Global Value Chains and Industrialization in Africa

By

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and

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Bringing Rigour and Evidence to Economic Policy Making in Africa

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List of abbreviations and acronyms

2SLS	Two-Stage Least Squares
AfDB	African Development Bank
DVX	Domestic Value-Added Exports
ETGAMA	Ethiopian Textile and Garment Manufacturers Association
FDI	Foreign Direct Investment
FVA	Foreign Value-Added
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GMM	Generalized Method of Moments
GVC	Global Value Chain
IMF	International Monetary Fund
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PCA	Principal Component Approach
RVC	Regional Value Chains
SME	Small and Medium-sized Enterprises
SSA	Sub-Saharan Africa
2SLS	Two-stage Least Squares
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
WDI	World Development Indicators
WTO	World Trade Organization

Abstract

The objective of this study is to analyse the main effects of the integration of African countries in the global value chains (GVCs) on their industrialization level. To this effect, we have specified an industrialization equation that takes into account the economic characteristics of the continent. We have then estimated that equation by the system GMM estimator method on a sample of 51 African countries with panel data spanning the period 1996–2018 sourced from international organization databases. The findings of the estimations are the following: (1) the participation and the position of African countries in GVC positively contribute to their industrialization. The imports of intermediate goods facilitate the access to foreign machinery and technologies, which stimulate local production. Furthermore, the position in value chains that are limited to assembling activities would also allow for achievement of significant industrial progress; (2) the main factors influencing the indirect transmission of GVC to industrialization are the human capital and the physical capital; (3) the results are stable as shown by several robustness check tests related to different modalities of integration in GVC, to the conception of a new participation indicator in GVC, and to sub-regional specificities. On the basis of these results, we recommend policy actions to enhance participation, but also to improve the position in GVC, while at the same time an appropriate strategy would be designed to accumulate human capital and physical capital in the long term.

Key words: Industrialization; GVC; Africa; Dynamic panel; System GMM.

1. Introduction

Industrialization is one of the five accelerators[1] (named High 5) set up by the African Development Bank (AfDB) to ensure the economic transformation of the African continent. Furthermore, according to AfDB et al. (2017), structural transformation of Africa will not be achieved without industrialization, which is considered as the only way to ensure the economic emergence of the continent and promote the convergence of the living standards to that of developed countries. On the factual plan, recent works show that industrialization boosts employment creation, increase in productivity, access to capital, learning and innovation (Alexiou and Tsaliki, 2010; Haraguchi et al., 2017; Szirmai and Verspagen, 2015; Stiglitz et al., 2013). Industrialization reinforces the capacity of countries to export through diversification of economies that creates technical spillover effects (Duarte and Restuccia, 2010).

In the light of these theoretical underpinnings, industrialization constitutes a major issue for the African continent. Even though we observe that economic growth achieved significant performances[2] during the past few years in Africa, industrialization remained at poor levels and even dropped sharply in some African countries. For example, up until the 1980s, countries such as South Africa, Morocco, the United Republic of Tanzania and Zambia were among the most industrialized in the world (UNCTAD [United Nations Conference on Trade and Development], 2011). The end of the 1990s and early 2000s were marked by a dramatic change (Szirmai, 2012). The average share of the industrial sector in gross domestic product (GDP) in Africa dropped from 32% in the 1980s to 30%[3] in the 2000s, while the services sector has increased from 43% to 45% in the same period (Szirmai, 2012). Notwithstanding that global downward trend observed in Africa, there is a great deal of variation between individual countries. Ivory Coast, Egypt and Ghana registered an upward trend of manufacturing production in the 1980s and 2000s, as the share of this sector increased from 13% to 19%; 12% to 17%, and 8% to 9% in these countries respectively. The

1 To Feed Africa, Light up and Power Africa, Integrate Africa, and Improve the living standards of the populations in Africa are the other four components.

2 It stood at an average level of 4.9% between 1995 and 2020, against 1.28% between 1980 and 1994.

3The manufacturing production recorded the same trend, dropping from 12% to 14.

share of the industrial sector in Morocco remained stable, standing at 17% of GDP. However, in the majority of African countries, industrial production experienced a downward trend. These countries include: Democratic Republic of Congo (from 15% to 7%), Zambia (from 19% to 11%), Tanzania (from 12% to 7%), Nigeria (from 8% to 4%), South Africa (from 22% to 19%), and Kenya (from 13% to 12%).

This tendency to deindustrialization remains a big concern, since, historically, it was observed that deindustrialization occurred only after full development, allowing resources to move to services sector. Various studies (Felipe et al., 2014; Palma, 2005;Rodrik, 2016; UNCTAD, 2003) have shown that, in the past few decades, the share of employment and added value in the manufacturing industry peaked and started declining to lower levels of GDP per capita. This phenomenon has been called in the literature "premature deindustrialization" (UNCTAD, 2003).

In the face of this declining trend of industrialization, several national, regional and continental strategies have been set up to counter the deindustrialization in Africa. At the national level, emergence programmes designed in many countries have assigned an important role to industrialization strategies as the engine of development. At the regional level, for example, the emergence path of the Central African Economic and Monetary Community has been conditioned on two main variables; availability of power and the manufacturing industrialization rate. On the continental level, the African Union has placed the industrialization on top of its priorities, through its 2063 Agenda (Objective 4 of Aspiration 1).

The efforts made in the conception and the attempts to implement industrialization policies have led to various outcomes. Recent data from the World Bank[4] indicate two evidences. The first is illustrated by regions that experienced continuous deindustrialization since 2010. This is the case for Central Africa, where the industrialization rate dropped from 36.6% in 2010 to 28.69% in 2020 and Northern Africa (from 33.57% in 2010 to 27.19% in 2020). The same development is observed in Southern Africa (from 28.51% in 2010 to 25.86% in 2020), where the weight of South Africa could not compensate for the weak industrialization rate in the other countries. The second case is observed in Western Africa, where the industrialization rate increased from 19.79% to 22.38%, and in Eastern Africa, where performance improved from 19.19% to 21.62%. Due to these muted performances, Africa experienced a fluctuating development, that is, 23.04 % in 2010, 25.18% in 2015, and 27.8% in 2020. The main lesson to be drawn from these fundamental developments is that deindustrialization is accelerating more than industrialization, which explains the difficult economic transformation in Africa.

It follows from the above that the current state of industrialization in Africa remains a big concern, and above all that efforts have to be made to increase the share of industry, which is the engine of a sustained growth in Africa. The causes of that deindustrialization in Africa have been examined in many studies, in which many factors were highlighted, including: poor power infrastructures, transport, and

4 Available at https://donnees.banque mondiale.org/indicateur/NV.IND.TOTL.ZS

telecommunication (Rodrick, 2015; Rowthorn Ramaswamy, 1997); poorly designed agricultural policies that are not consistent with a growing industry (Page, 2012); poor production diversification, corruption problems, and credit markets failure (Boillot and Lemoine, 1992). Besides these constraints, the weak level of human capital, the difficult access to new technologies and the scarcity of financial resources are other obstacles to industrialization in Africa. At this level, integration into the global value chains can play a catalyst role.

Global value chains (GVCs) refers to a set of activities undertaken by entrepreneurs to process a product or a service from its conception to final use (AfDB, 2013). This process is illustrated by the exchanges of intermediate goods, which registered a strong increase in the world during the last two decades. The main players in this trade are in Eastern Asia, Europe and Northern America (Baldwin, 2012), with a participation of around 85%. Despite a modest increase of around 1.4% and 2.9% between 1995 and 2020 (UNCTAD, 2021), Africa is lagging far behind. And yet, as paradoxical as it may seem, Africa shows a higher integration to GVCs than other regions (notably Latin America and the Middle East). However, Africa has experienced more of a downstream integration than an upstream[5] integration (AfDB, 2018).

The participation of African countries in GVC may be an opportunity to boost industrialization for many reasons. First, in the past, industrialization was conditioned by the capacity to participate in all the important steps of the value chains of complex manufactured products. Today, by integrating an international production network, countries can create one part of the value chains without the required upstream capacities (Cattaneo et al., 2013; Gereffi and Lee, 2012; OCDE, 2013). Africa, where most of the countries are far away from the technology frontier, will not need to control the whole production process of a product. For its export basket to include high technological products, it is no more necessary to have the whole set of industrial capacities, only the capacities linked with the specialization area are needed (Baldwin, 2012).

Different African countries can be located in upstream or downstream in the GVC, depending on their specialization, and their situation can change over time. It follows that these countries can integrate into GVC by specializing in activities related to assembling of final products; they can further increase their participation by creating a competitive procurement base of intermediate goods (in developing relationships) and in improving the quality of their exports. More precisely, countries like Cameroon, Congo, and Gabon, which are well-endowed in wood resources, participate in furniture production by engaging in partial transformation before exporting. Ivory Coast can do the same with cocoa. The cases of cotton, coffee, and hevea sectors also have to be mentioned. The next step for these countries in the transformation process may relate to assembling electronic components, household appliances, and vehicles.

5 Upstream participation measures the national value-added contained in the exports of other countries, while downstream participation measures the foreign value-added included in the export of a country.

After a successful integration in GVC through downstream participation, industrialization of African countries can be reinforced if local firms improve their position in GVC through the following channels (Humphrey, 2004; Humphrey and Schmitz, 2002; UNCTAD, 2013a): (i) modernization of products: companies develop more finished products with higher value-added; (ii) modernization of production processes: local firms introduce new technologies or organizational innovations to produce more efficiently; (iii) functional modernization: companies engage in more elaborate processes (and more skill-intensive) in the chain (for example, advancing from assembling tasks and production of normalized inputs to the processing of high-technology components and to conception); (iv) advancement in the chains: the enterprises use the acquired skills in a chain to have access to another chain. For example, the manpower used in assembling electronic devices can be utilized in the automobile industry.

Industrialization can also originate from regional value chains (RVC). According to Banga et al. (2015), the latter constitute a way for firms to become competitive globally, as they allow them to accumulate capacities and enhance their competitiveness. According to the links theory of Hirschman (1977), those linkages may be classified in three categories: (i) the upstream linkages, for example, which can be established between forestry (for countries like Cameroon, Congo, Gabon etc.) and the exploitation materials (made in South Africa); (ii) the downstream linkages which can be observed between wood industry, sawmills and furniture manufacturing or between cotton production and tissue and cloth production. It would be the same case for cocoa, fuel, and hevea sub-sectors etc.; (iii) lastly, the horizontal linkages, which can be materialized by the adaptation of the forestry exploitation equipment (in Cameroon) to cocoa culture (in Ivory Coast).

For the impact of GVC and RVC on industrialization to be effective in Africa, it is necessary to focus on a well-elaborated industrialization policy. According to UNCTAD (2016), there is no universal recipe guaranteeing the success of an industrialization policy. Each country has to conduct its own experience and learn by doing through the implementation of its own industrialization policy. Even though disparities can be observed between African countries, some measures supporting successful policy may be highlighted. These measures include: the establishment of industrial duty free zones and special economic zones. Thanks to these zones, African governments can offer high quality infrastructures to enterprises, notably providing reliable power, communication channels, fast internet connections and various other fiscal incentives aiming to compensate for potential difficulties that may result from their installation. In the technology area, industrial policy instruments should facilitate the assimilation of foreign skills by supporting extension programmes and technology transfer.

From the above considerations, it seems that the African integration in GVC did not result in the expected industrialization level. The question is to know whether the integration model into GVC is appropriate. To this effect, we agree that the high specialization in the production of primary products explains the weak contribution of GVC to African industrialization. We show that evidence by considering the integration

in GVC through participation. To illustrate, we refer to the distinction made between upstream and downstream participation in GVC. Our core assumption is that better participation of African countries in GVC significantly improves industrialization. Our main objective is to determine the effects of the integration into GVC on the industrialization of African countries. More specifically, we intend to evaluate the effects of participation and position in GVC (upstream and downstream) on the industrialization of those countries.

The motivation of this study is manifold: first, at the logical level, the aforementioned situation of deindustrialization is a matter of concern, because industrialization is a key determinant of economic emergence (Hugon and Marquez-Pereira, 2011). Given the new paradigm in exchanges prescribing the integration into GVC, we find it relevant to highlight their contribution to the industrialization of African countries. Second, at the practical level, the study attempts to analyse the issue from a new perspective, since the question is not to examine the exchanges considering finished products, but rather taking into account the level of the value-added. By highlighting the role of GVC in industrialization, this study will contribute to the literature by examining the specific case of African countries. On the basis of the findings of this study, we want to provide African decision-makers with recommendations on the issues related to the content and composition of external trade.

We adopt a methodological approach in three steps to test our hypothesis. First, we capture industrialization by means of a composite indicator that we constructed using its main determinants. Further, to measure the integration into GVC, we use the participation and position indicator proposed by Wang et al. (2017b), which provides a refined measure of total participation of a country in GVC. The sensitivity analysis is performed using the upstream and downstream participation in GVC. Lastly, we use recent estimation methodology based on the Generalized Method of Moments (GMM) that is adapted to the analysis of panel data. More precisely, we estimate a two-stage system GMM model. This approach allows controlling for potential endogeneity problems and takes into account the specific country's unobserved effects as well as the time invariant effects. Lastly, the empirical results will be subjected to various robustness tests.

After this introduction, which constitutes Section 1, the rest of the paper is structured as follows: Section 2 outlines a brief review of the literature; Section 3 presents stylized facts on the industrialization and integration in GVC for African countries included in our sample; Section 4 highlights the methodology used in the study; Section 5 discusses the results of the study. Section 6 evaluates the robustness of the results, and Section 7 concludes.

2. The effects of integration into GVC: Findings from the literature

In the new image of globalization based on integration into GVC, firms and countries take part in international trade through specialization in specific tasks of GVC, rather than in goods and services. The effects of those GVC on industrialization have been examined in many studies. It emerges from the literature that GVC affect industrialization directly and indirectly.

The direct effects of GVC on industrialization

The direct effects of GVC on industrialization can be positive or negative. Regarding the negative effects, Altomone et al. (2012) claim that the participation in GVC implies higher vulnerability to the demand induced by the global economic cycles. According to Staritz (2011), this tendency is more pronounced in the upstream than in the downstream integration and persists in the developing countries, as the lead firms pass on the uncertainties to small sub-contractors and their employees. Likewise, GVC negatively affect industrialization following the risks linked to relocation and investments. In case these transaction and production costs are higher in developing countries than in industrial countries, the firms will decide either to repatriate the part of production that was previously relocated (Cattaneo et al., 2013; Olney, 2013) or to deal with producers or suppliers in other countries (Plank and Staritz, 2013). The strong specialization in GVC is also the cause of that negative effect. Indeed, the skills needed in some GVC cannot be used in other activities or employed to upgrade in higher value chain (Kawakami and Sturgeon, 2011), Organisation for Economic Co-operation and Development [OECD] et al., 2013).

Participation in GVC could also stimulate industrialization. Piermartini and Rubínová (2014) show that integration into GVC opens countries to trade and foreign investment, which encourages transfer of technologies and knowledge. According to the WTO, those transfers are influenced in two ways by the participation in GVC: first, the skills in production techniques are transferred through the exchanges of intermediate products,[6] which create spillovers; second, technology can also be transferred when

6 The technology transfers are more important in the case of intermediate goods imports—which have the tendency to increase with the integration into GVC—than in the case of final consumption good imports (Amiti and Konings, 2007). Amiti, M., & Konings, J. (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from Indonesia. American Economic Review, 97(5), 1611-1638.

foreign firms invest directly in the economy of a country.[7] According to Keller (2000), the spillovers are more important when imports come from developed countries[8]; for Acharya and Keller (2009) and Blacklock and Gertler (2008), the imports of equipment goods, machinery and ICTproducts also generate spillovers. Likewise, the integration to GVC allows firms to get new capacities that stimulate up-grading. In this way, firms can gain a higher share in GVC and consequently improve their competitiveness (Gereffi et al., 2005; Humphrey and Schmitz, 2002). The industrialization process can also be intensified through the upgrading strategy, notably the "processes upgrading" (Maertens and Swinnen, 2014; Javorcik and Spatareanu, 2009; Schmitz and Knorringa, 2000 the "functional upgrading" (IMF, 2013; Navas-Alemán, 2011; Gereffi and Memedovic, 2003), and the "inter-sectoral upgrading" (Draper and Lawrence., 2013; Giuliani et al., 2005; Reardon and Berdegué, 2002).

The indirect effects of GVC on industrialization

Besides those direct effects, other studies show that GVC affect industrialization indirectly through different transmission channels, notably: those linked to development strategies (UNCTAD, 2015), conducive environment for business (UNCTAD, 2013b), national capacities to produce (UNCTAD, 2013b), and environmental, social and governmental challenges (Kozul-Wright and Fortunato, 2012).

Regarding the first policy action, since GVC lead to specialization in activities rather than in products and services, the subsidies intended to develop a vertically integrated sector or the restrictions imposed to essential imports for export activities, are inefficient (Milberg et al., 2014).

The retention of foreign direct investment (FDI) becomes a necessity. In this respect, the commercial and investment policies can promote a conducive environment for investment by stimulating long-term partnerships and collaboration between foreign and local firms, and by creating a local group of secondary suppliers (UNCTAD, 2011,2013b).

Beyond the retention of foreign direct investments (FDI), the characteristics of the private sector in developing countries, the prevailing entrepreneurial spirit in the local economy, and the governance structure of GVC improve the industrialization level and development (Gereffi, 2014, 2015; Gereffi et al., 2005; Farfan, 2005; Humphrey and Schmitz, 2002). For example, the size of the firm is important to realize economies of scale and establish relationships with lead firms worldwide, and its real capacities which determine the potential of productivity growth and modernization to higher value added activities and more sophisticated products (Farfan, 2005).

7 See the analysis of GVC related to relocation strategy by Grossman and Rossi-Hansberg (2008).

8 Because they are assumed to have more important technology content than when they come from developing countries.

By contrast, if asymmetries in power and skills are very pronounced in a value chain, between lead firms and firms in developing countries, the damage incurred by the latter may be substantial. The lead firms in downstream activities can reduce the margin of upstream firms due to imposition of trade restrictions, customs duties and other taxes. They also have the possibility to hamper the technological development and the entry in downstream activities by limiting the transfer of skills and technologies or by imposing standards in the commercial and investment agreements (Milberg and Winkler, 2013).

To overcome these challenges, developing countries can help local firms in the negotiation of contracts with foreign firms, by encouraging long-term contracts; for example, by supporting collective negotiations through associations of producers, or by providing training in negotiation and drafting of contracts (Milberg et al.,2014; UNCTAD, 2011, 2013b).

Regarding the second policy action based on the creation and maintenance of a conducive environment for business, UNCTAD (2013b) underscores the importance of facilitating trade, for example, by rationalizing customs duties and port procedures, encouraging investments through the rationalization of entry procedures and creation of firms with foreign capital (registration, providing licences, access to land, personnel recruitment, and fiscal regime). Concerning the third action, linked to the enhancement of national production capacities, several measures have been identified: (i) the creation of groups and linkages to encourage competitiveness through a good knowledge of competitors, suppliers, and clients; (ii) the support to science and technology, to improve the quality of products and productivity, and the design of an efficient framework of intellectual property to enhance the confidence of lead firms in the use of advanced technologies; (iii) the creation of services dedicated to the development of firms through specialized bodies and capacity enhancement structures; (iv) the promotion of entrepreneurship through firm incubation centres, training and support in capital-risk; and (v) the access of small and medium-sized enterprises (SMEs) to finance in order to support the development of national capacities and allow the SMEs to grow and reach a minimum volume of production.

The environmental, social and governmental challenges constitute the fourth channel. In this respect, the working conditions in firms participating in GVC have been a matter of concern, in particular, when the FDI are seeking cheap labour in countries having relatively weak regulatory frameworks. Global value chains have even the ability to facilitate the relocation of pollutant production processes in developing countries (Kozul-Wright and Fortunato, 2012). In this respect, governmental policies of public purchases can impose the respect of international labour standards, human rights, and environment. Furthermore, the duty free zones for export industry are able to provide assistance in matters related to labour, to inform firms on appropriate regulations and provide supporting services. Lastly, regarding good governance, some cases of repatriation of part of profits by branches of foreign firms have been observed,

leading to the inability of government in hosting country to use the value-added in the country. The public authorities have been setting up more and more restricting regulation frameworks in the area, by inflicting fines and sanctions to breaching firms.

It follows from the above literature review that the integration into GVC has a direct and indirect influence on industrialization; but what about the case of the African continent? The following section presents some stylized facts on the issue.

3. Industrialization and GVC: Measures and stylized facts

Measures of industrialization

Industrialization refers to the process by which the transformation of primary products allows to obtain products with higher value-added (Chandra, 1992). It allows at the same time to absorb the excess of agricultural labour and reduce the dependence of the African continent on exploitation of natural resources.

Several industrialization indicators have been defined in the literature. Some of them are: (i) the consumption spending of the industrial sector or the consumed value-added in the industrial sector (Herrendorf et al., 2013); (ii) the share of employment in the industrial sector compared to total employment (UNCTAD, 2016); the share of value-added of the industrial sector in GDP (Lectard, 2017; Neuss, 2019); and the share of manufacturing value-added in GDP. This measure captures the capacity of countries endowed with abundant natural resources to transform them into intermediate and final goods (Di Maio, 2009).

Due to the limits of these unidimensional indicators, Sarma (2008) has constructed a composite indicator for industrialization. The relevance of this indicator can be understood from different levels: (i) it allows to combine some factors enabling to explain the current state of the industrialization of Africa. For example, industrialization in Eastern Africa is mainly based on tourism and minerals. In Central Africa, in some countries (Congo and Equatorial Guinea), industrial policies are based on the natural resources transformation models. In Cameroon, the industrial policy is partially based on the transformation of natural resources, but with more focus on agro-industry activities. In North Africa, in general, electrical, mechanical and electronic industries have witnessed an important change, following the development of activities related to automobile and aeronautic components.

The estimation of the composite industrialization indicator (ICIndus) for Africa has been computed in the form of a geometric average as follows:

$$ICIndus_i = 1 - \frac{\sqrt{(1-f_{1t})^2+(1-f_{2t})^2+\cdots+(1-f_{nt})^2}}{\sqrt{n}} \quad (1)$$

Where: f_{it} represents i factor that is associated with time t. There

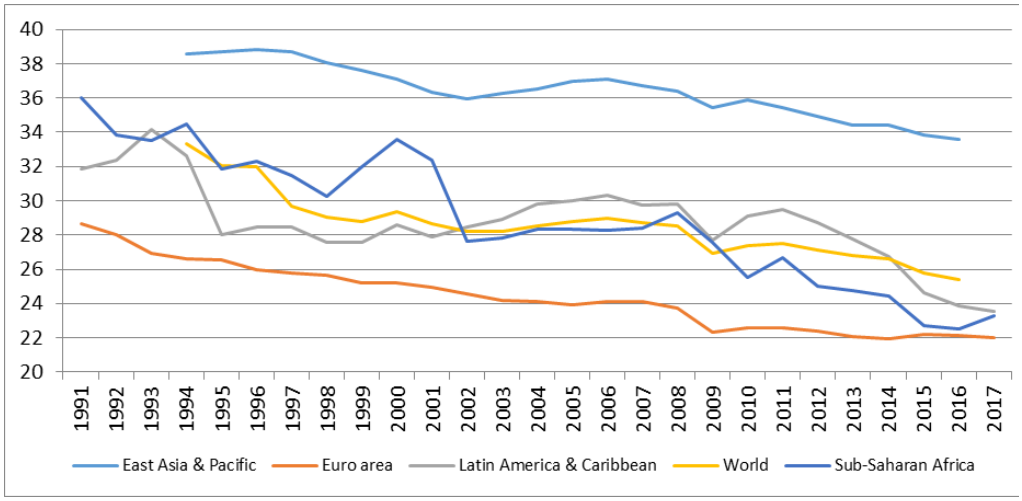
are six components of the indicator (the f_{it}): (i) the value-added of the industry in GDP; (ii) the share of employment in the industrial sector compared to total employment; (iii) the human capital represented by the secondary school enrolment rate; (iv) the power consumption represented by the number of Kwh per 1,000 inhabitants; (v) the number of tractors per 100 square kilometres; and (vi) the value-added of agriculture in GDP. In general, these components are ratios interpreted as percentages. The agricultural activity is not fully developed in all the countries.

Despite its relevance, the indicator is estimated by geometric average, which is not appropriate in this case, since it is based on theoretical weights. To circumvent this limit, we adopt the principal component analysis (PCA) approach which uses non-uniform weights that take into account the variability of the data. It is based on empirical weights resulting from internal characteristics that determine the trend of the data. Knowing that the selected data come from different sources and consequently reflect the heterogeneity of the measuring units, therefore, it is preferable to rely on the bounded principal component analysis (Baccini et al., 1996).

Industrialization in Africa: Some stylized facts

We first present a comparative evolution of industrialization in Africa and other regions in the world, and then we highlight the differences existing between the different sub-regions in the African continent. It may be observed in Figure 1 that industrialization, represented by the share of the industrial sector in GDP, registered a declining trend between 1991 and 2017. However, this development is not unique to Africa, as the other regions witnessed the same trend. We also observe that Africa is not the worst ranked, because, even though Africa is the worst performer compared to Asia and Pacific, the performances realized in Africa are far better than those observed in Europe and Latin America, and higher than the world average.

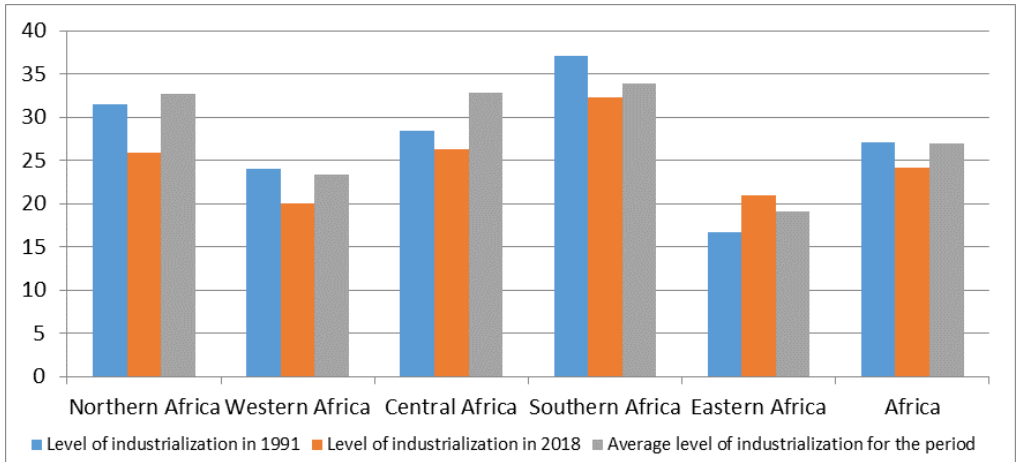
Figure 1: Evolution of the industrialization in different regions of the world



Source: Authors' own construction based on the World Development Indicators (WDI) database (World Bank, 2021).

Figure 2 presents a comparison in the development of the industrialization level (as a percentage of the value-added of the manufacturing sector in GDP) between the African sub-regions and the average level for the whole period. This development may be subject to different interpretations. First, we observe that the general average of the industrialization in Africa is relatively weak (exactly 26.9%). For most of those sub-regions, the trend is declining, that is, the share of the industrialization has declined between 1996 and 2018, except for the Eastern Africa, which registered an upward trend (rising from 16.32% to 20.98 % in the same period). The Southern Africa is the most industrialized sub-region. This development may be explained by the presence of South Africa which is the engine of development, not only for that sub-region, but also for the continent.

Figure 2: Industrialization level between the different sub-regions



Source: Authors' own construction based on the WDI database (World Bank, 2021)

Global value chains: Measures and stylized facts in Africa

Measures of GVC

Several generations of GVC measures can be found in the literature. The first measure identifies the integration into GVC through the exchanges of intermediate goods. This notably consists in the share of intermediate goods in the imports, in the exports, and finally in the total international trade of a country. But the main limit of those indicators is that they do not take into account the size of the economy. To solve this problem, Dullien (2010) suggests the share of intermediate goods in GDP. The criticism on this indicator, as well as to its predecessors, is that they do not show the relative position of each country in GVC. That is why the ratio between imports and exports of intermediate goods has been proposed. This ratio allows to determine the position of a country in GVC, since a country that is active in the upstream GVC will import less intermediate goods than it exports, and consequently, its ratio will be lower. By contrast, a country that is involved in the downstream GVC, will import more intermediate goods than it exports; its ratio of intermediate goods imports on exports will be higher. This ratio is also criticized to the extent that a country that imports substantial quantities of intermediate goods for the production of locally consumed products will have the same score as a country which imports and re-exports important quantities of intermediate goods.

Beyond specific critics to each of the indicators presented above, we can observe that they have a common drawback—they are unable to highlight the contribution of the value-added of each country to GVC. The next generation of those indicators attempts to take into consideration those limits by integrating the content in value-

added. Several indicators have been suggested: (i) the upstream participation, which captures the foreign value-added (FVA), which is included in the exports of a country; (ii) the downstream participation, which measures the content of national value-added in the exports of other countries (DVX); and (iii) the participation indicator (IP) in GVC (Wang et al., 2017b), which uses the gross exports as a weight for the sum of the two previous measures and provides an indicator of the participation of a country in GVC.

Following the above precisions, the participation indicator (IP) to GVC is estimated as follows:

$$IP = \frac{FVA}{X} + \frac{DVX}{X} IP = \frac{FVA}{X} + \frac{DVX}{X} \quad (2)$$

Where: X represents gross exports of the country. A relatively high value of the IP implies a strong participation in GVC.

To analyse the sensitivity of the indicator, we examine the effect of the different components (upstream and downstream participation) on the structural transformation. This choice is motivated by the nature of the information provided by these components, notably the total value-added by the individual country and the foreign value-added in the good exported by the country. This allows observing that the intermediate good imported by the country is subject to some transformation process. It is the same case for the indicator providing information on the local value-added in a good that is produced and locally consumed or exported. In either case, it is obvious that the local economy intervenes in the process of goods production. It is this production process that stimulates structural transformation. We know indeed that the level of intervention of a country in GVC determines the development of its structural transformation. A country that is involved in upstream interventions in GVC increases the value in the intermediate goods imported from another country before local consumption or export of that product. Likewise, the value-added included in the exports of other countries reflects the intervention of the domestic country in the production process and consequently, this intervention contributes to structural transformation.

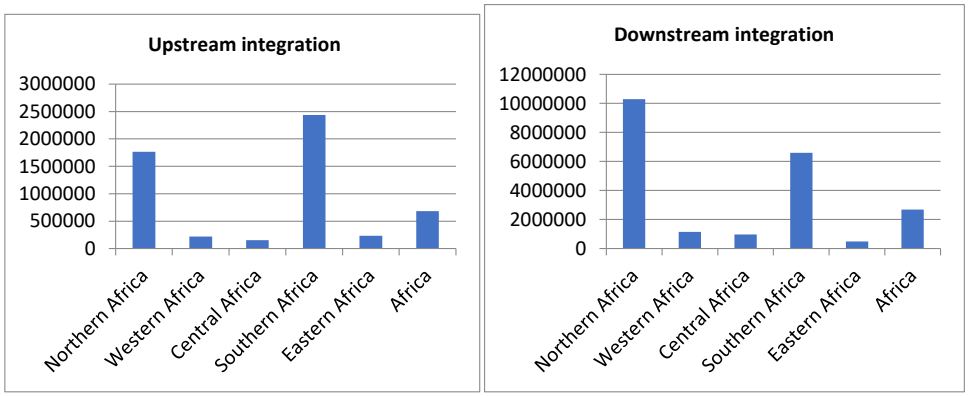
Stylized facts on the participation of Africa in GVC

Two main facts may be highlighted. The first is that, Africa integrates into GVC more through downstream than upstream participation. The second refers to the different developments observed in the specific sub-regions.

Figure 3 presents the upstream and downstream participation of the different African sub-regions in GVC. It shows that the downstream participation is stronger than the upstream participation. More precisely, the foreign value-added in the exports of sub-Saharan African (SSA) countries is lower than the value-added of those countries in the exports of other countries. This is explained by the fact that Africa, which is endowed with abundant natural resources, exports these natural resources more

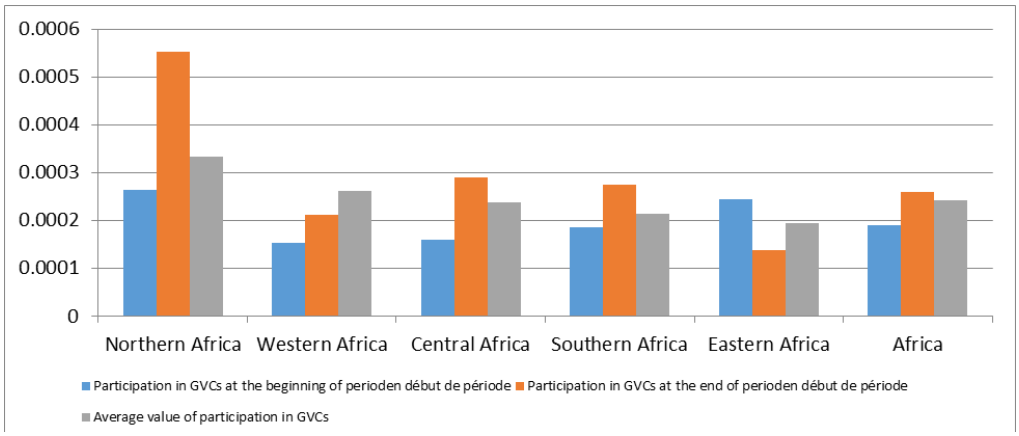
than it imports intermediate goods. In the different sub-regions, it is the Southern African sub-region that has the strongest upstream integration, with South Africa exhibiting the best score. Northern Africa has the best downstream performance. Central Africa registers the least upstream integration, while Eastern Africa exhibits the lowest performance for the downstream integration.

Figure 3: Upstream and downstream integration of African sub-regions in GVC



Source: Authors' own construction based on the UNCTAD-Eora Global Value Chain Database (2022).

Figure 4: Participation indicator of African sub-regions in GVC



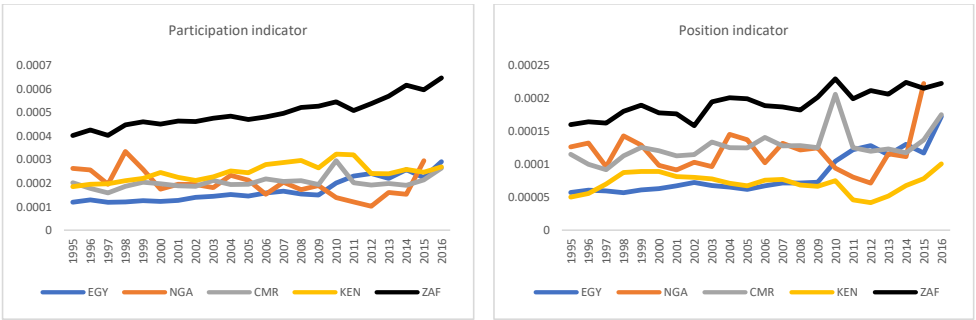
Source: Authors' own construction based on the UNCTAD-Eora Global Value Chain Database (2022).

Figure 4 presents the participation indicator of the African sub-regions in GVC. This indicator accounts for the upstream and downstream participation. It represents the sum of foreign value-added in gross exports (upstream participation) and the local value-added in the form of intermediate inputs in gross exports of other countries (downstream participation). We note that Africa in general, and the sub-regions in

particular, have registered an increasing trend of this participation during the period between 1996 and 2018. Northern Africa is ranking first in this participation, while Eastern Africa exhibits the worst performance.

Concerning the dynamics of GVC indicators by country, Figure 5 shows an ascending trend in general, even though it is not significant in several sub-regions or in the included countries. As regards the participation in GVC, countries that recorded the most significant performances between 1996 and 2018 are Egypt and South Africa, with respective growth rates of 144.23% and 60.86%. Countries such as Cameroon (30.8 %) and Nigeria (12.3%) recorded low progress, while Kenya registered a median performance with a score of 45.27% during the same period.

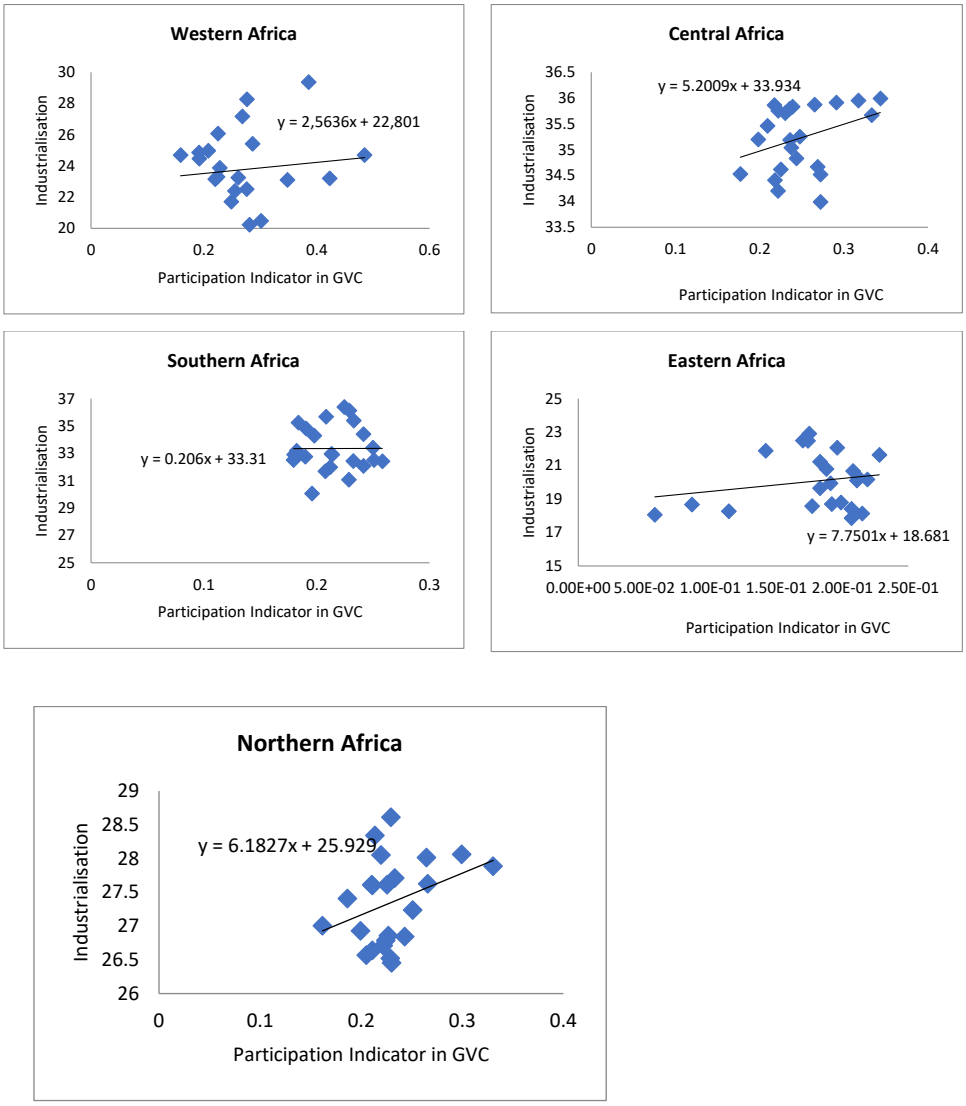
Figure 5: The dynamics of GVC indicators in some countries (1996–2018)



Source: Authors' own construction based on the UNCTAD-Eora Global Value Chain Database (2022).

The visual inspection of the correlations (Figure 6) reveals the existence of a positive relationship between the participation in GVC (participation indicator in GVC) and the industrialization (relative change of employment in the industrial sector) in Africa as well as in the sub-regions. The interventions of this part of Africa in the international process of goods production through the imports and exports of intermediate goods contribute to the improvement of the structural transformation.

Figure 6: Correlations between industrialization and participation in GVC in SSA



Source: Authors' own construction based on the UNCTAD-Eora Global Value Chain Database (2022) and WDI (2021).

4. Methodology of the study

Specification of the empirical model

In its reduced form, the model to be estimated is presented as follows:

$$ICIndusit = \alpha + \beta GVCit + \varphi Xit + \varepsilon it \quad (3)$$

Where: *ICIndsus* represents the composite measure of industrialization, as calculated by the methodology described earlier.

GVC is the variable of interest that captures the level of integration of African countries in GVC. We consider the participation indicator estimated according to the methodology proposed by Wang et al. (2017b), which provides a refined indicator of total participation of a country in GVC. The sensitivity analysis is performed using the upstream and downstream participation indicators in GVC.

X is the matrix of control variables, including real GDP. It is modelled in level with additional squared term, in order to test the "U" shaped relationship between GDP and industrialization or deindustrialization as hypothesized by Clark (1957). The urbanization level (*Urb*) of the country is proxied by the population living in urban areas. This variable captures the level of the demand for produced goods. The human capital (*Hum_Cap*) is captured by the level of secondary school enrolment rate. This variable facilitates the absorption of new technologies that are necessary for industrialization (Alaya et al., 2009). The gross fixed capital formation (*GFCF*) measures investment as a percentage of GDP in constant prices. This variable represents the accumulation of physical capital and increases the manufacturing value-added (Barios et al., 2005). The institutions are also accounted for. Following Humphrey and Schmitz (2000) and Dollar and Kidder (2017), this variable is calculated on the basis of an average indicator of the World Bank (2021).[9]

The set of explanatory variables will help to evaluate the influence of modern changes on industrialization. Indeed, the production of manufactured goods is generally capital-intensive and any change in investment affects the demand for manufactured goods (Rowthorn and Coutts, 2004). Following Brady et al. (2011), we observe that the industrialization process requires minimal global progress that may be represented by a number of factors such as urbanization, education, and physical capital formation.

9 Voice and accountability, political stability and absence of violence, government efficiency, quality of regulation, rule of law, and control of corruption.

To evaluate the effect of the transmission channels which captures the indirect effects of GVC on industrialization, we take into account the interactive variables in the following model:

$$Indus\text{it} = \alpha + \beta GVCit + \varphi ITit + \varepsilon it \quad (4)$$

IT captures two interactions. The integration may influence industrialization through the human and physical capital or through the gross fixed capital formation (Ouyang and Fu, 2012).[There are then four interactive variables, since we have selected two indicators for GVC.

The model to be estimated is specified as a dynamic panel and takes the following form:

$$Indus_{it} = \beta_0 + \beta_1 Indus_{i,t-1} + \beta_2 \ln(GDP_{it}) + \beta_3 \ln(GDP_{it}) squared + \beta_4 Urb_{it} + \beta_5 HumCap_{it} + \beta_6 GFCF_{it} + \beta_7 Inst_{it} + \beta_8 GVC \quad {}^{j}_{it} + \beta_9 GVC^{j}_{it} * HumCap_{it} + \beta_{10} GVC^{j}_{it} * GFCF_{it} + \varepsilon_{it} \quad (5)$$

Where: GVC^{j}_{it} is the indicator of the value chains, with j = {Participation, Position}. Both indicators will separately be taken into account; this implies two different specifications.

Presentation of the sample and data used in the study

The sample includes 51 countries (see the list in Table A1 in the appendix). The data of the study, the descriptive characteristics of which are presented in the appendix, cover the period 1996–2018. The choice of the period was constrained by the availability of the data on the institutional indicators and GVC. They have been sourced from databases of international organizations and research centres (Table A1 in the appendix).

Table 1: Matrix of correlations between the main variables of the study

	A	B	C	D	E	F	G	H	I	J	K
A	1.0000										
B	0.1987	1.0000									
C	0.0037	0.7538	1.0000								
D	0.2928	0.7950	0.2008	1.0000							
E	0.1321	0.9636	0.9020	0.6040	1.0000						
F	-0.1030	0.1480	0.3225	-0.0770	0.2284	1.0000					
G	-0.1012	0.1609	0.3327	-0.0672	0.2411	0.9992	1.0000				
H	-0.1187	0.1688	0.1925	0.0740	0.1892	0.2523	0.2653	1.0000			
I	0.0780	0.1974	0.0267	0.2697	0.1405	0.1940	0.1898	0.1073	1.0000		
J	-0.0310	-0.0487	-0.0665	-0.0113	-0.0591	0.0081	0.0024	0.1219	0.1414	1.0000	
K	0.1594	0.1007	-0.2443	0.3756	-0.0332	0.0264	0.0267	0.1997	0.2432	0.1028	1.0000

Notes: A = Industrialization Indicator; B = Participation Indicator in GVC; C = Position Indicator in GVC; D = Upstream Integration in GVC; E = Downstream Integration in GVC; F = ln GDP; G = ln GDP Squared; H = Urban Population; I = Education; J = Investment rate; K = Institutions Indicator.

Source: Authors.

As shown in Table 1, the correlations between the majority of the variables are not high, suggesting that there is no serious multicollinearity problem. Regarding the variables of interest, Table 1 shows that the participation and position indicators in GVC are strongly correlated (0.7538), implying potential multicollinearity. To remedy the problem, we integrate them separately in the regressions. We also note the existence of a positive relationship between industrialization and the integration into GVC. This preliminary analysis justifies the use of more advanced econometric techniques.

There are many ways to model industrialization. The first approach would be the conventional modelling techniques; that is, the ordinary least squares (OLS) and the linear panel techniques (fixed and random effects). However, these methods are not able to control for the potential endogeneity due to omitted variable bias or to reverse causality between industrialization and its determinants. Concerning reverse causality, industrialization and production influence each other: a strong production inducing a strong growth may lead to a higher manufacturing value-added, which in turn can be supported by growth. This analysis can be generalized to the variables of GVC.

Indeed, the more industrialized a country is, the more it will be involved in GVC, because its production capacity allows it to provide inputs or finished products to other countries. On the other hand, a strong participation in GVC stimulates modernization of the production system and the capacity to provide more and more sophisticated products, which leads to trade upgrading and increase of market shares. To control for this bias, many authors use the instrumental methods, which has two alternative estimators; that is, the two-stage least squares (2SLS) and the generalized method of moments (GMM). However, when the time span is short compared to the number of individual units (Roodman, 2009), with the potential presence of heteroscedasticity, it is recommended to use the GMM approach.

In this respect, when the lagged values of the first differences of the endogenous variable are used as instruments, Holtz et al. (1988) and Arellano and Bond (1991) have developed a GMM estimator in difference. However, Arellano and Bover (1995) and later on, Blundell and Bond (1998) have shown that when the endogenous variable is persistent, the lagged values are very poor instruments. Using additional conditional moments, these authors have developed the system GMM estimator, which is a more robust estimator than the GMM in difference. This method (system GMM) will be used in this study. It combines equations in level and in difference. These equations are estimated simultaneously. The variables are instrumented by their first differences and their lagged values, which must be validated by the Sargan and Hansen test. Furthermore, there should not be a second order correlation as suggested by Arellano and Bond (1991).

5. Analysis of the results and transmission channels

Preliminary results

Table 2 presents the results for the whole sample, taking into account the participation and the position indicators. These results show an important memory effect of industrialization. In other words, the industrialization dynamics depend on its own past performances. This auto-regression is significant at 1% significance level in all the specifications.

Regarding our variable of interest, we have obtained the expected result. Indeed, countries that are integrated into GVC have the tendency to be industrialized. These results, which are not consistent with those found by Baldwin and Venables (2013), Draper and Lawrence (2013), Gimet et al. (2010) and Kaplinsky (1998), are in line with the results of the OCDE (2013), Fernandez-Stark et al. (2011), ETGAMA (2014), Palpacuer (2000). Indeed, the participation in GVC has a positive and statistically significant sign. This result means that the integration of African countries in the international production process creates more opportunities for industrialization. This is made possible, not only by the access to intermediate goods, but also access to foreign technology and knowledge. Likewise, the position in GVC improves industrialization but has a lower significance level in some specifications. Those results reveal that the assembling tasks, which constitute the core of the interventions of SSA countries in GVC should be developed further. A strong upgrading is necessary to bring about a significant improvement.

The traditional variables of the model have in most cases the expected signs, but with different significance levels. The production level is an important determinant of industrialization in Africa. The estimates reveal that GDP is positively associated with industrialization. In other words, good macroeconomic performances stimulate industrialization in Africa, even though this relation is subject to a threshold. Indeed, beyond a specific production level, the composition of GDP changes and the share of industrialization declines, while that of services increases, providing evidence, as predicted by theories, that services develop higher value-added. This non-linearity that is captured by the squared term of the variable “ln GDP” in the model, has been tested the first time by Clark (1957) and was later theoretically demonstrated by Rowthorn and Wells (1987); it may be concluded that there is an inverted “U” shaped relationship between production and industrialization.

The urban population plays an important role in industrialization in Africa. This variable has been integrated in the model to capture the potential role of the market size as an engine for industrialization; it plays a positive role in the case of African countries. Indeed, the demographic growth in urban areas looks fundamental for industrialization in Africa, due to its contribution to development in these countries. Indeed, the two variables are linked in various ways. The first link is the consumption by middle class people associated with urbanization. The increase of incomes leads to higher discretionary expenditures. This kind of expenditures changes consumption habits and induces a higher demand of manufactured good for consumption and urban constructions. These changes lead to new markets for industry. Many recent works discuss on the relationship between the two variables (Rabb and Rotberg, 2014; Gollin et al., 2016; Rees, 2016; Avtar et al., 2019; Davenport, 2020).

Table 2: GVC and industrialization in Africa

	Dependent Variable : Industrialization Composite Indicator													
	Participation Indicator							Position Indicator						
L,Indicator	0,958***	0,985***	0,917***	0,951***	0,947***	0,936***	0,965***	0,945***	0,998***	0,954***	0,966***	0,975***	0,989***	0,917***
	(0,0086)	(0,0025)	(0,0163)	(0,0158)	(0,0092)	(0,0127)	(0,0151)	(0,0099)	(0,0035)	(0,0197)	(0,0112)	(0,0065)	(0,0173)	(0,0157)
Participation	**0,114*** **	**0,112*** **	**0,119*** **	**0,0791*** **	**0,0869** **	**0,0804*** **	**0,0781*** **							
	(0,0151)	**(0,0145)**	**(0,0232)**	**(0,0198)**	**(0,0411)**	**(0,0202)**	**(0,0208)**							
Position								**0,119*** **	**0,112*** **	**0,180*** **	**0,113** **	**0,117***	**0,0261** **	**0,0306** **
								(0,0395)	**(0,0410)**	**(0,0555)**	**(0,0456)**	**(0,0615)**	**(0,0131)**	**(0,0152)**
Ln(GDP)		0,0714***	0,496***	0,382***	0,412***	0,0735**	0,0323**	0,0857***	0,665*	0,414**	0,324***	0,567***	0,602*	0,565*
		(0,0139)	(0,0795)	(0,0413)	(0,0342)	(0,0358)	(0,0162)	(0,0172)	(0,361)	(0.2059)	(0,0509)	(0,1338)	(0,3545)	(0,330)
Ln(GDP) squared			-0,014**	-0,010*	-0,011*	-0,003**	-0,0003**		-0,013**	-0,011*	-0,007*	-0,013*	-0,011*	-0,011**
			(0,0071)	(0,0060)	(0,0065)	(0,0015)	(0,00015)		(0,0065)	(0,0066)	(0,0042)	(0,0077)	(0,0056)	(0,0055)
Urban population				0,185***	0,174***	0,0457***	0,0683***				0,202***	0,181***	0,178***	0,0637***
				(0,0329)	(0,0364)	(0,0126)	(0,0133)				(0,0343)	(0,0376)	(0,0377)	(0,0128)
Education					0,00199	0,00147	0,000490					0,00234*	0,00121	0,00148
					(0,00136)	(0,000913)	(0,000947)					(0,00140)	(0,00119)	(0,000989)
Investment						-0,00139	-0,00185						0,00212*	-0,00222
						(0,00153)	(0,00135)						(0,00119)	(0,00135)
Institution							0,213***							0,236***
							(0,0381)							(0,0358)
Constant	0,409***	2,058***	2,932	2,678	2,082	-0,111	1,256	2,525***	9,215**	2,660	2,539	4,712	-8,760	7,505*
	(0,0306)	(0,323)	(11,07)	(7,380)	(9,279)	(3,778)	(3,855)	(0,388)	(4,238)	(12,90)	(8,113)	(9,344)	(8,505)	(3,855)
Observations	1 037	1 020	1 020	1 020	811	776	739	1 020	1 020	1 020	1 020	811	776	739
Number of countries	51	51	51	51	50	50	50	51	51	51	51	50	49	49
Number of instruments	48	47	49	41	44	45	46	48	47	49	41	44	45	46
AR1 p-value	0,0056	0,0258	0,0684	0,0340	0,0421	0,0326	0,0215	0,0048	0,0568	0,0257	0,0369	0,0004	0,0047	0,0058
AR2 p-value	0,3538	0,2756	0,7422	0,7863	0,7867	0,5732	0,6115	0,5698	0,2547	0,4569	0,2365	0,4526	0,4557	0,8756
Hansen p-value	0,6978	02556	0,3635	0,2547	0,5889	0,4578	0,5843	0,4786	0,2638	0,4512	0,8963	0,2568	0,1557	0,1958

Notes: Robust standard deviations in parentheses; *** p< 0.01, **p< 0.05, *< 0.10.

The results also show that institutions are a determinant of industrialization in Africa. In contrast to the neoclassical theory for which institutions have no effects on the economy, the new institutional school focuses on the role of institutions. In this respect, specifically according to the works by North (1991), good quality institutions are an important determinant of economic development. Studies such as those by Asiedu (2003) on 22 sub-Saharan African countries reveal that, efficient institutions, economic and political stability, and low levels of corruption encourage inflows of private capital, which stimulate transformation industries. Daude and Stein (2007), note that instability and political violence, government efficiency, regulatory restrictions, rule of law, and corruption have a significant effect on the industrialization process. However, the representation and policy accountability indicators have a non-significant impact. This conclusion, theoretically discussed in Barro (1996) has been revisited following new empirical works (Babalola & Shittu, 2020; Armstrong, 2021).

Education plays a positive role on industrialization; however, this effect is not strong enough. Yet, a high education level allows a faster absorption of new technologies and higher return. In contrast, investment would rather be considered as a deindustrialization factor in Africa. Due to the great gap in human capital, the capital expenditures in Africa are more oriented to social projects such as hospital and schools, while fewer resources are invested in industrialization. Furthermore, the firms in charge of providing these investment services are most of the time foreign companies, which induces the export of the industrial value-added. Even though the capital expenditures increase in some African countries, these are meant for repairs and maintenance of existing structures, which implies a very low real value-added, in some cases it may even be inexistent. In most countries, a trend to deindustrialization has even been observed during the 1980s, and the effects of this trend are being witnessed today. Significant segments of the industry have disappeared in textile, mechanical activities, and others.

Transmission channels

The effects of GVC on industrialization may be direct or indirect. Considering the latter case, intermediary variables have been identified that may enhance or limit that effect. In this respect, two channels have been identified, i.e., the human and physical capital (Ouyang & Fu, 2012). In order to evaluate their impact on the relationship between industrialization and GVC, we calculate interactive variables with participation and position indicators. The results, presented in Table 3, show that for the two indicators, human capital is the most relevant interactive variable as it reinforces the positive effect on industrialization in the presence of GVC. In other words, the impacts of GVC are perceptible when competent and skilled people are working in the production process to modernize it and improve the quality of the goods produced. In other words, knowledge transfer through participation in GVC improves industrialization. By contrast, the efficiency of physical capital will be limited in an environment where its optimal use is constrained by macroeconomic and political instability, and bad quality institutions.

Table 3: Transmission channels

	Dependent Variable: Industrialization Composite Indicator					
	Participation			Position		
Participation	-0,133	0,140***	-0,127			
	(0,0836)	(0,0401)	(0,0804)			
Part*human capital	0,00215**		0,00317***			
	(0,000876)		(0,000871)			
Part*physical capital		-0,00289**	-0,00474***			
		(0,00128)	(0,00121)			
Position				-0,0822	0,136	-0,137
				(0,144)	(0,0914)	(0,141)
Pos*human capital				0,00114		0,00336*
				(0,00157)		(0,00204)
Pos*human capital					-0,00452*	-0,00706**
					(0,00273)	(0,00336)
Lag and controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	739	739	739	739	739	739
AR1 p-value	0,0564	0,0047	0,0068	0,0007	0,0579	0,0056
AR2 p-value	0,1442	0,1408	0,1645	0,0774	0,1066	0,1133
Number of countries	50	50	50	50	50	50
Instruments	47	48	42	45	48	47
Hansen p-value	0,2569	0,2547	0,3657	0,4558	0,5684	0,4586

Notes: Robust standard deviations in parentheses; *** p< 0.01, **p< 0.05, *< 0.10.

6. Robustness check of the results

Four robustness check tests of the results are performed in this article. The first consists in using an alternative estimation technique to control for endogeneity. The second takes into account the two modalities of integration into GVC, that is, the downstream and upstream integration. In the third test, we evaluate participation in GVC while controlling for the weight of the national production and not that of the exports. In the last test, we test the robustness of our results in the different African sub-regions with the view to capturing the specificities of the sub-regions.

Controlling for endogeneity by the two-stage least squares technique

Endogeneity is a fundamental issue in econometrics. If it is possible to control for dual causality bias by the system GMM, this methodology would not be appropriate in case of omitted variables and measurement errors. In the presence of this new source of endogeneity, it is advisable to use the 2GLS estimator, which consists in employing a relevant instrument for the explanatory variable that is suspected to be endogenous, in particular when it is assumed that heterogeneity is weak. We adopt two strategies to instrument the variables. In a first step, GDP and GVC indicators are considered as endogenous, they are then instrumented following Lewbel (2012, 2021) with their first order lags. In a second step, we will use an external instrument by selecting alternative variables as instruments. On the basis of the approach proposed by Frankel and Romer (1999) and Feyrer (2009), Kummritz (2016) recommends the use of the average commercial costs (customs duties) as the instrument of GVC indicators. Furthermore, the country and time fixed-effects are integrated to control for the omitted variables bias.

Table 4: Two-stage least squares estimator

	Dependent Variable: Composite Industrialization Indicator			
GVC indicators:	Participation		Position	
Instruments:	Lag of order 1	Commercial costs	Lag of order 1	Commercial costs
Participation	0,112***	0,112***		
	(0,0226)	(0,0237)		
Position			0,168***	0,166***
			(0,0537)	(0,0558)
Observations	986	970	986	970
R-squared	0,737	0,755	0,721	0,738
Control variables	No	Yes	No	Yes
Time fixed-effects	Yes	Yes	Yes	Yes
Country fixed-effects	Yes	Yes	Yes	Yes
Hansen p-value	0,2292	0,1487	0,5502	0,3475

Notes: Robust standard deviations in parentheses; *** p< 0.01, ** p< 0.05, * p< 0.1.

Following these instrumentation strategies, the robustness of the positive relationship between industrialization and GVC in Africa is recovered. This association is robust at 1% significance level, as shown in Table 4. Moreover, the instruments used are valid as illustrated by the Hansen test.

Downstream, upstream integration and industrialization in Africa

The participation in GVC depends on the capacity of the country to be involved in an upstream or downstream integration. This allows accounting for the limits of the aggregated GVC measure by integrating the content of the value-added.

Table 5: Downstream and upstream integration

	Dependent Variable: Composite Industrialization Indicator			
VARIABLES	Upstream Integration		Downstream Integration	
Upstream integration	0,470***	0,182**		
	(0,0569)	(0,0895)		
Downstream integration			0,116**	0,0788***
			(0,0572)	(0,0295)
Observations	982	735	982	735
R-squared	0,181	0,791	0,729	0,094
Lag and control variables	No	Yes	No	Yes
AR1	0,0078	0,0254	0,0468	0,0236
AR2	0,2486	0,8569	0,5463	0,2489
Number of countries	50	49	50	49
Number of instruments	47	45	44	45
Hansen p-value	0,1089	0,2581	0,1774	0,2450

Notes: Robust standard deviations in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

The upstream integration stipulates that the foreign value-added is predominant in the exports of a country. In addition, the downstream integration captures the national value-added in the exports of other countries. To test for this difference, we consider separately the indicators that have been calculated in accordance with the literature (Wang et al., 2017a).

The results obtained by the system GMM estimator (Table 5) validate the relevance of the two integration dimensions in GVC as explanatory variables of industrialization in Africa. However, the effect seems more significant for the downstream integration, reflecting that foreign value-added is predominant in the African exports. It follows that Africa participates in GVC due to the intermediate production of other countries and not due to its own intermediate production. While encouraging, this result reflects the dependence of African production system to foreign inputs and processes.

Proposal of new indicators of participation in GVC

We follow Wang et al. (2017a) who proposed alternative measures of participation in GVC that take into account the limits of the traditional approach developed by Hummels et al. (2001) and Koopman et al. (2014). Indeed, according to these authors, when exports are used as denominator in calculating the participation indicator in GVC, the share of participation in GVC could be very high for sectors having a few direct exports (for example, minerals and services). In such cases, the existing measure could overestimate participation in GVC for those sectors. Therefore, the authors have suggested using GDP as a weight for the indicators. Weighting participation indicator by GDP is appropriate to the extent that the composition and volume of exports would not be totally dependent on the efforts of the country. Through this correction, this measure allows to evaluate the impact of the size of the national economy in GVC.[10]

Table 6: New participation indicators in GVC

	Dependent Variable: Composite Industrialization Indicator					
VARIABLES	Upstream		Downstream		Participation	
Upstream integration (GDP)	0,468***	0,388**				
	(0,0768)	(0,160)				
Downstream integration (GDP)			0,213**	0,130		
			(0,0860)	(0,0941)		
Participation indicator (GDP)					0,202***	0,126*
					(0,0477)	(0,0672)
Observations	1 030	740	1 030	740	1 030	740
Lag and control variables	No	Yes	No	Yes	No	Yes
Number of countries	51	48	51	48	51	48
Number of instruments	45	44	45	44	45	44
AR1 p-value	0,0340	0,0147	0,0128	0,0285	0,0263	0,0315
AR2 p-value	0,5668	0,3654	0,8556	0,4748	0,5413	0,5851
Hansen p-value	0,4106	0,2762	0,2729	0,3083	0,2455	0,2990

Notes: Robust standard deviations in parentheses; *** p <0.01, ** p< 0.05, * p< 0.1.

The results reported in Table 6 are globally in line with expectations. The new upstream and downstream integration indicators, as well as the new participation indicator in GVC, are favourable to industrialization in Africa. Similar to previous estimation, the upstream integration seems to be predominant, with high and very significant coefficients.

10 This new measure is noted as follows:

$$Participation\ index = \frac{FVA}{GDP} + \frac{DVX}{Y} = downstream\ \ integration + upstream\ integration\ .$$

Taking into account the sub-regional characteristics

The robustness check of the results in the sub-regions is conducted in two steps. In the first step, we sequentially integrate the sub-regional dummy variables in order to capture the isolated specific effect of each sub-region. This strategy allows avoiding the dummy variable trap that could be caused by multicollinearity between the different dummies when the constant is taken into consideration. The results from this test (Table 7) strongly validate the positive impact of GVC on industrialization, notably regarding the participation in GVC. On the other hand, the coefficients associated with each sub-region show that Northern Africa, Eastern Arica and Southern Africa are favourable to industrialization compared to other regions, as their coefficients are positively and significantly associated with industrialization in all the specifications.

Table 7: Specific sub-regional effects

	Dependent Variable: Composite Industrialization Indicator									
VARIABLES	Northern Africa		Western Africa		Central Africa		Eastern Africa		Southern Africa	
Participation	0,0735***		0,0773***		0,0941***		0,0873***		0,0754***	
	(0,0201)		(0,0204)		(0,0180)		(0,0193)		(0,0199)	
Position		0,0222		0,0317		0,0320		0,0166		0,0166
		(0,0403)		(0,0409)		(0,0511)		(0,0520)		(0,0520)
Northern Africa	0,311***	0,335***								
	(0,0641)	(0,0661)								
Western Africa			-0,0168	-0,0119						
			(0,0550)	(0,0514)						
Central Africa					-0,609***	0,339				
					(0,0563)	(0,226)				
Eastern Africa							0,266***	1,178*		
							(0,0664)	(0,691)		
Southern Africa									0,135**	0,986***
									(0,0635)	(0,370)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	735	735	735	735	735	735	735	735	735	735
AR1 p-value	0,0047	0,0058	0,0056	0,0014	0,0069	0,0026	0,0368	0,0347	0,,0458	0,0589
AR2 p-value	0,1498	0,1185	0,1313	0,0754	0,2372	0,7804	0,1531	0,7884	0,1365	0,7883
Number of countries	48	48	48	48	48	48	48	48	48	48
Number of instruments	41	38	45	44	42	40	47	45	47	43
Hansen p-value	0,1813	0,2659	0,4706	0,1512	0,1040	0,7840	0,5838	0,6827	0,1555	0,6827

Notes: Robust standard deviations in parentheses; *** p<0.01, ** p<0.05, * p<0.1

In a second step, we isolate the sub-regions and capture the effects of the GVC on industrialization. Following this strategy, we set up five sub-samples that are consistent with the five African sub-regions. According to Roodman (2009), since the conditions to apply the GMM methodology is not met[11], we apply the 2SLS method to control for endogeneity, at least for the measurement error variable. As in the previous estimates, the results in Table 8 are encouraging for the participation as well as for the position in GVC. Excluding Northern Africa, the participation in GVC would be an advantage to boost industrialization in the other regions of Africa. In terms of position, only Western and Central African sub-regions show remarkable and profitable performances for industrialization.

11 For some sub-samples, the number of countries has been significantly reduced.

Table 8: Sub-regional samples

	Dependent Variable : Composite Industrialization Indicator									
	Sample 1 : Northern Africa		Sample 2 : Western Africa		Sample 3: Central Africa		Sample 4 : Eastern Africa		Sample 5 : Southern Africa	
Participation	-0,127***		0,155***		0,0651***		0,118*		0,191***	
	(0,0306)		(0,0285)		(0,0162)		(0,0654)		(0,0646)	
Position		-0,254***		0,236***		0,0408*		0,119		-0,204**
		(0,0392)		(0,0613)		(0,0229)		(0,142)		(0,0930)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	96	96	251	251	140	140	102	102	150	150
R-squared	0,776	0,831	0,310	0,254	0,573	0,521	0,514	0,503	0,530	0,505
Hansen p-value	0,1668	0,4526	0,2556	0,4552	0,3654	0,2678	0,4590	0,5896	0,4789	0,2573

Notes: Robust standard deviations in parentheses; *** p< 0.01, ** p< 0.05, * p< 0.1.

7. Conclusion and economic policy recommendations

The objective of this study was to evaluate the effects of integration of African countries into GVC on industrialization. To this end, we have specified an industrialization equation that takes into account the characteristics of the continent. We have then estimated that equation by the system GMM estimator and the following results were obtained: the participation and position of African countries in GVC contribute positively to industrialization in Africa. The imports of intermediate goods are instrumental in having access to foreign machinery and technology, which stimulate local production. Furthermore, the position in those chains that is limited to assembling activities would also lead to significant industrial advancements. It was also found that the main factors influencing the transmission of indirect effects of GVC to industrialization are human and physical capital. The results obtained are stable as shown by the different robustness check tests on different specifications related to the integration into GVC, to the conception of a new participation index, and to sub-regional characteristics.

On the basis of these results, we make the following general policy recommendations: African leaders should focus on a strong industrial development. This can be possible, only with more skilled labour and a sizeable investment in infrastructure. On the other hand, we make the following specific recommendations: following the observation that the integration into GVC stimulates industrialization and knowing that almost all African countries are weakly integrated into those GVCs, efforts should be made, not only to enhance their participation, but also to improve their position. For the resource-rich countries, actions should be taken to limit the exports of raw materials. Actions to ensure initial transformation of those resources should be encouraged. Countries that are weakly endowed with natural resources, in which industry is based on products related to electrical components, mechanical, electronics, automobile, and aeronautic should specialize more in these activities, and above all upgrade from the activities of assembling components to the next stage of processing them.

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Appendix

Table A1: Sample countries

Northern Africa	Western Africa	Central Africa	Eastern Africa	Southern Africa
Algeria Egypt Morocco Sudan Tunisia	Benin, Burkina Faso, Cape Verde, Ivory Coast, Gambia, Ghana, Guinea, Bissau Guinea, Liberia, Mali, Mauritania, Nigeria, Senegal, Sierra Leone, Togo	Angola, Burundi, Cameroon, Congo, Gabon, Equatorial Guinea, Central African Republic, DR- Congo, Rwanda, Tchad	Eritrea Ethiopia Kenya Uganda Tanzania	South Africa, Lesotho Madagascar, Malawi Mauritius, Mozambique Namibia, Eswatini Zambia, Zimbabwe

Source: Authors.

Table A2: Descriptive statistics of the variables of the study and sources of the data

Variables	N	Average	Standard Error	Min	Max	Source
Industrialization indicator	1,122	0.661	0.720	-0.553	5.930	Authors, WDI
Participation (% exports)	1,037	1.955	2.282	0	38.16	Authors, UNCTAD
Position (% exports)	1,037	0.708	1.331	-1.594	18.61	Authors, UNCTAD
Upstream integration (% exports)	1,033	0.626	0.656	0	9.758	Authors, UNCTAD
Downstream integration (% exports)	1,033	1.337	1.751	0	28.40	Authors, UNCTAD
Ln GDP	1,080	22.89	1.610	18.59	26.86	WDI
Ln GDP squared	1,080	526.4	74.20	345.6	721.7	WDI
Institutions	1,069	-0.674	0.602	-2.449	0.853	WGI
Urban population	1,117	39.83	17.25	7.211	87.37	WDI
Education	873	41.97	24.72	5.132	114.4	WDI
Investment rate	982	21.60	15.92	-2.424	219.1	WDI
Transmission channels						
Participation*human capital	815	192.2	190.9	0	2,080	Authors, WDI, UNCTAD
Position*human capital	815	63.01	111.7	-162.6	1,086	Authors, WDI, UNCTAD
Participation*physical capital	979	39.97	46.66	-7.669	515.5	Authors, WDI, UNCTAD
Position*physical capital	979	14.07	28.77	-34.50	381.1	Authors, WDI, UNCTAD
For robustness						
Dummy Northern Africa	1,122	0.118	0.322	0	1	Authors
Dummy Western Africa	1,122	0.314	0.464	0	1	Authors
Dummy Central Africa	1,122	0.216	0.411	0	1	Authors
Dummy Eastern Africa	1,122	0.157	0.364	0	1	Authors
Dummy Southern Africa	1,122	0.196	0.397	0	1	Authors
Participation (% GDP)	1,080	0.502	0.571	0	4.157	Authors, WDI, UNCTAD
Upstream (% GDP)	1,080	0.188	0.280	0	2.395	Authors, WDI, UNCTAD
Downstream (% GDP)	1,080	0.314	0.370	0	3.461	Authors, WDI, UNCTAD

Source: Authors.

Table A3: VIF test for multicollinearity

Model with participation indicator			Model with position indicator		
Variable	VIF	1/VIF	Variable	VIF	1/VIF
Education	1.15	0.867662	Position	1.25	0.798849
Urban population	1.14	0.873908	Institutions	1.21	0.825562
Ln GDP	1.12	0.896542	Ln GDP	1.20	0.830003
Institutions	1.11	0.902544	Urban population	1.17	0.856357
Participation	1.08	0.923137	Education	1.12	0.891106
Investment	1.05	0.955106	Investment	1.04	0.958847
Mean VIF	1.11		Mean VIF	1.17	

Source: Authors.

Mission

To strengthen local capacity for conducting independent, rigorous inquiry into the problems facing the management of economies in sub-Saharan Africa.

The mission rests on two basic premises: that development is more likely to occur where there is sustained sound management of the economy, and that such management is more likely to happen where there is an active, well-informed group of locally based professional economists to conduct policy-relevant research.

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