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# INDUSTRIALIZATION AND ECONOMIC GROWTH IN SUB-SAHARAN AFRICA: THE ROLE OF HUMAN CAPITAL IN STRUCTURAL TRANSFORMATION

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## *ABSTRACT*

The objective of this paper is to analyze the impact of the manufacturing sector on economic growth through the role of human capital. Our data cover Sub-Saharan African (SSA) countries from 1990 to 2015. We use fixed effects, random-effects and Hausman-Taylor estimators. We take into account the unobservable characteristics of countries by including fixed effects or random effects in the model. Our results show that the manufacturing sector through its value added has a positive impact on economic growth in SSA countries. In addition, the interacting models show that the quality of human capital is an accelerator of the role of the manufacturing sector. The coefficient of the catch-up term is negative and significant in all models indicating that countries with a larger productivity gap relative to China are developing faster than countries closer to China. This finding is consistent with the convergence effects usually found in growth model estimates, which are either related to convergences towards a stable state or to a catching-up of growth linked to the international diffusion of knowledge.

**Contribution/Originality:** Unlike previous work, this article brings three major innovations. First, the inclusion of the key role of human capital, then the construction of the productivity indicator by considering China as a reference, and finally the consideration of the endowments of natural resources of countries in sub-Saharan Africa as country-specificity.

## 1. INTRODUCTION

The early literature had highlighted a near consensus that the manufacturing sector is the main route to economic growth and therefore development. Thus, it is recognized that better economic performance is the result of industrialization. However, this consensus seems to be being challenged nowadays. Recent research raises questions about the continued importance of the manufacturing sector for economic development (Szirmai and Verspagen, 2015). In developed economies, the service sector accounts for nearly two-thirds of national production, giving the service industry a large weight in relation to manufacturing. Also, in developing economies, the service sector plays an important role. To this end, it is now argued that service sectors such as software, business processing, finance or tourism act as key sectors in development and that the role of the manufacturing sector is declining. The best example for this perspective is India since the 1990s (Dasgupta and Singh, 2005). Other authors



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argue that it is not manufacturing as a whole, but manufacturing sub-sectors such as information and communication technologies (Fagerberg and Verspagen, 1999; Jorgenson *et al*., 2005).

For some researchers, it is not a question of considering the entire industrial sector but of considering manufacturing sub-sectors such as information and communication technologies (Fagerberg and Verspagen, 1999; Jorgenson *et al*., 2005). For example, the East Asian experience documents the key role that industrialization has played in the economic development of developing countries over the past fifty years. In addition, all historical examples of successful economic development and catch-up since 1870 have been associated with successful industrialization (Szirmai, 2012).

Many countries in Sub-Saharan Africa have adopted industrial policies aimed at boosting economic growth. Indeed, the majority of African countries' industrialization strategies target specific economic sectors. Currently, in SSA, out of twenty-six industrialization strategies identified, nineteen target light manufacturing as an essential sector for development, including agro-industry, the wood, clothing, textiles, leather and footwear sectors; sixteen strategies focus on sustainable development aspects, such as the use of renewable energy and water protection; Fifteen strategies focus on agriculture, in particular livestock farming, forestry and fisheries products; thirteen strategies focus on tourism and high-tech services; one of them focuses on mining and resource extraction such as copper, oil and natural gas; eight strategies focus on the energy sector as a priority, and five on construction. However, it should also be noted that Africa's industrialization will not resemble what has happened in other regions of the world - if only because of the variety of profiles of the 54 African countries, which will therefore follow different trajectories. Secondly, this industrialization will not be based solely on the manufacturing sector, which, at 11% of the continent's GDP, remains small. 21st century industrial policies can target sectors with high growth potential, such as agri-food and value added services (African Economic Outlook, 2017). It is clear that, in addition to the importance given to the manufacturing sector, the service sector should attract attention in view of its ever growing importance in developing economies.

Statistics compared between the different regions of the world show that in 1950, the agricultural sector contributed 49%, 22%, 44%, 41% and 15% respectively in Asia, Latin America, Africa, Developing Countries (DCs) and Developed Countries (DPs); the industrial sector contributed 14% for Asia, 28% for Latin America, 19% for Africa and 42% for DCs. By breaking down the industrial sector into manufacturing and services, we find 10% against 36% in Asia, 16% against 50% in Latin America, 9% against 36% in Africa, and 11% against 40% in developing countries in general, 31% against 42% in developing countries. However, in 2005, the agricultural sector accounted for 13%, 7%, 26%, 16% and 2% respectively in Asia, Latin America, Africa, developing countries and developing countries, the industrial sector for 35%, 37%, 30%, 34% and 17%. The breakdown of industry into manufacturing and services shows 24% against 52% in Asia, 18% against 56% in Latin America, 12% against 45% in Africa, 18% against 51% in developing countries, and 17% against 70% in developing countries[1]. From these statistics on sectoral value added, the following conclusions can be drawn. Countries with high per capita income levels have a very dynamic service sector at the expense of the agricultural sector. As a result, there is a declining manufacturing sector for DPs. In Africa, it is noted that the agricultural sector increased from 44% in 1950 to 26% in 2005, while the industrial sector created more value added, increasing from 19% to 34%.

Szirmai and Verspagen (2015) reviewed the role of the manufacturing sector as an engine of growth in developed and developing countries from 1950 to 2005. They note that there is a moderate positive impact of the manufacturing sector on growth. Also, interesting interaction effects of the manufacturing sector with education and income gaps. Comparing sub-periods, it appears that since 1990, the manufacturing sector has had increasing difficulty in playing its role as a driver of economic growth.

[1]Source: Szirmai (2012)



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This research aims to highlight the cross impact of the manufacturing sector on economic growth and the quality of human capital on economic growth. This research fills the gap in specific studies on SSA countries in order to better control their individual specificities. Also, this article uses panel data to include the dynamic nature of the industrialization phenomenon. Unlike previous research, this new research focuses on the effect of interactions between the manufacturing sector and infrastructure, electricity and telecommunications, to see how the quality of infrastructure enables the manufacturing sector to play its role as a growth driver in SSA countries between 1990 and 2015. In addition, this paper categorizes countries into two groups, those dependent on natural resources and commodities and those not dependent on those produced. In doing so, we will highlight the impacts of manufacturing value added depending on whether the country is a dependent natural resource or not.

The rest of the article is presented as follows. Section 2 analyses the dynamics of the industrial sector in general and the African manufacturing sector between 1990 and 2015; Section 3 provides an overview of previous empirical work; data, model and estimation techniques are presented in Section 4; the results are discussed in Section 5 and Section 6 concludes.

## 2. MANUFACTURING SECTOR AS AN ENGINE OF ECONOMIC GROWTH

The growth engine hypothesis draws its arguments from both empirical and theoretical observations. The literature finds an empirical correlation between the degree of industrialization and the level of per capita income in developing countries (Kaldor, 1966; Rodrik, 2009). Developing Countries (DCs) with higher per capita incomes, have observed the share of the manufacturing sector in GDP and employment increased. These countries have therefore experienced dynamic growth in manufacturing output and exports. However, the poorest countries are invariably countries that have missed their industrialization and have an important contribution of agriculture sector to GDP. In the cross-sectional analyses, the relationship between GDP per capita and manufacturing share is curvilinear rather than linear. Indeed, low levels of GDP per capita are associated with low shares of production, intermediate levels of GDP per capita are associated with high shares and high-income economies with lower shares. These empirical findings lead to a relationship in the form of an inverted U (Rodrik, 2009). The growth driver hypothesis assumes that the correlation between GDP per capita levels and manufacturing sector shares results from the characteristics of the manufacturing sector, which makes a particular contribution to economic growth. This assertion is known as Kaldor's first growth law (Kaldor, 1966; Pacheco-López and Thirlwall, 2013).

Four main currents of ideas support the particular role of industrialization in the economic growth's process. Some authors argue that productivity in manufacturing sector is higher than in the agricultural sector (Fei and Ranis, 1964). The sector of manufacturing is also supposed to have more probable for productivity growth than other sectors. The resources' transfer from low-productivity sectors like traditional agriculture or high-productivity informal services and dynamic sectors like manufacturing (i.e. industrialization) scores a bonus for structural change. This is a provisional effect on growth, i.e. it occurs on condition that the share of manufacturing is increasing. Likewise, the resources' transfer from manufacturing to services can be a burden of structural transformation if many service activities have low potential for productivity growth (Baumol, 1967). As stated by the Baumol law, the growth of aggregate GDP per capita will tend to decrease when the part of services in GDP increases. This Baumol law has been defied in more recent literature (Riddle, 1986; Inklaar *et al.*, 2008; Timmer and De Vries, 2009) but it has certainly been used as an argument to drive growth in the past (Rostow, 1960; Gerschenkron, 1962; Higgins and Higgins, 1979; Kitching, 1982; Kitching, 2012). However, it should be noted that sectors such as transport, distribution, ICT and market services have the potential for productivity growth. But many service sectors such as personal services, health services and government services have less potential to increase productivity.

The second argument relates to the comparison made with the agricultural sector. The sector of manufacturing is supposed to present distinct opportunities for capital accumulation. Capital accumulation can be more simply



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achieved in the spatially concentrated manufacturing sector than in spatially dispersed agriculture and returns on capital in terms of labour productivity or total factor productivity are higher than in other sectors. Otherwise, one notices that productive investment opportunities in the manufacturing sector boost the high savings rates characteristic of East Asia's development.

One of the sources of growth is the capital accumulation. Thus, a growing part of the manufacturing sector will lead overall growth. The growth driver assumption implicitly argues that capital intensity in manufacturing is higher than in other sectors of the economy. Szirmai (2012) showed that this occurs in developing countries, but not in many advanced economies.

The third argument in the literature is that the manufacturing sector offers opportunities for economies of scale, which are less available in agriculture or services (Kaldor, 1966;1967) and for embodied and disembodied technological progress (Cornwall, 1977). Technological progress is considered to be concentrated in the manufacturing sector and is spreading to other economic sectors such as the service sector. Capital goods that are used in other sectors are produced in the manufacturing sector. Indeed, the coupling and spillover effects are assumed to be more pronounced in the manufacturing sector than in agriculture or mining. The idea of linkage effects refers to direct purchasing relationships upstream and downstream between different sectors and sub-sectors. Coupling effects create positive externalities for investments. Spillover effects are a special case of externalities related to investment in knowledge and technology. Linkage and spillover effects are assumed to be stronger in manufacturing than in other sectors (Hirschman, 1958). Cornwall (1977), Park and Chan (1989) and Guerrieri and Meliciani (2005) believe that cross-sectoral linkages and spillover effects between manufacturing and other sectors such as services or agriculture are also very pronounced.

The fourth and final argument refers to the effects on demand. When an economy observed his income per capita increased, the part of agricultural expenditure in total (consumer) expenditure decreases due to low income elasticity and the increase in the share of manufactured goods expenditure (Engel's law). Countries specializing in agricultural and primary production will therefore face an obstacle to demand growth unless they can take advantage of the expansion of global manufacturing markets, i.e. industrialization. Arguments have been made in favor of services (Falvey and Gemmell, 1996; Iscan, 2010). When per capita incomes increase, final and intermediate demand for services can increase. But for services that are not traded internationally, the growing demand for services may be more a consequence of rising incomes and the needs of other sectors, which are driving economic growth.

## 3. EMPIRICAL REVIEW

The empirical results on the growth driver hypothesis test are mixed. Indeed, the oldest literature tends to emphasize the importance of manufacturing production. However, the most recent one shows that the contribution of the service sector has increased. In addition, in the more recent literature, the manufacturing sector tends to be more important as a growth driver in developing countries than in advanced economies and also more important in the period 1950-1973 than after 1973. This mix of empirical results therefore refers to other empirical tests in order to strengthen this existing literature.

Fagerberg and Verspagen (1999) in their work, regress the real GDP growth rate on the growth rate of the manufacturing sector. If the coefficient of manufacturing growth is higher than it is for the share of manufacturing in GDP, then the manufacturing sector is considered to be the growth driver. These authors found that manufacturing production was generally a growth driver in the developing countries of East Asia and Latin America, but that there was no significant effect in the developing countries.

Taking into account the dynamic nature of the importance of manufacturing output and the service sector, Fagerberg and Verspagen (2002) examine the impact of manufacturing and service sector shares on economic growth over three periods, 1966-1972, 1973-1983 and 19841995 for a sample of 76 countries. They find that



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manufacturing production has much more positive effects before 1973 than after. It appears that the period 1950-1973 offers special opportunities for catching up through mass absorption of manufacturing production techniques in the United States. After 1973, ICTs began to become more important as a source of productivity growth, particularly in the 1990s. These technologies are no longer exclusive to manufacturing, but are also used in the service sector.

Szirmai (2012) in an article, examines the arguments of the growth driver hypothesis for a limited sample of developing countries in Latin America. It focuses on capital intensity and growth in production and labour productivity. He finds results that are still mixed. Overall, these results confirm the growth driver hypothesis, but for some periods the capital intensity in services and industry appears to be higher than in manufacturing.

Rodrik (2009) regresses five-year GDP growth rates on industry's share of GDP. He finds a positive and significant relationship and interprets the growth of developing countries in the post-war period in terms of the structural bonus argument. It explicitly concludes that this transition to modern industrial activities acts as an engine of growth. However, it is rather less precise about what it means by "modern". For Rodrik, structural transformation is the only explanation for accelerated growth in the developing world. Other authors highlight the role of services in economic growth.

Thomas (2009) concludes that services have been the driving force behind India's renewed growth since the 1990s. In an econometric analysis for India, Chakravarty and Mitra (2009) find that the manufacturing sector is clearly one of the determinants of overall growth, but construction and services are also important, particularly for manufacturing growth.

A recent article by Timmer and De Vries (2009) highlights the growing importance of the service sector in a sample of Asian and Latin American countries. Using growth accounting techniques, they examine the proportions of aggregate growth represented by different sectors during periods of accelerating growth, growth and deceleration. In normal growth phases, they find that manufacturing industry contributes the most. In the phase of accelerating growth, this main role is taken by the service sector, although the manufacturing sector continues to make a no less important positive contribution.

Szirmai and Verspagen (2015) reviewed the role of the manufacturing sector as an engine of growth in developed and developing countries over the period 1950-2005. They noted a moderate positive impact of the manufacturing sector on growth. They find interesting interaction effects with education and income gaps. In a comparison of sub-periods, it seems that since 1990, manufacturing production has struggled to play its role as a growth driver in developing countries. However, it should be noted that these authors did not take into account the interaction of the gap between the level of infrastructure, particularly energy and telecommunications.

In summary, the empirical work mentioned above does not specifically focus on Sub-Saharan African countries. The results of the test of the hypothesis of the growth driver of the manufacturing sector are increasingly mixed. Moreover, recent research shows that services play an increasingly important role in economies and that the importance of the manufacturing sector is decreasing over time. In this context, it is necessary to situate the position of the manufacturing sector in the economic growth of the SSA countries and above all to highlight the effect of the interactions of this sector with the quality of infrastructures, particularly telecommunications.

## 4. EMPIRICAL STRATEGIES

This article is based on the assumption of the manufacturing sector as a growth driver. In this sense, we test this hypothesis for sub-Saharan African countries by regressing the value added of the manufacturing sector on the rate of economic growth. In addition, we also investigate the interactions of the manufacturing sector with the level of development of countries and the level of education of the labour force. The first interaction captures the catch-up effect, the second highlights the role of the quality of human capital. As the empirical literature points to the increasingly important role of the service sector, we monitor its impact on growth. In doing so, this paper tests the



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hypothesis that the manufacturing sector contributes more to growth in developing countries than other sectors and whether this importance declines over time as highlighted by some authors in the literature (Szirmai and Verspagen, 2015). In summary, this research is based on two hypotheses.

Hypothesis 1: The manufacturing sector is a driving force for economic growth through the quality of human capital.

Hypothesis 2: The contribution of the manufacturing sector to economic growth declines over time.

### *4.1. Model, Variables and Data*

Our model is based on the work of Szirmai and Verspagen (2015). We add a variable to capture the quality of institutions in order to take into consideration the role of institutions in economic development. In addition, we categorize countries into two groups. Countries with natural resources and those with few natural resources.

$$\text{GDP\_GROWTH}_{it,+5} = \theta + \alpha MANU_{it} + \delta SER_{it} + \beta DIST\_CHINE_{it} + \delta EDUC_{it} + \varphi LNPOP_{it} + \rho INFR_{it} + \sigma OUV_{it} + \omega D_{it,+5} + \vartheta_{it} \quad (1)$$

$$\text{GDP\_GROWTH}_{it,+5} = (1/5)\,(\text{GDP\_CST}_{t+5} - \text{GDP\_CST}_t)/\,\text{GDP\_CST}_t \quad (2)$$

In this second model, we interact with the agricultural value added variable MANU with the level of education EDUC (MANEDUC), with relative productivity DIST_CHINA (MANDIST_CHINA) (Szirmai and Verspagen, 2015). To these interactions, we add the role of infrastructure in order to capture how the quality of this infrastructure improves the role of the manufacturing sector in economic growth (MANINFR).

$$\text{GDP\_GROWTH}_{it} = \alpha MANU_{it} + \beta \text{GDP\_}CHINE_{it} + \delta EDUC_{it} + \emptyset MANEDUC_{it} + \emptyset MANDIST\_CHINE_{it} + \rho MANINFR_{it} + \varphi X_{it} \quad (3)$$

#### *Description of the Variables*

GDP_GROWTH is the growth rate calculated as presented by equation 2 and is the dependent variable. The independent variables are as follows. MAN is manufacturing value added. SER is the indicator that measures the importance of services in growth and is captured by the value added of the service sector. GDP_CHINA is the country's GDP relative to China's GDP to measure the distance between the country's overall productivity and China's productivity, a country with very high productivity; this variable therefore measures the country's stage of development and captures the catching-up phenomenon that stipulates that the further away the country is from the productivity leader, the faster its growth acceleration rate is. EDUC is the variable that captures human capital measured by the proportion of the population with a high school education. This variable measures the absorptive capacity of the economy. OPEN measures the degree of openness of the country and is measured by the sum of trade in relation to GDP. The other variables are the Logarithm of population size, the state of infrastructure, i.e. access to electricity and telecommunications services INFR. Finally, the dummy variable D which captures the effect of time.

#### *Data and Sources*

The data are mainly from the World Bank database and the United Nations National Accounts database. They cover Sub-Saharan African (SSA) countries over the period 1990 to 2015, i.e. 26 years.

### *4.2. Estimation Techniques*

The estimation technique adopted is that of panel data. Given the size of our sample and the time dimension, we use fixed-effect, random-effect and Hausman and Taylor (1981) estimators. Indeed, since these are panel data, we take into consideration the unobservable characteristics of countries by including fixed effects or random effects in the model. In doing so, the Ordinary Least Square Estimator is no longer efficient.



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## 5. RESULTS AND DISCUSSION

Table 1 presents the results of the estimates of fixed effects, random effects and Hausman Taylor. These results are based on 840 observations from 40 countries in sub-Saharan Africa. All estimation methods are presented to arbitrate on the choice of the method with the greatest involvement. Estimation by the fixed-effects model provides higher coefficients than those of the other models but with insignificant coefficients, which justifies previous concerns about the limited intra-variability of the explanatory variables. It therefore seems that the choice of the Hausman-Taylor method as the main estimator for subsequent estimates is appropriate.

Manufacturing value added is not significant from one method to another.

The share of services in GDP (RES) is not significant, which at first sight suggests that the services sector does not function as a growth driver in sub-Saharan Africa. Human capital (EDU) is significant between random effects, fixed effects and Hausman-Taylor. The coefficient of our catch-up term (GDP per capita as a percentage of China's GDP, per capita GDP _CHINA) is negative and significant in all models.

The negative coefficient indicates that countries with a larger gap with China are developing faster than countries closer to China. This is consistent with the convergence effects usually found in growth model estimates, which are either related to convergences towards a stable state, or to a catching-up of growth linked to the international diffusion of knowledge (see Fagerberg (1994)). The population growth rate (LPOP) is significant for all estimates except for random effects.

**Table-1.** Determinants of growth: estimators Fixed Effects-Random Effects-Hausman-Taylor

| | (1) | (2) | (3) |
|---|---|---|---|
| **VARIABLE** | **Fixed Effect** | **Random Effect** | **H-T Model** |
| GDP_CHINA | -0.534** | -0.436** | -0.521** |
| | (0.216) | (0.198) | (0.213) |
| MAN | 0.000210 | -1.30e-05 | 0.000136 |
| | (0.00101) | (0.000797) | (0.000994) |
| SER | -0.000446 | 4.97e-05 | -0.000368 |
| | (0.000549) | (0.000480) | (0.000542) |
| LPOP | -0.288*** | -0.00241 | -0.127*** |
| | (0.0528) | (0.00707) | (0.0351) |
| EDUC | 0.00213*** | 0.00135*** | 0.00192*** |
| | (0.000243) | (0.000209) | (0.000235) |
| INFR | 0.000853 | -0.000520 | -4.44e-06 |
| | (0.00103) | (0.000386) | (0.000947) |
| OPEN | 0.000503*** | 0.000590*** | 0.000477*** |
| | (9.95e-05) | (9.51e-05) | (9.80e-05) |
| D_90_95 | -0.0498** | 0.0421*** | 0.00526 |
| | (0.0223) | (0.0111) | (0.0175) |
| D_96_00 | -0.0276* | 0.0283*** | 0.00648 |
| | (0.0160) | (0.0101) | (0.0134) |
| D_01_05 | -0.0114 | 0.0187** | 0.00656 |
| | (0.0107) | (0.00902) | (0.00968) |
| D_06_10 | | | 0 (0) |
| NatRess | | 0.0563*** | 0.164 |
| | | (0.0195) | (0.140) |
| Constant | 4.401*** | -0.0897 | 1.834*** |
| | (0.836) | (0.124) | (0.557) |
| Observations | 840 | 840 | 840 |
| R-squared | 0.136 | | |
| Number of id | 40 | 40 | 40 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

These preliminary results confirm the theoretical literature on growth. Based on Hausman Taylor's model, a 10% increase in manufacturing value added increases growth by about 0.00136 percentage points. This is not surprising, since an increase in the level of manufacturing in developing countries has almost the same effect on the



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growth rate as an increase in the level of manufacturing in industrialized countries. In order to capture the effect of industrialization on development more broadly, we are changing our model. This involves adding effects of the "manufacturing value added" variable and some of the other explanatory variables of the model, in particular with MANEDUC and MANDIST_CHINA by using the interaction effects between the variables of our model.

The new interaction variables that we introduce into the model are MANEDUC and MANDIST_CHINA. In this new estimate, we consider the variables LPOP, INFR and OUV as exogenous. On the other hand, the variables MAN, GDP_CHINA, SER, and EDUC were considered endogenous because they enter the interaction, not to mention the interaction variables themselves. The main results of the Hausman Taylor estimator are presented in Table 2. The first column of this table is based on the basic model in Table 1, i.e. a model without interaction effects. The second column of the same table includes the interaction term MANEDUC, and the third column includes both MANEDUC and MANDIST_CHINA.

**Table-2.** Determinants of growth: Hausman-Taylor estimator

| | (1) | (2) | (3) |
|---|---|---|---|
| **VARIABLE** | **Basic Model without interaction** | **Model with MANEDUC** | **Model with MANEDUC and MANDIST_CHINA interaction** |
| | **EXOGENOUS VARIABLES** | | |
| LPOP | -0.127*** | -0.119*** | -0.153*** |
| | (0.0351) | (0.0345) | (0.0372) |
| INFR | -4.44e-06 | -9.39e-05 | -0.000182 |
| | (0.000947) | (0.000943) | (0.000951) |
| OPEN | 0.000477*** | 0.000451*** | 0.000449*** |
| | (9.80e-05) | (9.85e-05) | (9.77e-05) |
| D_90_95 | 0.00526 | 1.771*** | 0.00100 |
| | (0.0175) | (0.533) | (0.0178) |
| D_96_00 | 0.00648 | 1.772*** | -0.000385 |
| | (0.0134) | (0.538) | (0.0136) |
| D_01_05 | 0.00656 | 1.772*** | 0.00343 |
| | (0.00968) | (0.543) | (0.00971) |
| D_06_10 | 0 | 1.764*** | 0 |
| | (0) | (0.547) | (0) |
| | **ENDOGENOUS VARIABLES** | | |
| MAN | 0.000136 | -0.00612* | -0.00783** |
| | (0.000994) | (0.00315) | (0.00316) |
| GDP_CHINA | -0.521** | -0.566*** | -4.310*** |
| | (0.213) | (0.214) | (1.052) |
| SER | -0.000368 | -0.000254 | -0.000153 |
| | (0.000542) | (0.000544) | (0.000540) |
| MANEDUC | | 7.04e-05** | 7.78e-05** |
| | | (3.36e-05) | (3.34e-05) |
| EDUC | 0.00192*** | 0.00114*** | 0.00107** |
| | (0.000235) | (0.000435) | (0.000433) |
| MANDIST_CHINA | | | 0.161*** |
| | | | (0.0443) |
| | **TIME-INVARIANT VARIABLES** | | |
| NatRess | 0.164 | 0.157 | 0.206 |
| | (0.140) | (0.136) | (0.157) |
| Constant | 1.834*** | 0 | 2.331*** |
| | (0.557) | (0) | (0.590) |
| Rho | 0.95 | 0.95 | 0.96 |
| Observations | 840 | 840 | 840 |
| Number of id | 40 | 40 | 40 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Almost all the coefficients associated with the variables in the models with interactions are significant. This statistically justifies their presence in the model. The different variables of the model with interaction show the expected signs. The variable GDP_CHINA has a negative impact on growth while the variable MANEDUC has a



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positive impact on growth in the last two columns of Table 2. The EDUC variable is positive and significant in both models, meaning that investment in human capital is a source of economic growth in sub-Saharan Africa. The degree of openness has a positive and significant impact on economic growth. Our results confirm the theoretical and empirical literature on the relationship between structural transformation and industrialization. Examples include the work of Pritchett (2001); Krueger and Lindahl (2001).

## 6. CONCLUSION

The recent empirical literature raises the issue of the continued importance of the manufacturing sector in the economic growth and development of nations. The hypothesis that the manufacturing sector remains the engine of growth is being challenged by reference to work on the structural transformation of economies, because of the increasingly important role of the service sector. In this article, two main objectives are pursued. First, it is a question of analyzing the impact of the manufacturing sector on economic growth (i), then, the effect of interactions between the manufacturing sector and infrastructure on the one hand, and the manufacturing sector and the quality of human capital on the other hand (ii). To achieve this, panel data are mobilized. They cover Sub-Saharan African (SSA) countries from 1990 to 2015. Since we consider five-year periods for the purposes of growth rate variability, the time dimension is reduced. Thus, we use fixed-effect, random-effect and Hausman and Taylor (1981) estimators. Our results show that the manufacturing sector through its value added has a positive impact on economic growth in SSA countries. In addition, interacting models tell us that the quality of human capital is an accelerator of the role of the manufacturing sector in economic growth. From this perspective, in the structural transformation of SSA economies, even though the transition to manufacturing interacts positively with growth, it is important to note the need for investment in human capital. In addition, the results also show that the coefficient of the catchup term is negative and significant in all models indicating that countries with a larger productivity gap relative to China are developing faster than countries closer to China. This is consistent with the convergence effects usually found in growth model estimates, which are either related to convergences towards a stable state, or to a catching-up of growth linked to the international diffusion of knowledge.

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