of human capital by enhancing enrollment and reducing unemployment of graduates;

6. Developing productive capacities especially in the manufacturing and agro-industrial sectors by encouraging entrepreneurship; mitigating side constraints that limit the supply capacity and export the private sector to limit the stress on credit markets, labor and capital;

7. Invest in research and development: research and development, the creation of specialized scientific centers, universities, research centers and development while providing those existing hardware and researchers;

8. Support research centers, universities or large companies that seek to invent new technologies or new products or processes that push the frontiers of knowledge and promote commercialization in the context of relationships with the private sector; the interface between the government and enterprises should be improved with more specific and clearer priorities discerned among the many economic visions and plans for the country;

9. Values to sectors based on natural resources where African countries have a comparative advantage. Indeed, most African countries currently have a comparative advantage in the area of commodities and industrialization based on natural resources is one means of developing regional value chains on the continent that African countries need to profit;

10. Establish the conditions for economic transformation: infrastructure, education and larger and more open markets;

11. The improvement of the supply chain and transport, the use of fertilizers and resistant seeds in order to increase agricultural productivity because Africa has 24% of global agricultural land, but it represents only 9% of world production;

12. Agricultural rents, mining and oil must be managed optimally and redirected towards infrastructure financing, development of R & D and technology acquisition.

Also, it is important that states invest in infrastructure advantage. Indeed, the policies must establish basic infrastructure and services necessary to develop the private sector and the promotion of the manufacturing sector.

4. Conclusion

The objective of this paper is to establish the relationship between the manufacturing sector and economic growth of African countries according to their natural resource endowments to propose actions for policy makers. The article examines whether natural resources in African countries favorably or unfavorably alter this relationship. After a brief review of the literature, it was discussed to analyze the effect indicators of manufacturing and resource endowments (exports, annuities) on economic growth using a growth model augmented with a combination of time averages variables of interest and important determinants of growth.

The data are from WDI, 2013. The methodology used in this study is inspired from (Szirmai, 2011). But, comparatively of him, we use dynamic panel date approaches proposed by Arellano and Bond (1991) and Blundell and Bond (1998). We present also the descriptive statistics of pertinent variables.

The results for the forty selected African countries (for reasons of data availability) for a period from 1980 to 2010 highlighted the positive and significant effect on the ratio of export of manufactures in exports on GDP growth per head if and only if the value of the share of minerals and fuels in total exports is less than a certain critical value (50% of exports).

We identify 37 countries where the share of manufactures in exports increases the per capita product (group 1: natres <50%) and 13 countries where this relationship is not significant (*group 2: natres >= 50%*). The high share of exports in natural as well as rents has significant adverse effects on growth in Africa resources. The added value of the agricultural sector is still low, a negative and significant effect on growth. Moreover, education, infrastructure investment and trade openness for manufactured products have powerful and positive impact on the level of output per capita in Africa. The results show that African countries have an interest in developing their manufacturing and strengthen export in the sector, improve their agricultural value added, put in place policies to ensure their demographic transition and increase their investment in infrastructure to stimulate growth.

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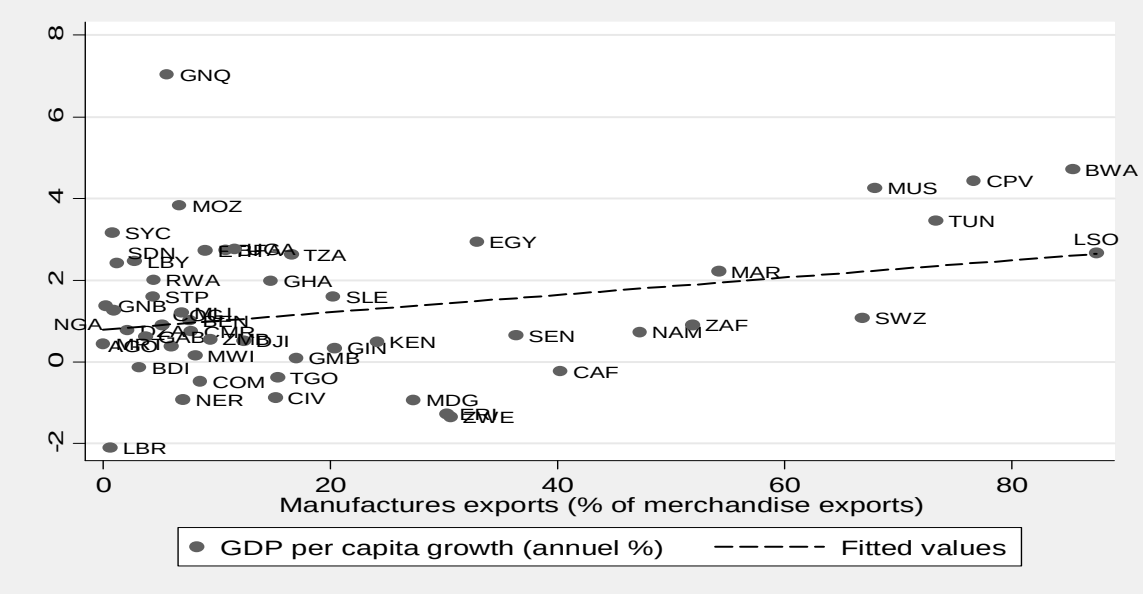
Annexes

Figure 1: GDP per capita growth (annual %) vs. Manufactures exports (% of merchandise exports)



Source: WDI, 2013; calculations by the author

Table 1: Manufactures exports (% of merchandise exports), 1996-2010

Region	1996-2000		2001-2005		2006-2010		1996-2010	
	$\overline{x}$	$\sigma/\overline{x}$	$\overline{x}$	$\sigma/\overline{x}$	$\overline{x}$	$\sigma/\overline{x}$	$\overline{x}$	$\sigma/\overline{x}$
East Asia & Pacific*	**84.91**	0.78	**85.22**	0.00	**81.81**	0.02	**83.98**	0.02
Europe & Central Asia*	76.25	0.02	74.99	0.01	72.11	0.01	74.45	0.03
Latin America & Caribbean*	51.97	0.03	51.45	0.02	46.91	0.05	50.11	0.06
High income	76.51	0.02	74.70	0.01	70.39	0.02	73.87	0.04
High income: OECD	79.77	0.01	78.39	0.01	74.46	0.02	77.54	0.03
Low & middle income	65.88	0.02	67.66	0.01	65.22	0.02	66.25	0.02
Low income	49.29	0.00	51.00	0.01	54.25	0.00	51.26	0.03
Lower middle income	51.91	0.04	55.20	0.04	48.71	0.02	51.94	0.06
Middle income	66.11	0.02	67.85	0.01	65.42	0.02	66.46	0.02
Middle East & North Africa*	**18.77**	0.19	**17.57**	0.10	**17.81**	0.16	**17.94**	0.15
Sub-Saharan Africa*	**25.69**	0.04	**29.71**	0.08	**27.02**	0.02	**27.13**	0.07

**all income levels;* $\overline{x}$ *: Average;* $\sigma/\overline{x}$ *: coefficient of variation*

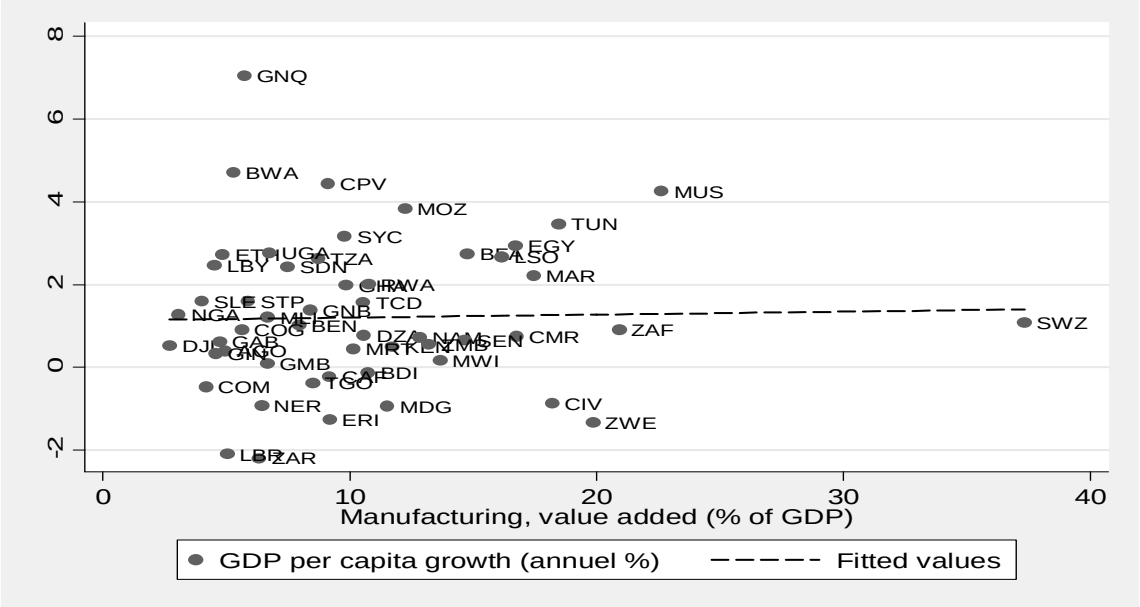
Source: WDI, 2013; calculations by the author

Table 2: Economic growth and growth in value added sector: an econometric approach

Dep. var: ***GDP per capita growth***	**(1)**		**(2)**		**(3)**	
	Med	**Moy**	**Med**	**Moy**	**Med**	**Moy**
Manufacturing, value added (annual % growth)	**0.24**	**0.09**				
	(5.17)***	(8.13)***				
Industry, value added (annual % growth)			**0.34**	**0.37**		
			(5.24)***	(9.31)***		
Services, etc., value added (annual % growth)					**0.27**	**0.36**
					(2.29)**	(7.80)***
Constant	0.17	0.51	-0.23	-0.74	-0.04	-0.62
	(0.57)	(2.28)**	(0.64)	(2.64)**	(0.09)	(2.06)**
R^2 Ajusté	0.36	**0.59**	0.36	**0.65**	0.27	**0.57**
Fstat	26.69***	66.16***	27.44***	86.68***	5.26***	60.81***
BG Test (p-value)	1.00***	1.00***	1.00***	1.00***	1.00***	1.00***
JB Test (p-value)	0.80***	0.73***	0.23***	0.05*	0.00	0.01*
Pagan Test (p-value)	0.81***	0.57***	0.35***	0.02	0.00	0.00
Nb of obs (countries).	46	46	48	48	47	47

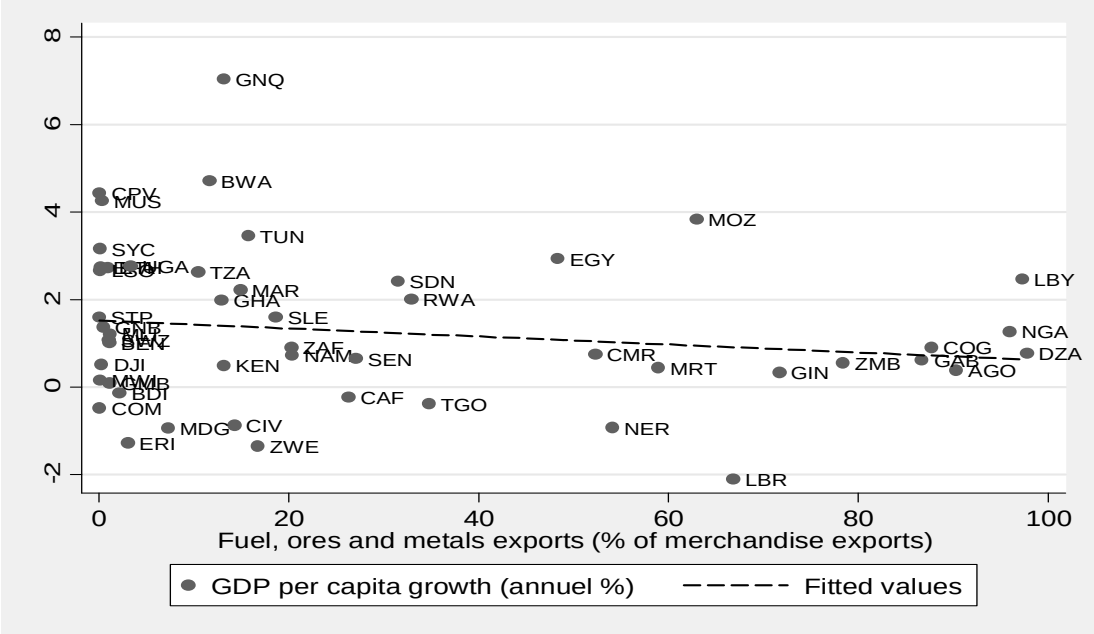
Source: *WDI, 2013, author's calculation*
(.) *Absolute value of t-student*
Fstat*: Test Fischer overall significance of the model*
BG Test*: Test Breusch Godfrey autocorrelation AR (p) Ho: No autocorrelation*
JB Test*: Test of normality Jarque and Bera, Ho: Normality of residues*
Pagan Test*: heteroscedasticity test Breusch Pagan, Ho: Homoscedasticity*
***, **, ****Significant respectively at 10%, 5% and 1%.*
Med: median; Moy: Average

Figure 2: GDP per capita growth (annual %) vs. Manufacturing, value added (% of GDP)



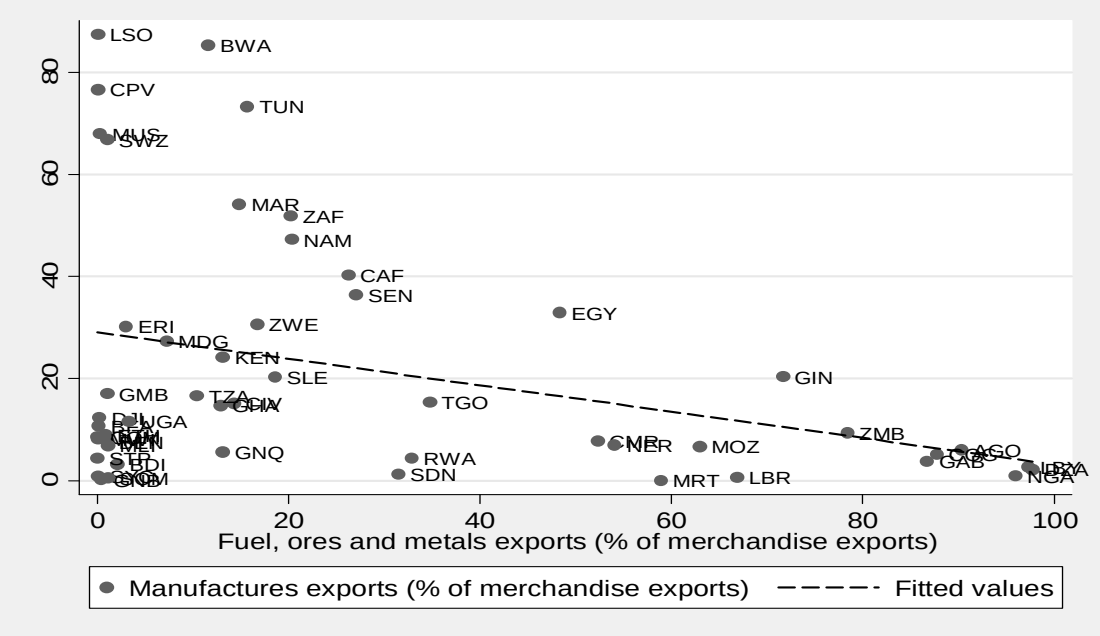
Source: WDI, 2013; calculations by the author

Figure 3: GDP per capita growth (annual %) vs naturals resources (% of merchandise exports)



***Source: WDI, 2013**; calculations by the author*

Figure 4: Manufactures exports vs. natural's resources (% of merchandise exports)



***Source: WDI, 2013**; calculations by the author*

Table 3: Results of the estimation by GMM method system (GMMS): Direct Effects

Dépendant variable: **ln(GDB per capita constant US$ 2005)**; GMM system								
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
lagged GDP per capita $(1+\hat{\beta}_1)$	1.0934 (117.96)***	1.0701 (123.44)***	0.9460 (46.48)***	1.0423 (101.72)***	1.0664 (147.54)***	1.0648 (129.82)***	1.0482 (77.31) ***	1.0403 (126.67) ***
lvam=ln(VAM/GDP)	**-0.0802** (4.78)***							
lmanex=ln(MAN/Exports)		**0.0100** (8.80)***						
lagr=ln(AGR/GDP)			**-0.1814** (10.88)***					
lind=ln(IND/GDP)				**0.1260** (4.68)***				
fuel_ex=Fuel/Exports (%)					**-0.0010** (5.35)***			
nat=Nat. res. rents/ GDP (%)						**-0.0004** (4.01)***		
natres=fuel_ex+ores_ex							**-0.0015** (3.11) ***	
lser=ln(VAS/GDP)								**0.1837** (10.41) ***
Constant	-0.3867 (6.29)***	-0.4354 (7.76)***	0.9561 (5.44)***	-0.6381 (8.12)***	-0.3754 (7.51)***	-0.3740 (7.54)***	-0.2298 (2.34)***	-0.9169 (13.16) ***
Hansen J-Test (p-value)	0.124***	0.147***	0.138***	0.163***	0.159***	0.152***	0.215***	40.72***
Serial Correlation Test (p-value)-AR(1)	0.652***	0.554***	0.958***	0.971***	0.580***	0.979***	0.753***	0.943***
Serial Correlation Test (p-value)-AR(2)	0.226***	0.608***	0.092***	0.083***	0.702***	0.272***	0.835***	0.249***
Number of Observations	220	210	220	220	210	220	210	220
Number of Country, *n*	44	42	44	44	42	44	42	44
Number of Instruments, *i*	34	34	34	34	34	34	34	34
Instrument Ratio, *(n/i)*	1.3	1.2	1.3	1.3	1.2	1.3	1.2	1.3
Fisher-Test (p-value)	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

***Source**: calculations by the author based on data from WDI 2013 under Stata12*
Test-Hansen J or Sargan: Ho: No correlation of instruments with residues (validity test instruments)
Test Arellano & Bond: Ho: Lack of AR effect for residues.

Table 1: Results of the estimation by GMM method system (GMMS): Equations of growth increased

Modèles	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**
Variables	***Include lmanex and nat***	***Exclude lmanex, include lvam***	***Exclude lmanex, and lvam***	***Exclude lmanex, include lser***	***Include lmanex, nat and lagr***
lagged GDP per capita $(1+\hat{\beta}_1)$	0.8602	0.5970	0.6854	0.6156	0.9045
	(16.32)***	(7.23)***	(8.34)***	(9.63)***	(15.76)***
school=ln(TBSS)	0.0433	0.1037	0.0594	0.1060	0.0608
	(2.71)***	(3.12)***	(2.06)**	(2.93)***	(2.12)**
ln(1+phones)	0.0892	0.2191	0.1848	0.2221	0.0035
	(2.78)***	(3.97)***	(3.19)***	(4.27)***	(0.10)
lmanex	0.0309				0.0284
	(2.22)**				(4.60)***
Trade/GDP	0.0227	0.0654	0.0515	-0.0237	-0.1128
	(0.38)	(1.60)	(0.97)	(0.30)	(2.41)**
Fixed investment/GDP	0.1480	0.1661	0.2135	0.1251	0.1646
	(4.54)***	(3.72)***	(5.31)***	(2.73)***	(4.80)***
txpop=ln(pop)	-0.0250	-0.1874	-0.1442	-0.1285	0.0130
	(0.89)	(3.00)***	(2.72)***	(3.04)***	(0.37)
Natural Resources, nat	0.0050	0.0087	0.0061	0.0030	0.0074
	(3.21)***	(4.89)***	(3.75)***	(1.71)*	(4.57)***
lvam=ln(VAM/GDP)		0.1029			
		(1.21)			
lind=ln(IND/GDP)				0.1532	
				(2.09)**	
lagr=ln(AGRI/GDP)					-0.1377
					(4.06)***
Constant	0.4798	4.0494	3.1465	3.2633	0.5373
	(0.65)	(2.69)**	(2.41)**	(3.27)***	(0.60)
Hansen J-Test (p-value)	0.367***	0.265***	0.188***	0.216***	0.340***
Serial Correlation Test(p-value)-AR(1)	0.656***	0.504***	0.692***	0.518***	0.204***
Serial Correlation Test(p-value)-AR(2)	0.120***	0.227***	0.215***	0.118***	0.196***
Number of Observations	200	210	210	210	200
Number of Country, *n*	40	42	42	42	40
Number of Instruments, *i*	32	32	28	28	33
Instrument Ratio, *(n/i)*	1.3	1.3	1.5	1.5	1.2
Fisher-Test (p-value)	(0.000) ***	(0.000) ***	(0.000) ***	(0.000) ***	(0.000) ***

***Source**: calculations by the author based on data from WDI 2013 under Stata12*

Test-Hansen J or Sargan: Ho: No correlation of instruments with residues (validity test instruments)

Test Arellano & Bond: Ho: Lack of AR effect for residues.

Table 6: Results of the estimation by the GMM system method (GMM): Equations of increased growth (continued)

Variables	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
	Exclude lmanex, Include lvam and natres	***Exclude lmanex, and lvam***	***Exclude lmanex, and lvam, Include lind***	***Include lmanex, and natres, lagr***	***Exclude lmanex, and natres, Include lvam and fuel_ex***	***Exclude lmanex, lvam and lvam, Include fuel_ex***	***Exclude lmanex, lvam and natres Include lind***	***Include lmanex, fuel_ex and lagr***
lagged GDP per capita	0.9562	0.7886	0.6573	0.8389	0.9472	0.7695	0.7207	0.7683
$(1 + \hat{\beta}_1)$	(11.04)***	(8.76)***	(7.97)***	(15.26)***	(10.33)***	(10.07)***	(9.13)***	(10.89)***
school=ln(TBSS)	0.0771	0.1041	0.1183	0.0488	0.0657	0.0880	0.0922	0.0576
	(3.00)***	(3.31)***	(3.81)***	(2.68)**	(3.69)***	(3.65)***	(3.55)***	(2.06)**
ln(1+phone)	0.0081	0.0786	0.1799	0.0072	0.0522	0.1287	0.1545	0.0182
	(0.15)	(1.22)	(2.77)***	(0.27)	(1.16)	(2.57)**	(3.01)***	(0.43)
Lmanex				0.0129				0.0553
				(1.48)				(3.59)***
Trade/GDP	0.0265	0.1255	0.0175	-0.0400	0.1168	0.1240	0.0210	-0.0505
	(0.63)	(2.60)**	(0.30)	(1.18)	(2.32)**	(2.91)***	(0.37)	(2.27)**
Fixed investment/GDP	0.1904	0.1621	0.1430	0.1867	0.1425	0.1190	0.1363	0.1369
	(5.64)***	(3.85)***	(3.94)***	(6.68)***	(3.91)***	(2.83)***	(3.54)***	(4.78)***
txpop=ln(pop)	0.0170	-0.0422	-0.0823	0.0126	0.0492	-0.0311	-0.0257	-0.0223
	(0.41)	(0.94)	(1.90)*	(0.45)	(1.39)	(0.85)	(0.63)	(0.58)
natres=fuel_ex+ores_ex	-0.0022	-0.0011	-0.0004	0.0009				
	(2.45)**	(1.23)	(0.33)	(1.59)				
lvam=ln(VAM/GDP)	-0.1779				-0.1262			
	(3.74)***				(2.53)**			
lind=ln(IND/GDP)			0.1257				0.1815	
			(1.62)				(1.93)*	
lagr=ln(AGR/GDP)				-0.2197				-0.2088
				(7.62)***				(7.10)***
Fuel_ex=Fuel/Exports (%)					-0.0052	-0.0042	-0.0035	0.0038
					(3.32)***	(3.20)***	(2.38)**	(2.50)**
Constant	-0.3957	0.7256	2.1592	0.9668	-1.2006	0.8293	0.8158	1.9676
	(0.37)	(0.59)	(1.80)*	(1.23)	(1.31)	(0.80)	(0.76)	(2.06)**
Hansen J-Test (p-value)	0.290***	0.269***	0.227***	0.239***	0.408***	0.426***	0.255***	0.175***
Serial Correlation Test(p-value)-AR(1)	0.460***	0.571***	0.779***	0.299***	0.596***	0.879***	0.938***	0.497***
Serial Correlation Test(p-value)-AR(2)	0.078**	0.077**	0.077**	0.073**	0.063**	0.108**	0.056**	0.055**
Number of Observations	200	200	200	200	200	200	200	200
Number of Country, N	40	40	40	40	40	40	40	40
Number of Instruments, i	32	28	28	36	32	28	28	36
Instrument Ratio, (N/i)	1.3	1.4	1.4	1.1	1.3	1.4	1.4	1.1
Fisher-Test (p-value)	(0.000) ***	(0.000) ***	(0.000) ***	(0.000) ***	(0.000) ***	(0.000) ***	(0.000) ***	(0.000) ***

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

***Source**: calculations by the author based on data from WDI 2013 under Stata12*

Test-Hansen J or Sargan: Ho: No correlation of instruments with residues (validity test instruments)

Test Arellano & Bond: Ho: Lack of AR effect for residues.

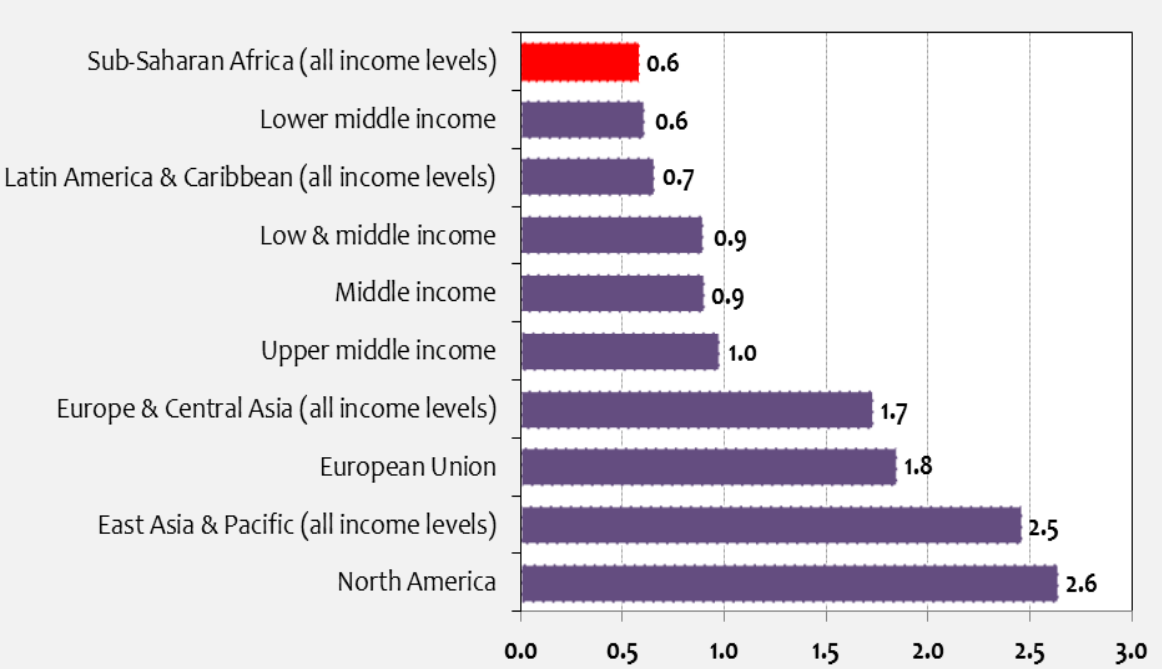
(.) Absolute magnitude of t-student

Table 2 : List of African countries used

Algeria	Congo, Dem. Rep.	Lesotho	Nigeria	Tunisia
Angola	Congo, Rep.	Madagascar	Rwanda	Uganda
Benin	Cote d'Ivoire	Malawi	Senegal	Zambia
Botswana	Egypt, Arab Rep.	Mali	Seychelles	Zimbabwe
Burkina Faso	Ethiopia	Mauritania	Sierra Leone	
Burundi	Gabon	Mauritius	South Africa	
Cameroon	Gambia, The	Morocco	Sudan	
Cape Verde	Ghana	Mozambique	Swaziland	
Central African Republic	Guinea	Namibia	Tanzania	
Chad	Kenya	Niger	Togo	

Source: WDI, 2013, *author's calculations*

Figure 5: Research and development expenditure (% of GDP) in 2007



Source: WDI, 2013*, author's calculations*

Compared to other regions of the world, African countries are not investing enough in education, training and research and development. In 2007, the share of spending on research and development in the GDP is 0.6%.

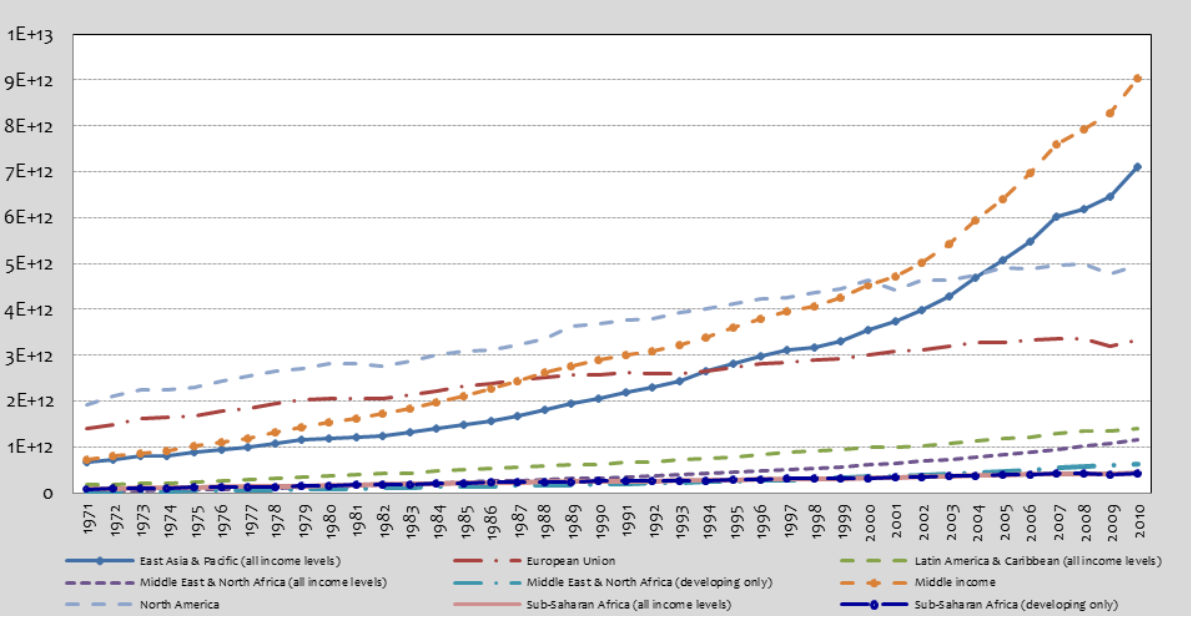
Table 3: Investment in research and development, 2009

	Percentage of GDP spent on R&D	Percentage of expenditure on R&D worldwide
Africa	0.4	0.9
Europe	1.8	28.5
Latin America & Caribbean	0.7	3.1
North of America	2.7	32.7
Asia	1.6	33
Oceania	2.2	1.8

Source: *UNESCO, December 2012.*

In 2009, the gross enrollment rate in higher education was only 6% in sub-Saharan Africa, while on average the rate is 27% worldwide (UNESCO, December 2012). Moreover, Africa spends less than 1% of its GDP on research and development, and these costs represent only 0.9% of global spending in this regard. Compared to 2007, expenses on research and development fell.

Figure 6 : Electricity production (kWh)



Source*: WDI, 2013, author's calculations*

Production of electrical energy to Africa is still low compared to other regions of the world. This situation is not favorable for a good development of manufacturing enterprises in Africa to the extent that electricity is an essential input in the production of larger companies especially are more likely to engage in international trade.

Table 4 : Manufacturing, value added (% of GDP), 1996-2010

Region	1996-2000		2001-2005		2006-2010		1996-2010	
	$\bar{x}$	$\sigma/\bar{x}$	$\bar{x}$	$\sigma/\bar{x}$	$\bar{x}$	$\sigma/\bar{x}$	$\bar{x}$	$\sigma/\bar{x}$
East Asia & Pacific*	**24.49**	0.01	**23.21**	0.01	**22.84**	0.03	**23.51**	0.04
Europe & Central Asia*	19.91	0.01	17.96	0.03	16.38	0.05	18.08	0.09
Latin America & Caribbean*	18.93	0.01	18.52	0.02	17.48	0.02	18.31	0.04
High income	18.67	0.02	16.84	0.02	15.61	0.04	16.79	0.08
High income: OECD	18.76	0.01	16.86	0.02	15.59	0.04	16.81	0.08
Low & middle income	22.61	0.01	21.99	0.01	21.75	0.02	22.12	0.02
Low income	11.52	0.01	11.95	0.02	12.56	0.01	12.01	0.04
Lower middle income	18.31	0.02	17.65	0.01	17.77	0.03	17.91	0.03
Middle income	22.91	0.01	22.25	0.01	21.98	0.02	22.38	0.02
Middle East & North Africa*	**11.00**	0.02	**11.19**	0.03	**10.51**	0.01	**11.00**	0.03
Sub-Saharan Africa*	**14.97**	0.02	**13.18**	0.06	**12.71**	0.06	**13.62**	0.09

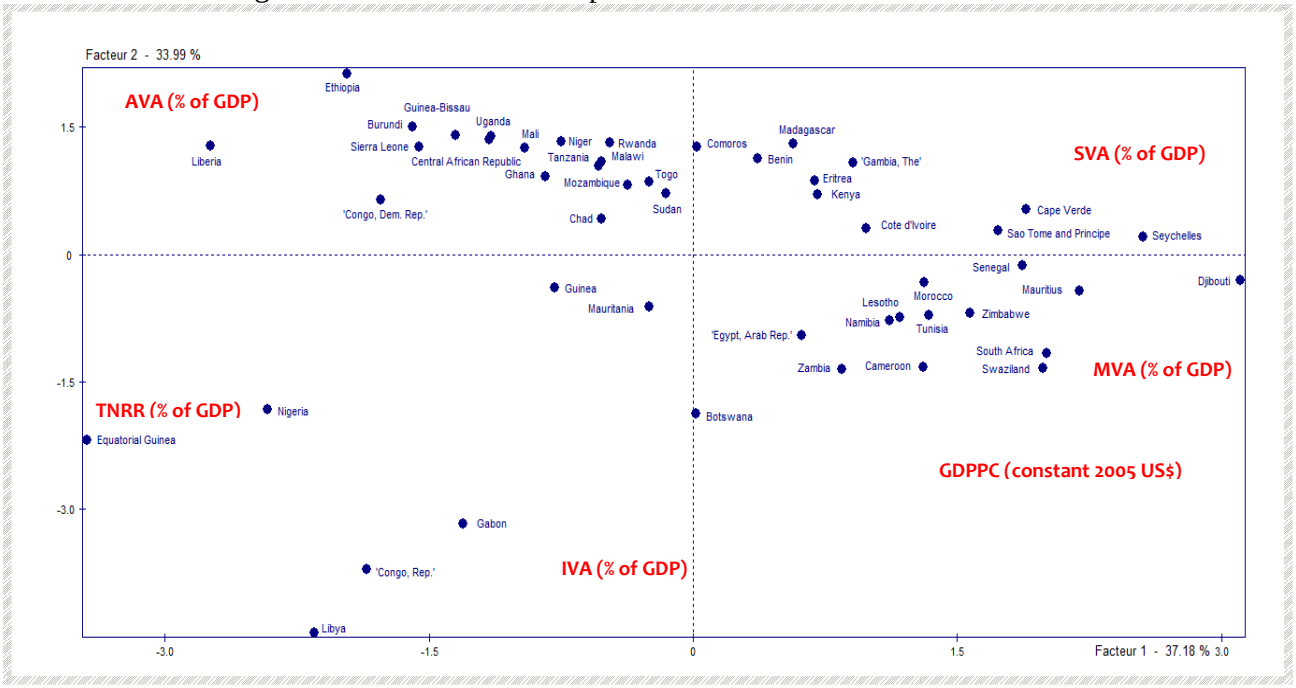
*all income levels

***Source**: **WDI, 2013**, author's calculations*

Manufacturing value added in GDP remains low in Africa. With low variability, this share was 14% in the period 1996-2010, whereas it is 24% in Asia and the Pacific. Moreover, according to data from UNIDO, the value added in manufacturing per capita in 2010 was less than $ 20 in 17 African countries out of 52, but more than $ 200 in 9 countries (with a record $ 1,200 for Seychelles). Between 1990 and 2010, 23 countries experienced a decline in the VAM and only 5 countries over 4% growths per year on average (Angola, Lesotho, Mozambique, Namibia, and Uganda).

The Principal component analysis performed on the median values of the variables of interest over the period 1980-2010 shows that African countries like Libya, the Democratic Republic of Congo, Equatorial Guinea, Nigeria, Gabon, in a lesser extent Mauritania and Guinea are characterized by the importance of their natural resources and high value-added industries in value of their GDP.

Table 5 : Positioning of African countries compared to the variables of interest, 1980-2010



Source: WDI, 2013, *author's calculations*

Most WAEMU countries are characterized by the importance of the value of their agriculture and service sector in GDP. In addition, South Africa, Swaziland, Seychelles, Djibouti, Mauritius is illustrated by the large share of value added in GDP.

Table 6 : Industry, value added (% of GDP), 1991-2010

Region	1991-1995		1996-2000		2001-2005		2006-2010	
	$\overline{x}$	$\sigma/\overline{x}$	$\overline{x}$	$\sigma/\overline{x}$	$\overline{x}$	$\sigma/\overline{x}$	$\overline{x}$	$\sigma/\overline{x}$
East Asia & Pacific*	**37.59**	0.01	**36.15**	0.02	**33.83**	0.01	**33.15**	0.02
Europe & Central Asia*	31.27	0.03	29.34	0.01	27.45	0.02	26.76	0.03
Latin America & Caribbean *	32.99	0.05	29.69	0.01	31.60	0.06	33.51	0.02
High income	30.35	0.02	28.52	0.02	26.31	0.01	25.30	0.04
High income: OECD	29.71	0.02	27.96	0.02	25.71	0.01	24.59	0.04
Low & middle income	35.94	0.02	35.46	0.01	36.26	0.03	37.33	0.02
Low income	19.10	0.01	20.13	0.02	22.13	0.05	23.83	0.02
Lower middle income	29.96	0.01	30.43	0.01	31.56	0.03	32.71	0.02
Middle income	36.38	0.02	35.87	0.01	36.62	0.03	37.67	0.02
Middle East & North Africa*	**41.96**	0.03	**42.82**	0.07	**47.33**	0.05	**51.75**	0.01
Sub-Saharan Africa*	**30.34**	0.01	**30.01**	0.02	**31.75**	0.03	**30.83**	0.05

*all income levels

Source: WDI, 2013, *author's calculations*

Table 7 : Services, etc., value added (% of GDP), 1991-2010

Region	1991-1995		1996-2000		2001-2005		2006-2010	
	$\bar{x}$	$\sigma/\bar{x}$	$\bar{x}$	$\sigma/\bar{x}$	$\bar{x}$	$\sigma/\bar{x}$	$\bar{x}$	$\sigma/\bar{x}$
East Asia & Pacific*	54.38	0.02	57.14	0.02	60.89	0.01	62.47	0.01
Europe & Central Asia*	**64.61**	0.02	**67.18**	0.01	**69.77**	0.01	**71.08**	0.01
Latin America & Caribbean*	59.05	0.04	63.94	0.01	62.36	0.03	61.02	0.01
High income	66.99	0.01	69.26	0.01	71.89	0.00	73.25	0.01
High income: OECD	67.79	0.01	69.94	0.01	72.60	0.01	74.03	0.01
Low & middle income	46.80	0.02	49.74	0.02	51.35	0.01	52.16	0.02
Low income	43.27	0.01	44.02	0.01	46.50	0.02	48.57	0.01
Lower middle income	45.04	0.02	46.90	0.02	48.79	0.00	50.33	0.02
Middle income	46.89	0.02	49.89	0.02	51.47	0.01	52.25	0.02
Middle East & North Africa*	**48.40**	0.02	**48.12**	0.05	**44.89**	0.04	**41.46**	0.01
Sub-Saharan Africa*	**51.29**	0.01	**52.76**	0.01	**49.96**	0.04	**54.53**	0.06

*all income levels

Source: WDI, 2013, *author's calculations*

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