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# Is Structural Transformation Generate Economic Growth in Sub-Saharan Africa?

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## Abstract

This article examines the effect of structural transformation on the growth of Sub-Saharan African economies. Thus, from a sample of 46 countries observed over the period 1995-2020, we estimate a model in panel data by the method of Generalized Moments in system. Overall, our results show that Structural Transformation (ST) contributes significantly to the growth of the economies under consideration. However, this effect is counterbalanced by the low share of high value-added activities. Human capital and infrastructure level minimally support the positive effect of ST on economic growth. The results remain broadly stable when checked for the different dimensions of the SC. In addition, they remain robust in the face of changing economic growth indicators and the use of competing estimators. We suggest a promotion of activities with higher local added value.

## Keywords

Economic Growth, Structural Transformation, Sub-Saharan Africa, GMM in System

## 1. Introduction

Economic growth in Sub-Saharan Africa (SSA) has changed strongly in recent years. But it has not translated into an improvement in the socio-economic conditions of the populations. This strong growth has not enabled the SSA to meet its important challenges in terms of reducing poverty, inequality and unemployment among young graduates. According to the African Development Bank (BAfD, 2020), it has not translated into expected economic and social development. This situation raises the problem of the productive structure of these countries. The literature shows that specializations in products with limited value-added (textiles/clothing, agriculture) have a reduced effect in the social field

(Amable, 2000; Péridy & Bagoulla, 2012). Activities with high added value are considered to be the only way to ensure that the level of population is improved. The role of productive transformation and much more, that of structural transformation deserves to be evaluated.

The effects of structural transformation on economic growth are analysed in the economic literature using two main approaches. The first is the classic approach that structural transformation fosters growth supported through "laissez-faire". Specifically, markets are able to better allocate resources and maximize the growth potential of the economy. The price system determines what to produce and how to produce it, with structural transformation occurring automatically as the economy grows and markets redeploy factors of production into more productive sectors with better returns. Although constituting the dominant theoretical framework during the 19th century, this approach has as a weakness the failure to take into account the important role of technological change and industrial modernization in sustained economic growth. This is how another approach, called modern and aimed at correcting this limit has emerged.

This second approach has developed on three axes: 1) the first axis based on growth theories essentially linked to the neoclassical tradition explains the effects of structural transformation on growth by taking into account the technological evolution that is acquired through investments in research and development. Thus, more investment in research and development creates opportunities for technological spin-offs and ultimately leads to increasing returns to scale at the global level (Acemoglu, et al., 2001; Aghion & Howitt, 1992; Romer, 1987, 1990); 2) the second so-called structuralist axis states that it is impossible to achieve high rates of production growth without a substantial change in the shares of the various sectors. In this regard, economic development and structural transformation stipulate a) that rapid growth in manufacturing output induces a high rate of GDP growth; b) rapid growth in manufacturing output leads to a high rate of labour productivity growth in manufacturing; c) Rapid growth in manufacturing output leads to a high rate of growth in overall labour productivity. 3) the third axis, that of the new structural economy, believes that structural transformation promotes growth when it is achieved through the acquisition of new types of capacity, i.e. by undertaking new productive activities in strategic sectors (Lin, 2011; Lin & Treichel, 2014).

Beyond these theoretical analyses, several empirical works have been carried out. Felipe (1998); Tregenna (2007); Chandrasekhar (2007); Rodrik (2009); Kathuria and Raj (2009); Ray (2015) showed that structural transformation (captured by industry's shares in GDP and employment) is associated with stronger economic growth, with these results remaining unchanged when the sample is split into advanced and developing countries. Similarly, Fagerberg and Verspagen (2002) such as Szirmai and Verspagen (2015) conclude that manufacturing plays a much more prominent role and that the larger share of services' value added in GDP is positively linked to GDP growth.

In view of the performance achieved by Sub-Saharan Africa both in terms of structural transformation and economic growth and in the light of the literature presented above which tells us that the effects of structural transformation on growth vary according to the indicators considered and the sample selected, it seems relevant to us to ask the following question: What is the contribution of structural transformation to economic growth in Sub-Saharan Africa?

It appears that the structural transformation of the SSA has not been accompanied by a productive structure with high added value. It is therefore a question of questioning the model of structural transformation adopted. We accept that the rise of the services sector at the expense of the industrial sector explains these low-productivity activities in Sub-Saharan Africa. It appears that the structural transformation of the SSA has not been accompanied by a productive structure with high added value. It is therefore a question of questioning the model of structural transformation adopted. We accept that the rise of the services sector at the expense of the industrial sector explains these low-productivity activities in Sub-Saharan Africa.

Regarding the estimation technique, we take into account the endogeneity bias that remains very likely either because of the omission of relevant variables or because of the inverse causality between economic growth and its determinants. We choose the method of Generalized Moments in a two-stage system that allows us to correct these potential problems of endogeneity and to take into account the specific fixed effects of countries The interest of this study is twofold: firstly on the positive level, we note that this question has been the subject of several works and that studies concerning Sub-Saharan Africa are quite rare. We will thus contribute to this literature from the specific case of the countries of this part of Africa observed over the period 1995-2020. Second, we adopt a three-step methodological approach to test our hypothesis. First, we understand structural transformation through the Hirshman Diversification Index. To test the robustness of this indicator, we use two other ST indicators: the relative share of employment in the industrial sector and the relative share of employment in the tertiary sector. Unobservable and invariant over time (Yi et al., 2013).

After this introduction, which is the subject of the first section, the rest of this article consists of five other sections. The second section presents some stylized facts about the economic growth and structural transformation of the countries of Sub-Saharan Africa. The third section highlights the methodology of the study. The fourth section provides a discussion of the results. The fifth section concludes by highlighting the implications of economic policy.

## 2. Structural Transformation and Economic Growth: Stylized Measures and Facts

### 2.1. Stylized Measures and Facts of Structural Transformation in Sub-Saharan Africa

#### 2.1.1. Measures of Structural Transformation

As noted above, a country is said to be structurally transformed when it successfully transfers labour and other productive resources from low-productivity economic activities to high-productivity activities. According to authors such as Fisher (1939), Clark (1940), manufacturing and service activities create more added value than agricultural activities. In the same vein, Cadot et al. (2016), Nguimkeu and Zeufack (2019) argue that a Structural Transformation focused on the expansion of the manufacturing sector and then that of services is conducive to economic development. Industrialization would therefore be an impulsive driver of inclusive economic transformation.

Following the industrialization approach, Structural Transformation is understood by: 1) the consumption expenditure of each sector of activity or the value added consumed (Herrendorf et al., 2013); 2) the shares of different sectors of activity in total employment and total value added (UNCTAD, 2021), and 3) value added created in an economy (Lectard, 2017; Neuss, 2019).

Beyond industrialization, several other measures of structural transformation have been defined. In particular, sophistication and diversification. For Lall et al. (2005), the level of product sophistication is an "amalgam of several factors", which Hidalgo et al. (2007) call capabilities. Commonly used sophistication indices are: The PRODY of Hausmann et al. (2007), which classify products according to their "implicit level of productivity/income" estimated by the income level of exporting countries. The PRODY level of property k is defined by:

$$PRODY_k = \sum_j \frac{x_{jk}/X_j}{\sum_j \left( x_{jk}/X_j \right)} Y_j \tag{1}$$

$X_j$ is the total exports of country $j$ and $x_{jk}$ is the export of goods $k$ by country $j$. $Y_j$ is the GDP per capita of the country $j$. The numerator of the weighting, $X_{jk}/X_j$ is the share of product $k$ in total exports of country $j$. The sum of $X_{jk}/X_j$ aggregates the share of exports of product $k$ in all countries' total exports.

We also have the Product Complexity Index (PCI) which is a measure of sophistication proposed by Hausmann et al. (2011). It is based on the factor endowments necessary for production. The authors place particular emphasis on "productive knowledge", which includes the ability and experience to combine the different factors of production in order to produce a good. While previous work estimated all these capabilities by countries' income, Hausmann et al. (2011) estimate them based on two concepts: the "ubiquity" of goods and the "diversity" of countries' export basket. This classification adopts a "product" and "country" approach. Moreover, the "country characteristic" used is based on the productive structure of exporting countries, whereas PRODY is built on the basis of their income alone. This methodology therefore rejects the criticism of circularity made to PRODY. The Product Complexity Index therefore seems. We also have the Product Complexity Index (PCI) which is a measure of sophistication proposed by Hausmann et al. (2011). It is based on the factor endowments necessary for production. The authors place particular emphasis on "productive knowledge", which includes the ability and experience to combine the different factors of production in order to produce a good. While previous work estimated all these capabilities by countries' income, Hausmann et al. (2011) estimate them based on two concepts: the "ubiquity" of goods and the "diversity" of countries' export basket. This classification adopts a "product" and "country" approach. Moreover, the "country characteristic" used is based on the productive structure of exporting countries, whereas PRODY is built on the basis of their income alone. This methodology therefore rejects the criticism of circularity made to PRODY. The Product Complexity Index therefore seems more suitable than its predecessors to measure the "sophistication" dimension of a country's structural transformation. Diversification refers to "the dispersion of productive activities in a large number of activities that differ from each other by the nature of the goods and services produced". It is apprehended by the phenomenon of variety (which reflects the different products exported) and concentration (which retains the distribution of these exports). If the distribution is balanced, concentration is low and exports are diversified. Conversely, if the distribution is highly unequal then exports are concentrated.

Diversification is measured by several indicators including the indices of Theil ($T$), Hirshman ($H$ which is between 0 and 1) or Gini ($G$) whose formulas are respectively given by:

$$T = \frac{1}{n}\sum\nolimits_{k=1}^{n}\frac{x_k}{\mu}\ln\left(\frac{x_k}{\mu}\right) \text{ with } \mu = \frac{\sum\nolimits_{k=1}^{n} x_k}{n} \quad (2)$$

With $n$ is the number of export lines, $n_j$ is the number of export lines of group $j$ and $\mu$ is the average value of exports, $\mu_j$ is the average value of exports of group $j$ and $x_k$ is the exports of the product (or export line) $k$.

$$H = \frac{\sum\nolimits_{k=1}^{n}\left(S_k\right)^2 - 1/n}{1 - 1/n} \quad (3)$$

with $S_k = x_k \Big/ \sum\nolimits_{1}^{n} x_k$

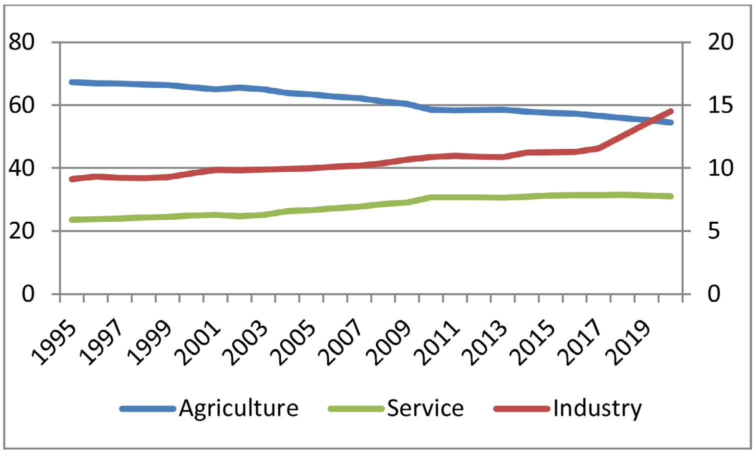
The share of export line $k$ ($x_k$ represents exports of good $k$) in total exports and $n$ the number of export lines.

#### 2.1.2. Structural Transformation: Some Stylized Facts in SSA

Following the industrialization approach, two major facts should be noted: the overall trend is that of a slight improvement in structural transformation in Sub-Saharan Africa; However, the disaggregated observation reveals a disparity in performance between sub-regions.

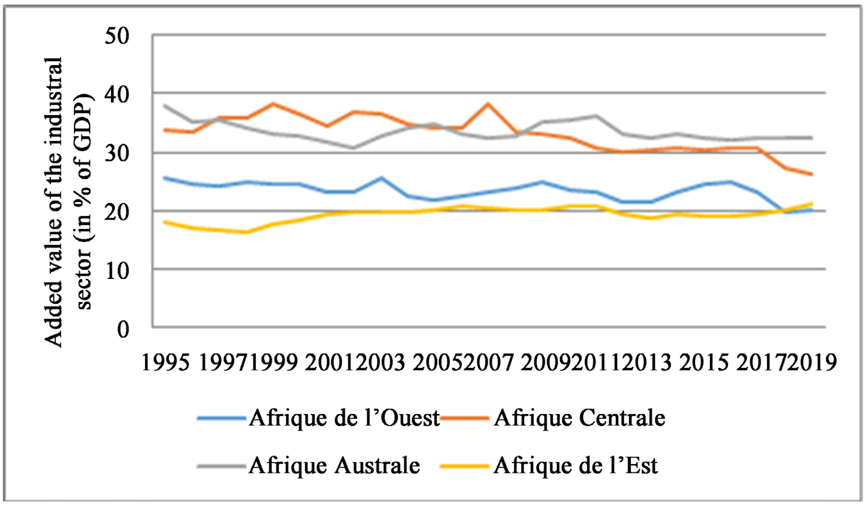
**Figure 1** shows the evolution of structural transformation (ST for the future) in SSA apprehended by the relative change in employment in the different sectors of activity between 1995 and 2020. From his observation, it appears that employment in the agricultural sector decreased by 13.5 percentage points from 69% to 54.5%, while employment in the industrial and service sectors showed an upward trend from 9% to 14.5% and 23% to 31% respectively. This progression indicates the beginning of the ST process. But the slow evolution of this SC confirms that the actions carried out so far have not achieved the expected results.

Figure 2 presents a comparison of the evolution of the level of SC (as a percentage of industrial sector value added in GDP) between SSA sub-regions between 1995 and 2020. We find that the overall average level of SC in Africa is relatively low at 25.38%. Looking at the various subregions, we see a downward trend, except in East Africa, which has seen an upward trend ranging from 16.32 percent to 20.98 percent. This result can be justified by the efforts of the leading countries of this sub-region such as Kenya and Ethiopia, which are resolutely




Note: Agriculture and services shares are represented on the left-hand scale and industry shares are represented on the right-hand scale. Source: authors, based on the World Bank's WDI database.

Figure 1. Relative evolution of employment (in percentage) in the different sectors of activity in SSA.




Source: Authors, based on World Bank WDI database.

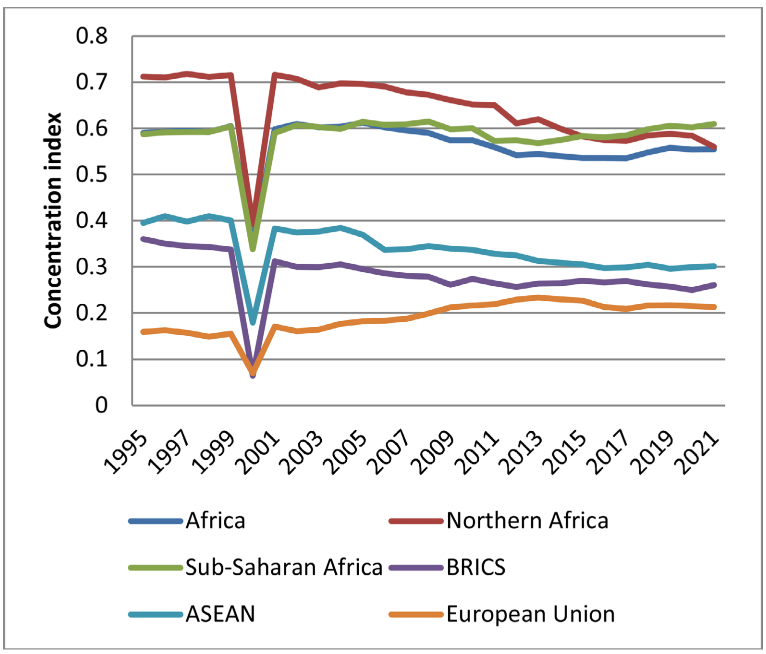
Figure 2. Value added of the secondary sector in GDP (in percentage) of SSA sub-regions.

committed to far-reaching reforms of their economies. Despite the downward trend observed in the Southern Africa sub-region, it remains the best ranked. This can be justified by the presence of South Africa, whose industrial sector is quite developed.

Figure 3 below shows the evolution of the concentration index in selected regions of the world. We find from his observation two groups. The first group (ASEAN, EU and BRICS) with a concentration index below 0.2. The second group (SSA, North Africa) with an index greater than 2, reflecting the limited number of varieties of goods offered to trading partners. This high value can also be explained by a limited number of partners. We know that for the majority of Sub-Saharan African countries export a small range of goods to a limited number of partners. On the other hand, the countries of the first group export a wide variety of goods to multiple partners.

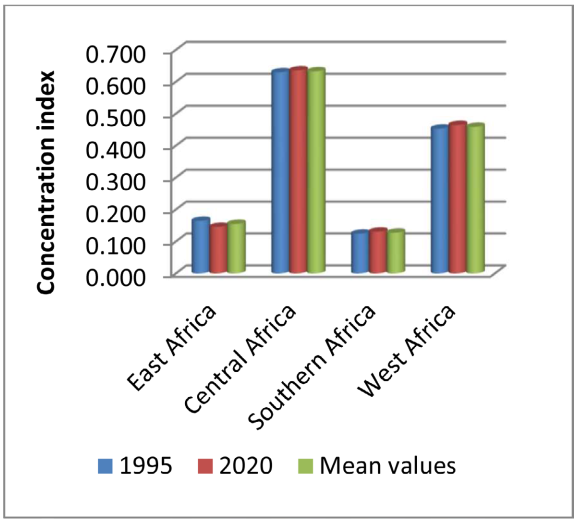
Figure 4 below shows the change in the concentration index of the different SSA sub-regions from 1995 to 2019. We find that Central Africa is the most concentrated, followed by West Africa, East Africa and Southern Africa closes the list. Central Africa's ranking is attributable to its high endowment of natural resources, which constitute the bulk of exports. Cameroon, Gabon, DRC and Chad export more wood, oil and some minerals. Côte d'Ivoire mainly exports cocoa. These resources are mainly destinations France, China, Germany.

Figure 5 below highlights the evolution of the diversification index of the different SSA sub-regions from 1995 to 2019. The observation of this representation shows that Central Africa is the least diversified. This is due to its high endowment of natural resources, whose activities are limited to their extraction and export in their raw state. West Africa is the most diverse subregion. This is a testament to the efforts made by countries such as Nigeria, Ghana and others. These economies are multiplying activities of processing oil, cocoa, and other minerals.



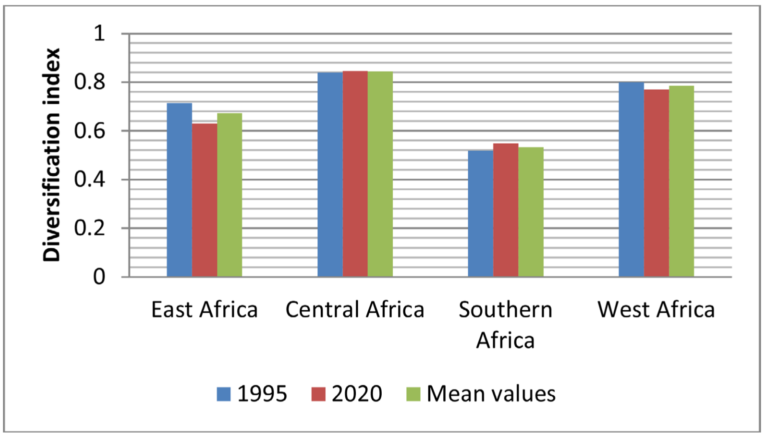

Source: Author, based on UNCTAD database.

Figure 3. Evolution of the concentration index in selected regions of the world between 1995 and 2019.




Source: Author, based on UNCTAD database.

Figure 4. Evolution of the concentration index in the different sub-regions of SSA between 1995 and 2019.




Source: Author, based on UNCTAD database.

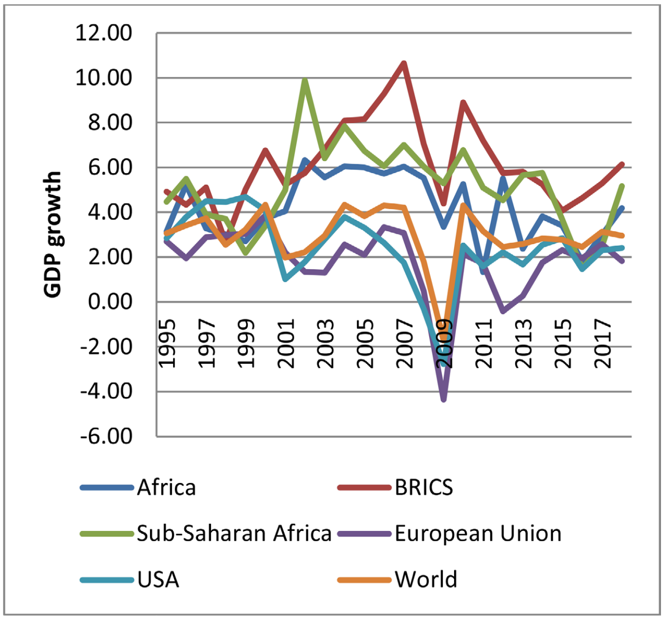
Figure 5. Evolution of the diversification index in the different sub-regions of SSA between 1995 and 2019.

## 2.2. Economic Growth in Sub-Saharan Africa

We carry out a global analysis of economic growth in Sub-Saharan Africa on the one hand and we present the disparities that exist between the countries of this part of Africa on the other hand.

### 2.2.1. Strong Growth of SSA Relative to Some Regions of the World

The observation of Figure 6 below allows us to note on the one hand that the economic growth of Sub-Saharan Africa has undergone a rollercoaster evolution between 1995 and 2020. With an average level of 5.17% throughout the period, the lowest growth was achieved in 2016 (1.28%) and the ceiling level was reached in 2002 (7.79%). This improvement in the situation is attributable not only to external facts, but also to internal ones. Regarding external justifications, we




Source: author from UNCTAD database (UNCTAD, 2021).

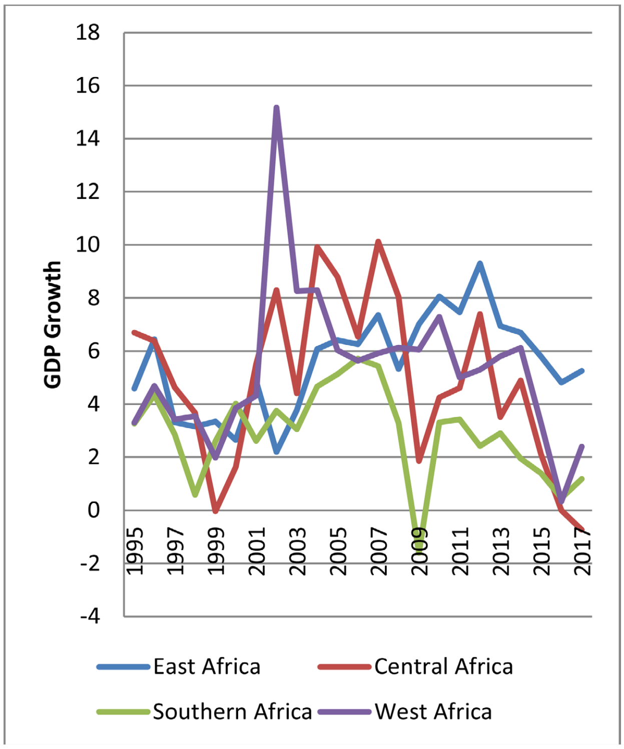
**Figure 6.** Developments in GDP growth in SSA and other regions of the world Source: authors from UNCTAD database (UNCTAD, 2021).

have on the one hand the implementation of macroeconomic policies proposed by the Betton Woods institutions (IMF and World Bank) and on the other hand the strong demand for commodities on the world market by the newly emerging countries, which has led to higher prices for these products and consequently improved the revenues of African countries. Internally, these performances are attributable not only to the devaluation of the 1994 CFA franc zone, which enabled the economic recovery of the 14 countries of the franc zone (CEMAC and ECOWAS countries), but also to political stability and the implementation of effective macroeconomic policies.

On the other hand, we find that the growth curves of these different regions of the world all have the same pace. But there is a clear difference between these developments. Growth rates in Sub-Saharan Africa and the BRICS countries are higher than in other regions. Between 2000 and 2008, growth in all these regions of the world was uneven with small magnitudes. But in 2009, there was a sharp fall that brought the growth of the USA, the European Union and the world to a level below zero (−4.35% for the EU, −2.77% for the USA and −1.72% for the world). Nevertheless, this growth remains positive in SSA (5.29%) and the BRICS (4.39%). This situation is attributable to the financial and economic crisis that broke out in 2007 in the USA and spread to other countries of the world, but to a lesser extent, which justifies its limited impact on the growth of these countries.

#### 2.2.2. Disparity in Growth between Different Subregions

Figure 7 below shows the evolution of economic growth in the different SSA




Source: author from UNCTAD database (UNCTAD, 2021).

**Figure 7.** Evolution of GDP growth in SSA sub-regions (in %).

sub-regions. Looking at it, we see that West Africa achieved the strongest performance in 2002 with a growth rate of 15.18%. But the highest average growth over the period was achieved by East Africa (5.53%) followed by Central Africa (5.31%). Southern Africa occupies the last position with only 2.90%.

Table 1 below shows the performance of countries in each subregion. If we look at the last two periods, we see that Botswana, which ranked first in the period 2013-2015, ranks last in the period 2016-2020. Côte d'Ivoire's low growth rate throughout the 2000s, which was due to the political crisis, improved from 2011 onwards to occupy the first position in the last sub-period. This performance is attributable to the renewed political stability combined with effective economic policies.

#### 2.2.3. Large Disparities in Growth across Groups of Countries

Figure 8 below shows the different countries of Sub-Saharan Africa according to the performance achieved in terms of economic growth. This scatterplot shows that these countries can be classified into three groups. The first group consists of countries that have achieved a growth rate well above average (upper right dial of the scatterplot). We do see that Equatorial Guinea ranks first. Other countries include Angola, Rwanda, Mali, Chad, Cape Verde, Uganda and Mozambique. The second group consists of countries whose growth rate is close to the average value (countries located in the upper left and lower right dials). The third consists of countries with a growth rate well below average (they are

**Table 1.** Evolution of GDP growth in SSA sub-regions (in %).

| | Dependent variable: GDP growth | | | | |
|---|---|---|---|---|---|
| | 2000 2003 | 2004 2007 | 2008 2012 | 2013 2015 | 2016 2020 |
| Southern Africa | 3.9 | 4.96 | 4.46 | 2.92 | 1.25 |
| High rate | Botswana 6.17 | Namibia 6.53 | Swaziland 8.39 | Botswana 7.28 | Lesotho 3.41 |
| Low rate | Namibia 3.15 | Lesotho 3.55 | Botswana 7.45 | Lesotho 4.90 | Botswana 2.29 |
| Central Africa | 6.34 | 7.29 | 5.32 | 5.17 | 1.57 |
| High rate | Eq Guinea 33.78 | Eq Guinea 15.32 | Eq Guinea 10.5 | DRC 7.48 | DRC 5.37 |
| Low rate | RCA 0.65 | RCA 0.53 | Chad 1.45 | Congo 3.50 | Eq Guinea −6.09 |
| West Africa | 4.14 | 4.41 | 4.17 | 5.37 | 3.03 |
| High rate | Liberia 9.64 | Nigeria 13.77 | Liberia 6.56 | Sierra Leo 14.07 | Ivory Coast 8.57 |
| Low rate | Ivory Coast −1.39 | Ivory Coast 0.72 | Nigeria 0.47 | Gambia 7.11 | Sierra Leo −1.80 |
| East Africa | 3.03 | 4.47 | 4.85 | 7.90 | 5.64 |
| High rate | Rwanda 8.72 | Ethiopia 8.52 | Ethiopia 10.87 | Zimbabwe 11.74 | Ethiopia 9.13 |
| Low rate | Zimbabwe −4.77 | Zimbabwe −4.70 | Eritrea −0.73 | Madagascar 1.89 | Zimbabwe 1.66 |

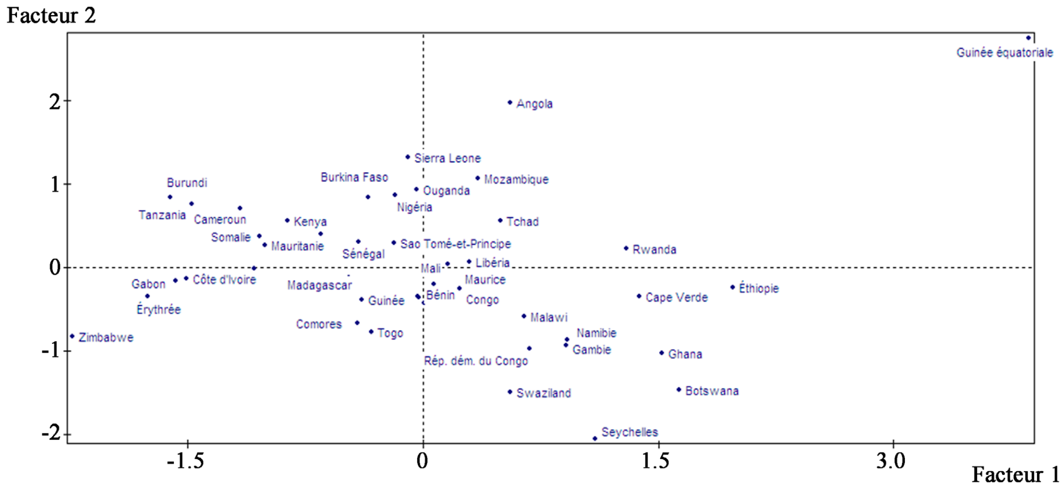
Source: author from UNCTAD database (UNCTAD, 2021).

located in the lower left dial). Zimbabwe is the most mediocre. There are also countries such as Eritrea, Comoros, Togo, Gabon, Ivory Coast, Madagascar, etc.

Figure 9 below shows the scatterplots between economic growth and structural transformation in Sub-Saharan Africa. It emerges from the observation of these different representations that economic growth is an increasing function of structural transformation in SSA. Specifically, diversification, the service sector and the development of the industrial sector promote economic growth in SSA.

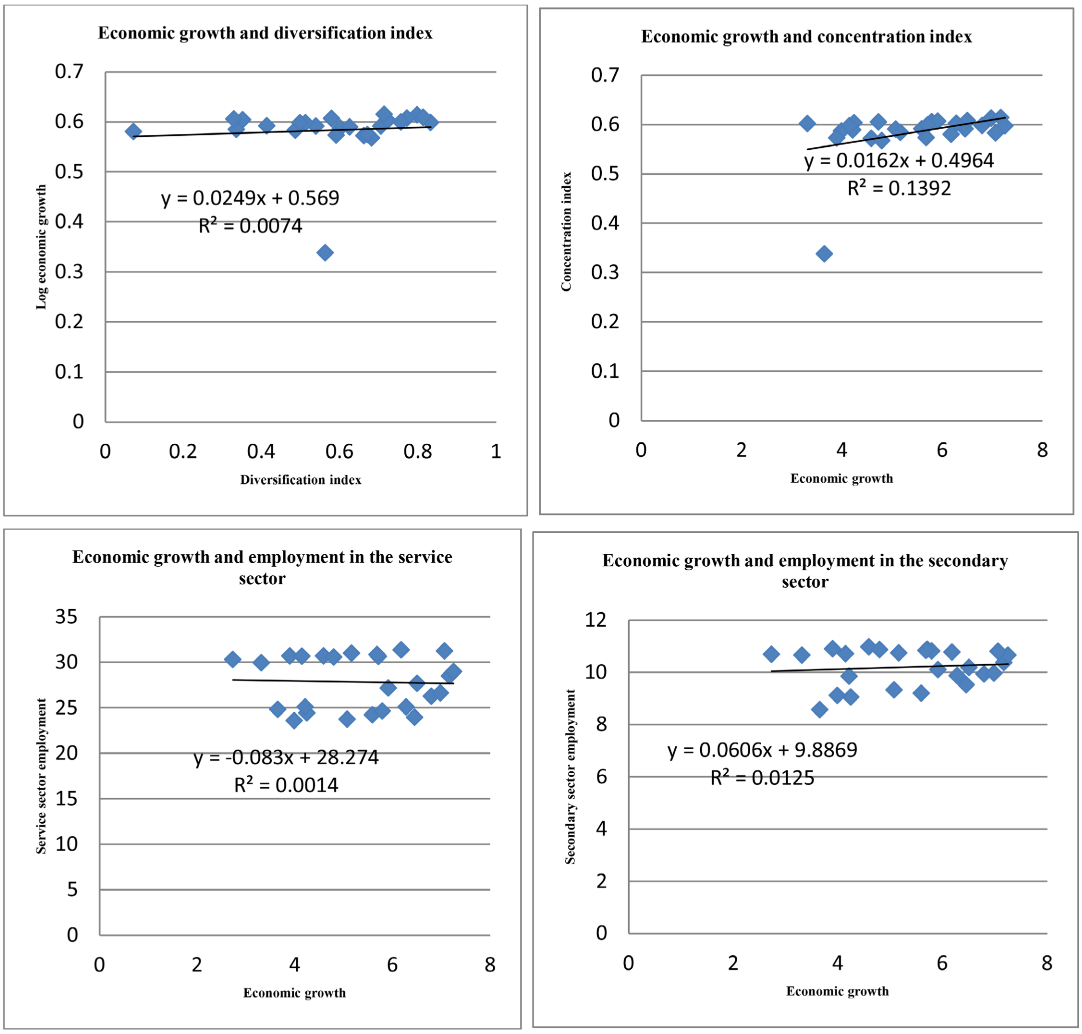
## 3. Study Methodology

Three main concerns are ours in this section: Study design specification, study sample and data, and estimation strategy.




Sources: Author from UNCTAD database (UNCTAD, 2021).

**Figure 8.** SSA scatterplot by level of economic growth achieved.




Source: Author, based on WDI databases of the World Bank and UNCTAD.

**Figure 9.** Scatterplots between economic growth and structural transformation in SSA.

### 3.1. Study Design Specification

The growth model used in this study is the augmented Solow model from the work of Mankiw et al. (1992). Although criticism has been levelled at the validity of Solow's aggregate production function, his study actually forms the basis for explaining economic growth. Our empirical specification is therefore as follows:

$$\begin{aligned}\ln y_{it} = {} & \beta_0 + \beta_1 \ln\left(y_{it-1}\right) + \beta_2 \ln\left(ST_{it}\right) + \beta_3 \ln\left(CapHum_{it}\right) + \beta_4 \ln\left(CapPhys_{it}\right) \\ & + \beta_5 \ln\left(RapFert_{it}\right) + \beta_6 \ln\left(ComExt_{it}\right) + \beta_7 Instit_{it} \\ & + \beta_8 \ln\left(ST * CapHum_{it}\right) + \beta_9 \ln\left(ST * CapPhys_{it}\right) + \mu_t\end{aligned}$$

where $y_{it}$: represents the annual real growth rate of the country's GDP $i$ in year $t$. $y_{it-1}$ is the initial income according to neoclassical theory. A negative sign of its coefficient indicates a convergence of economies towards their level of balanced growth. We test the sensitivity of this variable by the per capita growth rate. *ST*: refers to structural transformation. This is our variable of interest. The main indicator used here is the Hirshman diversification index. To test the robustness of this indicator, we use two other SC indicators: 1) the relative share of employment in the industrial sector and 2) the relative share of employment in the tertiary sector.

*CapHum*: refers to human capital. This variable is retained in accordance with the theory of endogenous growth. Some studies such as those of the BAfD (2020) and the Banque (2018) highlight the central role that human capital plays in the development process of African countries. Based on the work of Mankiw et al. (1992), Benhabib and Spiegel (1994), we use secondary school enrolment as a proxy for human capital.

*CapPhys*: refers to physical capital with reference to Romer (1987). Based on models of endogenous growth, several studies have highlighted certain factors that are taken into account in stimulating economic growth. These include infrastructure. This variable for each country is measured by gross fixed capital formation as a percentage of GDP.

*Rafert*: refers to the ratio of fertile land to total area for each country. This variable takes into account the land which represents for developing countries one of the main sources of wealth.

*ComExt*: represents foreign trade. This variable is retained with reference to the conclusions of empirical studies that conclude on a positive effect of trade on growth (Dollar & Kraay, 2004). As an indicator of this trade, we use the share of raw materials in the exports of African countries as an indicator of this variable. This choice is justified by the high percentage of these raw materials in the trade of these countries.

*Instit*: designates institutions. Given the shortcomings observed in the area of institutions in SSA (BAfD, 2021), we integrate it into our growth equation and understand it through the governance index. It is recognized in the literature that governance plays a fundamental role in GVC integration (Asongu et al., 2021; Asongu & Odhiambo, 2019; Dollar & Kidder, 2017). It also contributes to improved productivity. Several indicators have been selected to monitor the role of governance.

$ST^* CapHum$ and $ST^* CapPhys$ represent respectively the interaction variables between structural transformation and human and physical capital. These variables allow us to assess the indirect effects of SC on economic growth through human capital and physical capital.

$\mu_t$ represents the time effect, which measures the effect on temporal variations in each country's inclusive growth of changes in supposedly unobservable variables common to all countries (including macroeconomic, political and technological shocks); $\nu_i$ is the controlled country fixed effect for time-invariant, country-specific unobservable characteristics; and $\varepsilon_{it}$ is the error term.

### 3.2. Sample Presentation and Data Sources

The model is estimated from a sample of 46 countries in Sub-Saharan Africa (see table list in Appendix 1). The data used cover the period 1995-2020. This spatio-temporal choice is justified by the availability of data. They come from the databases of international organizations or research centres (see data sources in Annex 2). **Table 2** and **Table 3** below present descriptive statistics and correlations between the study variables, respectively. **Table 3** shows that correlations between the majority of explanatory variables are not high enough to cause serious problems of multicollinearity. The correlation coefficient between economic growth and our variable of interest (SC) is positive and high. This justifies the use of more advanced econometric estimates to clarify the type of relationship.

**Table 2.** Descriptive statistics of study variables.

| Variable | Observations | Average | Table Column Head | | |
|---|---|---|---|---|---|
| | | | Stan deviate | Minimum | Maximum |
| Real growth rate | 1108 | 4.84 | 6.52 | −36.7 | 95.26 |
| Per capita growth rate | 1108 | 2.32 | 7.03 | −36.82 | 91.64 |
| Hirshman diversification index | 1085 | 0.43 | 0.54 | 0.07 | 0.79 |
| Relative share of employment in the sector industries | 1108 | 18.91 | 15.84 | 8.94 | 39.86 |
| Relative share of employment in the tertiary sector | 1108 | 25.33 | 26.74 | 18.14 | 43.78 |
| Secondary school enrollment rate | 1108 | 48.829 | 19.479 | 15.623 | 68.822 |
| Gross fixed capital formation (% GDP) | 1108 | 21.349 | 22.344 | 9.722 | 36.353 |
| Fertile land (in % area) | 1075 | 8.285 | 2.584 | 1.041 | 35.927 |
| Raw materials (% export) | 1088 | 30.33 | 35.74 | 18.14 | 43.78 |
| Governance | 1012 | 2.285 | 0.977 | −2.300 | 1.801 |

Source: Author based on UNCTAD-Eora GVC Database, UNCTADstat WDI, IMF.

**Table 3.** Correlation matrix between study variables.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1 | 1 | | | | | | |
| 2 | 0.0872 | 1. | | | | | |
| 3 | 0.124 | 0.083 | 1 | | | | |
| 4 | 0.095 | 0.003 | 0.108 | 1 | | | |
| 5 | 0.084 | 0.037 | −0.058 | 0.053 | 1 | | |
| 6 | 0.019 | 0.135 | −0.024 | 0.012 | 0.082 | 1 | |
| 7 | −0.058 | 0.027 | −0.021 | −0.044 | 0.134 | 0.052 | 1 |

1. Real growth rate 2. Diversification index 3. Secondary school enrolment rate 4. FBCF 5. Fertile land 6. Raw materials 7. Governance.

### 3.3. Estimation Strategy

Several econometric approaches can be used to model the determinants of growth. For example, conventional estimation methods can be used, including ordinary least squares and linear panel methods (fixed effects or random effects). However, these methods ignore the existence of an endogeneity bias, which remains very likely either because of the omission of the relevant variables or because of the reverse causality between economic growth and its determinants. In terms of reverse causality, SC and economic growth influence each other. An accelerated pace of ST can lead to a high level of growth, due to the conversion to higher value-added activities. The latter can in turn be maintained by growth. This analysis can be generalized to the other variables.

To overcome this bias, most authors use the instrumental variable technique, which has two competing estimators, namely the double least squares estimator and the generalized method of moments estimator. However, when the temporal dimension is small compared to the individual dimension (Roodman, 2009), and in the presence of potential heteroscedasticity, it is recommended to use the GMM estimator. In this regard, there are two variants: the different GMM estimator (Arellano & Bond, 1991) and the GMM system estimator (Blundell & Bond, 1998; Arellano & Bover, 1995). This second estimator is more robust than the first because it combines the equations in difference with those in level.

Variables are instrumented by their primary differences and lagging values. We therefore retain it in the context of this work. We perform the Sargan test to assess the validity of the selected instruments. Moreover, we should not observe an autocorrelation of order 2 as revealed by Arellano and Bond (1991).

## 4. Presentation of Results and Robustness Tests

### 4.1. Discussion of Results

Table 4 below presents the results of GMM system estimates of the economic

**Table 4.** Results of GMG system estimates of our economic growth equation.

| | Dependent variable: Real growth rate | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Retarded growth rate | 0.183*** | 0.174*** | 0.1590*** | 0.122 | 0.129*** | 0.101*** |
| | (0.0632) | (0.0622) | (0.0703) | (0.0658) | (0.0673) | (0.0474) |
| Diversification index | 0.068* | 0.097* | 0.072* | 0.168* | 0.103* | 0.177* |
| | (0.0413) | (0.0545) | (0.0405) | (0.0863) | (0.0629) | (0.0803) |
| Secondary school enrolment | | 0.196** | 0.222** | 0.078** | 0.082* | 0.069* |
| | | (0.0630) | (0.0739) | (0.0732) | (0.0800) | (0.0906) |
| Gross fixed capital formation | | | 0.405* | 0.2146* | 0.103 | 0.410* |
| | | | (0.102) | (0.1797) | (0.113) | (0.113) |
| Fertile Land Report | | | | 0.146 | 0.187 | 0.176* |
| | | | | (0.964) | (0.322) | (0.213) |
| Raw materials | | | | | 0.247** | 0.188** |
| | | | | | (0.085) | (0.058) |
| Governance | | | | | −0.082** | −0.052** |
| | | | | | (0.0453) | (0.0223) |
| TS*CapHum | | | | | | 0.118** |
| | | | | | | (0.0570) |
| TS*CapPhys | | | | | | 0.113** |
| | | | | | | (0.013) |
| Constant | 2.230** | 1.849** | 1.824** | 0.946** | 0.947** | 0.659** |
| | (0.365) | (0.521) | (0.658) | (0.193) | (0.245) | (0.393) |
| Observations | 1021 | 1019 | 1019 | 1020 | 1020 | 1015 |
| Number of countries | 46 | 46 | 46 | 46 | 46 | 46 |
| Wald $chi^2$ | 25.75 | 22.08 | 23.54 | 27.06 | 26.37 | 27.81 |
| Prob > $chi^2$ | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.001 |
| Number of instruments | 43 | 42 | 41 | 41 | 40 | 41 |
| Sargan *p*-value | 0.36 | 0.24 | 0.37 | 0.27 | 0.28 | 0.33 |
| AR1 *p*-value | 0.021 | 0.003 | 0.010 | 0.007 | 0.003 | 0.001 |
| AR2 *p*-value | 0.324 | 0.284 | 0.267 | 0.542 | 0.354 | 0.510 |

Robust standard deviations in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Source: Author.

growth equation for all countries in our sample observed over the period 1995-2020. Six models are estimated. The first retains as explanatory variables the rate of stunted growth and our variable of interest which is the Hirshman diversification index. We gradually integrate the control variables into the four models that follow. In the fifth and final model, interaction variables are added. It is apparent from that table that all those specifications are significant overall.

Indeed, the null hypothesis of Wald's global significance tests is rejected ($p$-value is equal to 0.000). In addition, Sargan's over-identification test confirms the validity of the lagging variables in level and difference as instruments used in all our specifications. Moreover, Arellano and Bond's second-order autocorrelation test does not reject the hypothesis of the absence of second-order autocorrelation in our specifications.

It is also clear from this table below that the delayed real GDP growth coefficient has a positive and significant sign at 1% in most cases. This reflects the dynamic aspect of this variable and especially the influence of the previous value on that of the period considered.

The variable of interest that is structural transformation and apprehended here by the Hirshman diversification index has a positive and statistically significant coefficient of 10% in all six models. This reflects the small effect of structural transformation on economic growth in Sub-Saharan Africa. It is partly consistent with those of Agosin et al. (2012), Cadot et al. (2011) and Naudé and Rossouw (2011) who find a U-inverted relationship.

Jarreau and Poncet (2012) point out in the case of the Chinese economy that the effects of structural transformation on growth are conditional; if this TS is obtained through FDI or assembly activities, its effects are not significant. The limited effect of SC on growth in Sub-Saharan Africa can be attributed to several facts: 1) African countries' exports are poorly diversified and concern only low-processed (and therefore low value-added) products. This is the case, for example, of Cameroonian, Gabonese and Congolese wood, which is no longer systematically exported in its raw state. But the simple transformations of this wood only concern the cleaning of bark and cutting into planks. 2) the few finished products exported by Sub-Saharan Africa are those that have benefited only from assembly activities (low added value). This is the case, for example, of the automotive industry in South Africa, Nigeria and Ghana.

The coefficients of the control variables are in most cases consistent with economic intuition with, however, various statistical significances. The human capital captured here by the enrolment rate in secondary education has an overall positive and statistically significant coefficient of 5% on average. This reflects the positive role of a well-trained workforce on economic growth. Training promotes the acquisition of foreign technologies and therefore contributes to high value-added production.

The Physical Capital variable, measured by gross fixed capital formation as a percentage of GDP, has a positive and statistically significant sign at 10%. Investment in infrastructure construction is conducive to economic growth in Sub-Saharan Africa. This result is consistent with that found by Barrios et al. (2005). Specifically, several countries have embarked on the construction of energy infrastructure, transportation, etc. These investments encourage the establishment of industrial enterprises. The coefficient of the commodity variable has a positive and significant sign at 5%, reflecting the positive effect of exports of these products on economic growth. However, this effect is limited because these exported products are low value-added.

The coefficient of the governance variable has a negative and significant sign at 10%, suggesting that poor governance disadvantages the development of wealth production in Sub-Saharan Africa. This result is in line with analyses that already found that poor governance, as measured by the level of corruption, is a handicap to economic growth since it undermines the public policies necessary to consolidate an industrial base. Bribery is a very common practice in the majority of Sub-Saharan African countries and is a discouraging factor inhibiting growth.

Beyond the direct effects, TS has indirect effects on economic growth. In this second consideration, we identify mediating variables capable of reinforcing or limiting this effect. Two main channels are identified, namely human and physical capital (Ouyang & Fu, 2012) and governance (Altenburg & Melia, 2014). We understand their impact on the relationship between growth and ST by calculating interactive variables. **Table 4** above shows that human capital is the most relevant mediating variable in that it reinforces the positive effect of ST on growth.

In other words, the effects of ST are noticeable when skilled and competent men assimilate knowledge and technology. This promotes the modernization of the production apparatus and improves productivity. Similarly, physical capital supports the effects of TS on growth. However, the efficiency of physical capital is limited by insufficient supply, particularly in the field of electricity and transport infrastructure.

## 4.2. Robustness Assessment

As noted above, the robustness of our results will be assessed based on three tests. The first concerns the robustness of our dependent variable; the second concerns the robustness of our variable of interest; In the third and final test, we test the estimation technique.

Here we take into account the competing indicators of economic growth. **Table 5** below shows that the ST contributes positively to per capita income. But the effect remains higher for the real economic growth rate.

Beyond the Hirshman diversification index, ST is also captured in the literature by the relative share of employment in the industrial sector and the relative share of employment in the tertiary sector (Avom & Nguekeng, 2020). We find that these alternative indicators help to reinforce the diversification index as a measure of structural transformation.

Endogeneity is a rather worrying issue. In-system GMM makes it possible to better control double causality bias, but it is not always effective in cases of omission of variables and measurement error. Faced with this new source of endogeneity, it is relevant to use the double-least squares estimator, which consists in

**Table 5.** Results of robustness relative to competing indicators of economic growth.

| VARIABLES | (1) Real growth rate | (2) renew for the habitant |
|---|---|---|
| Lagged dependent variable | 0.101*** | 0.109*** |
| | (0.0474) | (0.0501) |
| Diversification index | 0.177* | 0.113* |
| | (0.0803) | (0.0613) |
| Constant | 0.659** | 0.667** |
| | (0.393) | (0.301) |
| Observations | 1015 | 1012 |
| Number of countries | 46 | 46 |
| Wald chi² | 27.81 | 25.08 |
| Prob > chi² | 0.001 | 0.000 |
| Number of Instruments | 41 | 41 |
| Sargan *p*-value | 0.33 | 0.31 |
| AR1 *p*-value | 0.001 | 0.032 |
| AR2 *p*-value | 0.510 | 0.201 |

Robust standard deviations in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Source: Author.

**Table 6.** Results of robustness against competing SC indicators.

| VARIABLES | Hirshman Diversification Index | Relative share of employment in the industrial sector | Relative share of employment in the services sector |
|---|---|---|---|
| Lagged dependent variable | 0.101*** | 0.054*** | 0.072*** |
| | (0.0474) | (0.0218) | (0.0363) |
| Structural transformation indicators | 0.177* | 0.104** | 0.0836* |
| | (0.0803) | (0.0501) | (0.0382) |
| Constant | 0.659** | 0.192* | 1.008 |
| | (0.393) | (0.076) | (0.667) |
| Observations | 1015 | 823 | 836 |
| Number of countries | 46 | 46 | 46 |
| Wald chi² | 27.81 | 22.81 | 36.18 |
| Prob > chi² | 0.001 | 0.000 | 0.000 |
| Number of instruments | 41 | 40 | 40 |
| Sargan *p*-value | 0.33 | 0.30 | 0.31 |
| AR1 *p*-value | 0.001 | 0.013 | 0.002 |
| AR2 *p*-value | 0.510 | 0.305 | 0.157 |

Robust standard deviations in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Source: Author.

proposing a relevant instrument for the suspected endogenous explanatory variable, especially when heterogeneity is assumed to be small. We adopt the instrumentation strategy in accordance with Lewbel (2012, 2021) by their order 1 delays. In addition, country and time fixed effects are integrated to correct for bias due to omission of variables.

It appears from Table 7 above that as a result of this instrumentation strategy, we find the persistence of the positive relationship between TS and economic growth in Sub-Saharan Africa. This relationship is statistically significant at 10%. And also, the results of the Hansen test show that the proposed instruments are valid.

## 5. Conclusion and Policy Recommendations

The objective of this article was to analyze the main effects of structural transformation on economic growth in Sub-Saharan Africa. We estimate this equation using the system-generalized moment method on a sample of 46 SSA countries observed between 1995 and 2020. The results of these estimates show that the SC of SSA countries promotes their economic growth on average across the sample. However, this effect is counteracted by the low value-added of exports.

**Table 7.** Double least squares estimator results.

| Instruments: | Order 1 delay | GMM in system |
|---|---|---|
| Indice de diversification | 0.084* | 0.177* |
| | (0.059) | (0.0803) |
| Observations | 1005 | 1015 |
| R-carré | 0.714 | |
| Control variables | No | |
| Time fixed effects | Yes | |
| Country fixed effects | Yes | |
| Hansen *p*-value | 0.326 | |
| Observations | | 1015 |
| Number àf countries | | 46 |
| Wald chi$^2$ | | 27.81 |
| Prob > chi$^2$ | | 0.001 |
| Number of instruments | | 41 |
| Sargan *p*-value | | 0.33 |
| AR1 *p*-value | | 0.001 |
| AR2 *p*-value | | 0.510 |

Robust standard deviations in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Source: Author.

These results obtained remain broadly stable when controlled by the different dimensions of the ST. In addition, they remain robust in the face of changing economic growth indicators and the use of competing estimators.

For an improvement in the contribution of SC to economic growth, we suggest the promotion of secondary and tertiary sector activities and the relative reduction of primary sector activities. This requires strengthening the level of human capital, increasing investment in energy and transport infrastructure, and improving governance. These measures will facilitate migration to a modern production base, capable of adapting to economic changes through strong diversification and the supply of higher value-added goods.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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