DOES HUMAN CAPITAL MATTER IN MANUFACTURING VALUE ADDED DEVELOPMENT IN AFRICA?

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ABSTRACT

Very few countries have been able to grow and accumulate wealth without investing in their manufacturing industries. Also, a strong and thriving manufacturing sector precipitates industrialization. Unfortunately, manufacturing value added (MVA) development in Africa has been very low. This paper empirically assesses the role of human capital in MVA (% of GDP) in Africa for the period, 1990-2011, using the IV-SLS technique with year and sub-regional fixed effects. Our results indicate that not all human capital indicators are “born” equal with respect to MVA: Primary education has an inverted U-shaped relationship with MVA in Africa; secondary education has a negative significant relationship with MVA in the continent; and tertiary education has a significant positive association with MVA - tertiary education is good for increasing MVA in Africa. Other drivers have substantial relationship with African MVA. For example, economic development is significantly associated with MVA to the third degree polynomial, with negative leading coefficients. Other drivers with differential impacts include natural resources dependence, domestic investment, government consumption expenditure, trade openness, FDI stock, age dependency, credit to the private sector, social and political globalization, civil violence, and energy use intensity. We conclude with policy implications.

Contribution/ Originality: This study is the first to empirically investigate the role of human capital in manufacturing value added development in Africa. It uses the most recent data to present new, interesting stylized facts. It empirically assesses the impact of human capital in manufacturing value added, drawing key lessons for the continent.

1. INTRODUCTION

Very few countries have been able to grow and accumulate wealth without investing in their manufacturing industries, and a strong and thriving manufacturing sector usually precipitates industrialization: manufacturing is labor-intensive & export-focused; by increasing value to commodities before they are sold, revenues are boosted, thus raising average earnings per input; manufacturing development enables dynamic learning-by-doing gains that raise productivity and income; the manufacturing sector is more sustainable and less vulnerable to external shocks than primary commodities, for example; and recently, African countries have been buffeted by four very serious and interrelated external shocks, namely hikes in food prices, increases in energy prices, the global
financial and economic crisis, and the collapse in commodity (especially oil) prices that started in 2014, whose economic and social costs in a number of African countries have been quite substantial. These quadruple crises have refocused attention on Africa’s high vulnerability to external shocks and the need for African policymakers to take urgent action to diversify their production and export structure to build resilience to external shocks. In addition, a strong manufacturing industry contributes to the development of the private sector, which further increases the economy’s resilience to external shocks. Manufacturing goods locally to supply the domestic market has a positive impact on the structure of the trade balance, improving external accounts (see UNIDO, 2015; Anyanwu, 2017).

Also, as Szirmai (2009) argues, since the late 18th century, the manufacturing sector has been the main engine of growth, development and catch up. He further argues that manufacturing is important for growth. This is because (a) there is an empirical correlation between the degree of industrialization and per capita income in developing countries; (b) productivity is higher in the manufacturing sector than in the agricultural sector; (c) manufacturing is assumed to be more dynamic than other sectors; (d) developing countries with higher shares of manufacturing and lower shares of services show faster growth than the advanced service economies; (e) compared to agriculture, it is argued that the manufacturing sector offers special opportunities for capital accumulation; (f) the manufacturing sector offers special opportunities for economies of scale, which are less available in agriculture or services; (g) the manufacturing sector offers special opportunities for both embodied and disembodied technological progress; (h) linkage and spillover effects are stronger for manufacturing than for agriculture or mining; and (i) as per capita incomes rise, the share of agricultural expenditure in total expenditure declines and the share of expenditure on manufactured goods increases (Engel’s law).

Unfortunately, apart from the fact that manufacturing development in Africa has not improved over time, there has been less empirical studies investigating the role of human capital in manufacturing value added development, especially in Africa. Our study examines the important role of human capital (education) among other key drivers of manufacturing development in Africa.

In particular, this paper extends and contributes to the literature in three ways. Firstly, we document stylized facts on recent manufacturing development in Africa. Secondly, the paper empirically assesses the role of human capital (education) among the other key drivers of manufacturing value added in the continent using a time series cross-sectional data set of African countries for the period, 1990 to 2011 – and unlike many previous studies we employ a third degree polynomial of economic development and second degree polynomial of the indicator(s) of education, in recognition of their recent stated theoretical and empirical relationships with MVA development (Haraguchi and Rezonja, 2011; 2012; UNIDO, 2015; Haraguchi, 2016). Thirdly, we offer policy suggestions in light of the evidence that would help African countries to formulate and implement human capital policies as well as effectively tackle other problems hindering manufacturing value added development in the continent with a view to scaling up and “breaking into” substantial manufacturing development across the countries. To the best of our knowledge, the comprehensiveness of this study is, to date, unmatched in Africa in terms of focus, the scope of databases sourced and the range of variables covered.

This study is also important as it will help point the way towards the attainment of Sustainable Development Goal (SDG) 9, which is to “build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation”. This is more so since the attainment of this Goal is a primary engine not only of skills development and technology transfer but also of investment flows, job creation, and economic growth. In particular, Goal 9.2 aims at promoting inclusive and sustainable industrialization and, by 2030, significantly raising industry’s share of employment and gross domestic product, in line with national circumstances, and doubling its share in least developed countries.

The remainder of the paper is organized as follows. Section II discusses key stylized facts. Section III presents a brief review of the theoretical framework and empirical literature, while Section IV dwells on the model and data. The empirical results are presented and discussed in Section V while Section VI concludes with policy implications.
2. STYLIZED FACTS

This section presents some recent stylized facts on manufacturing value added (MVA as a share of GDP. Figure 1 shows that Africa has the lowest MVA (%GDP) (averaging just 11 percent against East Asia & Pacific’s 25 percent between 1995 and 2015) among the world’s regions. Africa’s MVA has also been on a declining trend. Africa produced just 2.0 percent (the lowest of global regions) of global manufacturing in 2015 against Asia and Pacific’s 48.5 percent and Europe’s 25.3 percent (UNIDO, 2017). Also, in 2015, Africa’s share of MVA in GDP was 10.5 percent at a time China’s was a high of 32.2 percent (UNIDO, 2017).

![Figure 1. Regional Trends in MVA as % of GDP, 1995-2005](source)

The global regional averages shown in Figure 1 mask the global shares and structural differences. For example, Figure 2 shows the distribution of value added (in 2010 constant prices) of selected manufacturing divisions among developing regions in 2015. Africa not only has a very tiny but also the lowest sectoral manufacturing value added shares. Asia and the Pacific region has both huge and the largest share in all the manufacturing sectors.

![Figure 2. Distribution of Value Added (in 2010 constant prices) of Selected Manufacturing Divisions Among Developing Regions, 2015 (Percentage)](source)

Source: Author, based on data from UNIDO (2017).
As Figure 3 demonstrates, total manufacturing value added has been consistently higher in North Africa than in Sub-Saharan Africa (SSA). It averaged almost 17 percent in North Africa as against only about 11 percent in SSA between 1990 and 2015. However, both (and hence Africa’s) have assumed a generally downward trend recently.

![Figure 3. North Africa Versus Sub-Saharan Africa: Trend in Average MVA as% of GDP, 1990-2015](image)

Source: Author, using data from World Bank (2016).

As a way to gauge the performance of natural resources-dependent African economies, we plot the MVA shares of the MVA in net oil exporting countries against those of net oil importing countries in Figure 4. The graph shows that MVA of net oil-exporting countries is trumped by that in net oil-importing countries.

![Figure 4. Africa: Manufacturing Value Added (%GDP): Net Oil Exporters Versus Net Oil Importers, 1990-2015](image)

Source: Author, using data from World Bank (2016).

In Africa, there are also country differences. For example, as Figure 5 shows, Swaziland has the highest average MVA as percentage of GDP at about 39 percent, followed by Mauritius at about 21 percent, Morocco at about 19 percent. Tunisia and South Africa follow at slightly less than 19 percent and 18 percent, respectively.

Also, according to McKinsey Global Institute (2016) Africa’s total manufacturing output was worth around $500 billion and the vast majority of that was focused in five countries—Egypt, Morocco, Nigeria, South Africa, and Tunisia. It further indicated that 70 percent of this production was focused on meeting domestic needs and was
consumed in the country of manufacture; some 10 percent was traded within Africa, and just 20 percent was exported beyond Africa.

3. A BRIEF THEORETICAL FRAMEWORK AND THE REVIEW OF THE LITERATURE

Conceptually, we follow Becker (1998) to broadly present human capital as constituting education, on-the-job and other training, and health – the embedding of resources in people. In particular, according to Sturm (1993) the theory of human capital considers education as an investment that makes individuals more productive and focuses on pecuniary gains. The productive value of education has been called the “worker effect” (the static effect) by Welch (1970) and it is seen as the increased output per unit of change in education holding other inputs constant.

A complementary human capital effect has been called the (dynamic) “allocative effect” of education (Schultz, 1975; Bartel and Lichtenberg, 1987). This is the case where education and training improve allocative skills, that is, better-educated individuals taking advantage of new production and service possibilities or adjusting existing techniques to new market situations more quickly than less-educated individuals. Such efficiency gains are quickly translated into lower prices or better products and services by more educated individuals.

On must, however, mention a major competing framework to the human capital approach - the “screening hypothesis” - suggested by Arrow (1973); Spence (1973) and others. This hypothesis posits that education does not improve productivity of individuals but is a mechanism that distinguishes inherently more-productive from less-productive individuals and sorts them into appropriate occupations. However, as Riley (1979) and Willis (1986) have noted, the two theories are not empirically distinguishable by their results since they are similar as far as the correlations between income, productivity, and education are concerned.

It has also been posited that human capital affects manufacturing output development and indeed growth generally through a number of channels. Most importantly, it is argued that high levels of human capital facilitate technology adoption (see (Romer, 1990; Barro, 1991; Benhabib and Spiegel, 1994; 2005; Topel, 1999; Acemoglu, 2003; Caselli and Coleman, 2006)). The argument is that skilled-labor augmenting technologies increase the productive efficiency of skilled relative to unskilled workers.

Therefore, if high levels of human capital facilitate technology adoption, output growth in human-capital-intensive industries should be faster in economies with high levels of human capital. This is the “human capital level effect”. In addition, there is also the channel of “human accumulation effect”. It is posited by neoclassical theories of international specialization (that treat human capital as an input in the production process) that faster human capital accumulation should move productive resources to schooling-intensive sectors and hence foster growth in human-capital-intensive industries (see (Ventura, 1997; 2005; Romalis, 2004; Levchenko, 2007; Nunn, 2007)).
Recently, Ciccone and Papaioannou (2009) have found statistically robust and economically significant support for both the human capital level and human capital accumulation effects.

Figure 6 presents a simple illustration of the transition from the various levels of education through education outputs to manufacturing. In particular, primary education supplies the unskilled labor needed in basic manufacturing while secondary education provides some level of skills required in manufacturing activities. Tertiary education, on the other hand, provides manufacturing firms the technological capabilities and research and development required for more sophisticated manufacturing activities.

![Figure 6. Human Capital (Education) and Manufacturing Development: The Linkages](source: Adapted from UNECA (2013)).

Results by Bigsten (2000) with respect to the effect of human capital (total years of education of workers in manufacturing firms) on value added in manufacturing production, show that education is only positive and significant in Kenya and not in Cameroon, Ghana, Zambia, and Zimbabwe.

Without additional controls, Amin and Mattoo (2008) find a positive and significant effect of human capital (enrollments at the national level) on value added in total manufacturing and registered manufacturing. However, these statistically significant effects do not survive robustness checks or addition of full control variables.

Isaksson (2010) in studying the relationship among public capital, infrastructure and industrial development (1970-2000), shows that human capital displays a large positive effect on manufacturing level per capita. Also, change in human capital delivers economically significant effect on manufacturing growth per capita.

Using the autoregressive lag distribution technique to determine the relationship between foreign direct investment and manufacturing value added in Nigeria for the period, 1970 to 2009, Adejumo (2013) finds a non-significant relationship between the growth rate of human capital and the growth rate of manufacturing value added.
Dabla-Norris et al. (2013) in a study benchmarking structural transformation across the world, find that tertiary education enrollment was insignificant in the OLS regressions for real manufacturing value added shares. However, the effect becomes positive and statistically significantly for above-median real value added manufacturing shares, suggesting that more sophisticated manufacturing products require higher levels of education.

Dey and Ellis (2013) using average years of schooling as human capital proxy variable in Indonesia, find consistently negative effect of human capital on value added manufacturing in various sectors, particularly for electric machinery, paper and products, and printing and publishing.

The study by Fang and Chao (2015) for the Shandong Province of China for the period, 1996–2010, shows that the level of human capital (average years of schooling) has a positive and significant effect on the development of the tertiary industry.

Ahmed (2016) investigating the impact of social infrastructure affect the productivity of manufacturing firms in Pakistan, finds that education (net enrolment in primary school and the literacy rate of people aged 10 and above) is positively and significantly related to firm level productivity in manufacturing industries in urban districts of the country. However, for rural regions, education shows a negative impact on firm productivity.

Anyanwu and Kponnou (2017) find that secondary education enrollment is positive and statistically significantly correlated with food, beverages and tobacco MVA in North Africa but the reverse is true for Sub-Saharan Africa. Also, secondary education enrollment is positive and statistically significantly correlated with total MVA in North Africa (Anyanwu, 2017) in line with the results of Dabla-Norris et al. (2013).

In a recent study by Anyanwu and Ozurumba (2017) primary education has a significant U-shaped relationship with machinery and transport equipment, while exhibiting an inverted U-shaped relationship with chemical manufacturing value added development. The level of primary education has a significant positive relationship with textiles and apparel manufacturing value added development. Secondary education has a U-shaped relationship with chemicals manufacturing value added development. Its level is positively and significantly correlated with machinery and transport equipment but negatively and significantly correlated with food, beverages and tobacco and “other” manufacturing sectors. There is also a strong support for a non-monotonic, inverted U-shaped relationship between food, beverages and tobacco, textiles and clothing and other manufacturing MVA with tertiary education. The level of tertiary education is positive for machinery and transport equipment, textiles and clothing, and “other” manufacturing sectors while the quadratic terms are negative. On the other hand, the level of tertiary education is negative for food, beverages and tobacco, and chemicals value added development.

The above review shows that the few studies that had been carried out on the role of human capital in manufacturing value added had been outside Africa. In contrast to these papers, we examine the role of human capital, proxied by education, in MVA in Africa as a whole, and account for other key drivers of MVA in the continent using a broader set of fundamental as well as policy and institutional drivers. From a policy perspective, the results of this paper will serve as a useful platform to formulate series of new agenda and policies for manufacturing development in African countries, especially with respect to the role of human capital.

4. THE MODEL AND DATA

4.1. The Model and Estimation Technique

The model used by Chenery (1960) to estimate value added per capita for manufacturing industries as a dependent variable, captured the universal effects of income and country size (population) with the argument that supply and demand factors are embedded in the level of income. His linear logarithmic regression equation was stated as follows:

$$\log V_i = \log \alpha_{i0} + \alpha_{i1} \log Y + \alpha_{i2} \log N \ldots \ldots (1)$$
Where $V_i$ is per capita value added for manufacturing industry $i$ and $\alpha_1$ and $\alpha_2$ represent growth elasticity and size elasticity, respectively. Chenery used cross-section data of 38 countries available for any year between 1950 and 1956 to estimate this equation. This equation, which became the basis for subsequent structural change research and its modifications have been widely used in later studies. For example, Chenery and Taylor (1968) included a quadratic term for income as the decline in elasticities with rising income became apparent. Chenery and Syrquin (1975;1989) later applied a more general equation, which allows a non-linear effect for population and including dummy variables to identify period effects:

$$x = \alpha + \beta_1 \ln y + \beta_2 (\ln y)^2 + \lambda_1 \ln y N + \lambda_2 (\ln N)^2 + \Sigma \omega_i T_i \ldots \ldots (2)$$

Where $x$ is a respective dependent variable, covering different aspects of structural change (usually expressed as a share in GDP), $y$ is per capita GNP in 1980 US dollars, $N$ is population in millions, and $T$ is a dummy variable for time periods taking a non-zero value for different periods.

As discussed by Haraguchi and Rezonja (2010;2012;2015); Haraguchi and Rezonja (2011; 2012) and Haraguchi (2016) in the long term, it is assumed that industries undergo three development stages—pre-takeoff, growth and decline—following a pattern of a cubic function. While those industries which can sustain growth over a long period of time may have a more linear development trajectory, other industries which experience growth from a very early stage of development and only decline at a later stage, may indicate a more quadratic pattern. As a result, they used the following equation for each manufacturing industry in the group of large economies:

$$\ln RVA_{it} = \alpha_1 + \alpha_2 \ln RGDP_{it} + \alpha_3 \ln RGDP^2_{it} + \alpha_4 \ln RGDP^3_{it} + \alpha_c + \epsilon_{it} \ldots \ldots (3)$$

where $RVA$ indicates real value added per capita; $RGDP$ stands for real GDP per capita; $RGDP^2$ denotes squared real GDP per capita; $RGDP^3$ signifies cubic real GDP per capita; $\alpha_i$ is country fixed effect; and $\epsilon_{it}$ is the unexplained residual.

Augmenting and incorporating human capital represented by the various levels of education enrolments, our basic estimation equation becomes:

$$MVA_{it} = \alpha_0 + \beta_1 (\log rgdppc_{it}) + \beta_2 (\log rgdppc_{it})^2 + \beta_3 (\log rgdppc_{it})^3 + \beta_4 (Educ_{it}) + \alpha_c + \epsilon_{it} \quad (i = 1, \ldots, N; t = 1, \ldots, T), \ldots \ldots (4)$$

where $MVA$ indicates value added as percentage of GDP; rgdppc stands for real GDP per capita; rgdppc’ denotes squared real GDP per capita; rgdppc^’ signifies cubic real GDP per capita; Educ denotes the various levels of education; $\alpha_i$ is sub-regional fixed effects; and $\epsilon_{it}$ is the unexplained residual.

However, as the European Commission (2009a) states, manufacturing and sectoral manufacturing performance is driven by a myriad of distinct sources. Though, no single, comprehensive theory exists which can explain the role of these elements within a jointly integrated economic model, six groups of related factors can be identified, including macroeconomic conditions, inputs to production, Research & Development (R&D) and innovation, market structure, openness and barriers to trade, and demand side factors. Figure 7 illustrates these six major dimensions and the corresponding sub-categories of growth drivers. Macroeconomic conditions - aggregate fluctuations in GDP and employment, interest rates, exchange rates, government spending, corporate tax rates, and the change in relative prices - affect sectoral growth and performance by defining the environment within which companies and industries operate. Inputs to production - physical capital and labor (including ICT and non-ICT assets and high- or low-skilled workers) - constitute the resource base of firms and sectors. Research & Development (R&D) and innovation - R&D expenditures and technological regimes - affect changes in the production function and the process of value-creation, more generally.
Market structure such as entry, exit, firm turnover; distribution of firms according size; industry concentration; regulatory impact and political regime determines the kind and degree of competition within the industry as well as the impact on consumer welfare and selection among heterogeneous suppliers. Openness and barriers to trade, including export openness, import penetration, FDI inflows, liberalization of trade in services, and political and social globalization indicate differences with respect to the degree of global competition and transactions between international partners within an industry. Demand side factors such as consumer expenditures, population, investment spending, government spending, net exports and demand for intermediary inputs guide the allocation of scarce resources among competing uses.

![Figure-7. Stylized Model of the Drivers of Manufacturing and Manufacturing Sectors](image)

Source: Adapted from European Commission (2009b) and the Literature.

Based on the above and the extensions of Haraguchi and Rezonja (2010; 2012; 2015); Haraguchi and Rezonja (2011; 2012) and Haraguchi (2016) our extended modified relationship is expressed in equation (5) below:

\[
MVA_{it} = \alpha_0 + \beta_1 (\log \text{rgdppc}_{it}) + \beta_2 (\log \text{rgdppc}_{it})^2 + \beta_3 (\log \text{rgdppc}_{it})^3 + \beta_4 (\text{Educ}_{it}) + \beta_5 (X_{it}) + \lambda_i + \alpha_c + \epsilon_{it} \\
(i = 1,...,N; t = 1,...,T),..................(5)
\]

where \(MVA_{it}\) is MVA as percentage of total GDP in country \(i\) at time \(t\); \(\alpha_0\) is the constant term; \(\beta_1, \beta_2\) and \(\beta_3\) are the elasticities of MVA with respect to real per capita GDP in 2011, \text{rgdppc}, its quadratic and cubic terms, respectively; \(\text{Educ}_{it}\) is vector of primary school enrolment, secondary school enrolment and tertiary education enrolment ratios (education), \(X\) is the control variables, including natural resource rents as percentage of GDP (oil, mining, natural gas, coal, and forest), domestic investment rate, domestic credit to the private sector (as % of GDP), trade openness, and FDI stock (as % of GDP). Other control variables are social globalization index, political globalization index, institutionalized democracy (polity2), total population (in log), age dependency (old), age dependency (young), information and communications technology (ICT) accessibility (proxied by mobile phone subscriptions (per 100) and fixed phone subscriptions), energy intensity level of primary energy (MJ/$2011 \text{PPP GDP})$, and civil conflict incidence. In addition, \(\lambda\) denotes year fixed effects, \(\alpha_c\) is sub-regional fixed effects while \(\epsilon_{it}\) is an error term capturing all other omitted factors, with \(E(\epsilon_{it}) = 0\) for all \(i\) and \(t\).

Thus, in addition to GDP per capita, we include square and cubic terms of GDP per capita in the equation in order for the results to denote possible patterns of manufacturing development in Africa, depending on the statistical significance of these GDP per capita terms.
The effect of education on MVA is captured by including the shares of primary, secondary and tertiary education enrollments. Increased human capital leads to improved productivity, both in sectors and overall, while it allows for operating more complicated tasks and producing outputs that are "high-skill". High levels of human capital increase the scope that new technologies are appropriate. Also, while human capital could imply positive externalities, it is observed that foreign direct investments (FDI) tend to locate in human capital-rich places. Thus, apart from the "human capital effect" discussed in the theoretical framework, to benefit from FDI knowledge externalities and technology transfer requires that domestic firms have sufficiently high human capital levels or absorptive capacity. The education proxies may enter the equation in non-linear forms (Anyanwu, 2017).

Included also is domestic investment ratio. The European Commission (2009b) notes that the average investment ratio, used as a proxy for the capital intensity, is expected to be positive as it reflects primarily the neglected capital costs. According to Tkalec and Vizek (2009) high technological intensity industries strongly react to changes in investments. The degree of financial sector development is proxied by the ratio of domestic credit to the private sector to GDP, which is posited to enable investment in higher productivity activities, greater diversification, and risk sharing, and hence facilitate resource allocation across the economy (Levine, 2003).

Our estimates also include natural resources endowments by including the share of oil, mining, natural gas, coal and forest in GDP to account for the fact that a large fraction of economic activity in resource-rich economies in Africa is subsumed by the rents from natural resources extraction. It is posited that the endowment of abundant natural resources normally works against manufacturing development, holding other conditions constant (Haraguchi and Rezonja, 2011; 2012; UNIDO, 2012). UNIDO (2015) shows that high natural resource endowments do not have a positive effect on a single industry, but they have particularly strong negative effects on electrical machinery and apparatus, motor vehicles (for large countries) and chemicals, which are key in deepening and sustaining industrialization from the upper middle-income stage. This is largely because exports of resource commodities often lead to currency appreciation, making tradable manufacturing products less competitive. We also include proportion of agricultural land, whose product supplies manufacturing industries hence an expected positive relationship.

We include factor endowments, such as population. Chenery and Taylor (1968) show that a country's population size tends to have overarching influence on economic structural change. UNIDO (2015) shows that a larger population is generally conducive to manufacturing development though there are differences in structural change within manufacturing between large and small countries. Large countries, at higher incomes, tend to have a divergent pattern of thriving and other industries, while in small countries, growth in most manufacturing industries slows at higher incomes. Our estimates include age dependency ratios (i.e., the non-working old and young populations as fractions of the labor force) since they can affect labor supply, savings and consumption behavior.

Following the widely held view that globalization can facilitate technology transfer and contribute to efficiencies in production, we include different globalization indicators. Two principal economic globalization indicators included are international trade openness (measured as the ratio of exports plus imports to GDP) (Matsuyama, 2008) and inward FDI stock (as percent of GDP). FDI can provide access to technology, to brand names, to global markets and has the potential to provide spillovers to the domestic economy (UNIDO, 2015). FDI may affect sectoral MVA through various mechanisms: boosting productivity in the long run; filling expectations of demand increase; strengthening competition and weakening oligopoly/monopoly elements; diffusing knowledge of new production processes; stimulating the entry of firms in other sectors (horizontal linkages); and creating the right conditions to enhance structural change. Also included are KOF’s indices of social globalization and political globalization.

The accessibility to ICT technology and infrastructure or service can influence sectoral MVA by either facilitating or obstructing the reallocation of resources. To capture this, we include telecommunications network as
proxied by mobile phone and fixed phone subscriptions. An increase in access to such ICT in a manufacturing sector can contribute to increase in sectoral MVA by eliminating relative price distortions and facilitating the reallocation of labor and other inputs, thereby raising sector productivity. R&D is proxied by the number of publications in scientific and technical journals. Institutionalized democracy is represented by polity2 and it is expected to be positively correlated with MVA.

As the US National Association of Manufacturers (2005) notes, energy is the lifeblood of manufacturing. Manufacturing industries convert fuels to thermal, electric or motive energy to manufacture their products. Energy enables manufacturing industries to transform raw materials into final consumer goods. Such raw materials pass through a number of intermediate stages, with these intermediates representing the bulk of industrial energy consumption. Thus, energy performs the work of adding value to intermediate products as they are progressively transformed into final consumer products. As UNIDO (2015) notes, resource efficiency is an important strategy for sustainable growth. Thus, manufacturing production processes today have to be highly productive, less energy intensive, and more resource efficient. Energy is captured by energy intensity level of primary energy (MJ/$2011 PPP GDP).

In particular, civil conflicts adversely affect manufacturing development because they lead to the destruction of productive forces (especially human and physical capital) of the economy, increase in transaction costs, reduction in social spending, and disruption of economic activity due to an unsafe business environment (Bircan et al., 2010). Also violence- or conflict-affected countries may have adverse impacts on manufacturing companies’ operations and/or on their relationships with third parties, including suppliers or other actors in the supply chain (OECD, 2011). In addition, such conflicts could cause severe disruptions of the main transportation routes or production hubs. Such poor transport adds to production and marketing costs, while damage to infrastructure worsens this situation by, for example, raising traders' or distributors' margins. In addition, growing security concerns due to violence and civil conflicts usually increase investment in the defense and security industry, causing a range of new industry regulations and requirements across supply chains and transport networks that may disrupt manufacturing development (Mueller and Stewart, 2011; World Economic Forum (WEF), 2012).

One possible problem with the pooled OLS estimate is that it assumes that all of the right-hand side variables in the model — including real per capita GDP — are exogenous to MVA. However, it is possible that real per capita GDP may be endogenous to sectoral MVA. Reverse causality may be taking place: real per capita GDP may be increasing sectoral MVA, but sectoral MVA may also be affecting the level of real per capita GDP. Without accounting for this reverse causality, the estimated coefficients may be biased. One way of accounting for possible endogenous regressors is to pursue an instrumental variables approach. Therefore, to deal with this problem, we estimate the equation, “instrumentalizing” real per capita GDP variable with its two lagged levels, using a two-step (IV) estimation method, including sub-regional and time (year) fixed effects. The IV estimates are presented in columns 3 and 5 of Table 2.

The consistency of the IV-2SLS estimators depends on whether the instruments are valid in the MVA regression. We examine this issue by considering the tests of over-identifying restrictions. The no rejection of the null hypothesis implies that instrumental variables are not correlated with the residual and are satisfying the orthogonality conditions required. The IV-2SLS results pass the relevant tests. For example, in column 5 of Table 2, the Sargan test of overidentifying restriction fails to reject that the instruments are valid, i.e., not correlated with the error term at conventional significance levels in the reported regression (p-value of 0.9057) while the corresponding Basmann p-value is 0.9222. Also, the estimates pass the endogeneity test with the Durbin p-value of 0.3209 and the corresponding Wu-Hausman p-value of 0.4124.
4.2. The Data

Data for the African countries (1990 to 2011) for the variables in equations (4) and (5) are largely drawn from the World Bank (2016) except institutional democracy (polity2) from the Polity (2015) (see also Marshall et al. (2016)) KOF’s indices of social globalization (comprising personal contacts, information flows, and cultural proximity) and political globalization (comprising embassies in country, membership in international organizations, participation in UN Security Council Missions, and international treaties) developed by Dreher (2006) (see also Dreher et al. (2008)). The descriptive statistics are presented in Table 1. It reports the observations, sample mean, median and standard deviation of the variables used in the estimations.

Table 1. Descriptive Statistics of Main Regression Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
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<tr>
<td>Primary education</td>
<td>927</td>
<td>91.20</td>
<td>96.1</td>
<td>26.88</td>
</tr>
<tr>
<td>Secondary education</td>
<td>683</td>
<td>38.61</td>
<td>32.8</td>
<td>25.97</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>606</td>
<td>6.22</td>
<td>3.4</td>
<td>8.07</td>
</tr>
<tr>
<td>Log of Scientific &amp; technical journals</td>
<td>1110</td>
<td>2.87</td>
<td>2.89</td>
<td>2.04</td>
</tr>
<tr>
<td>Log of Real GDP per capita</td>
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<td>7.82</td>
<td>7.65</td>
<td>1.02</td>
</tr>
<tr>
<td>Domestic investment (%GDP)</td>
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<td>21.52</td>
<td>19.5</td>
<td>17.17</td>
</tr>
<tr>
<td>Government consumption expenditure</td>
<td>1043</td>
<td>16.05</td>
<td>14.7</td>
<td>7.67</td>
</tr>
<tr>
<td>Trade openness</td>
<td>1091</td>
<td>76.55</td>
<td>64.1</td>
<td>49.18</td>
</tr>
<tr>
<td>FDI stock (%GDP)</td>
<td>1148</td>
<td>38.02</td>
<td>16.2</td>
<td>115.60</td>
</tr>
<tr>
<td>Social globalization index</td>
<td>1163</td>
<td>25.85</td>
<td>23.4</td>
<td>11.24</td>
</tr>
<tr>
<td>Political globalization index</td>
<td>1163</td>
<td>53.06</td>
<td>51.91</td>
<td>18.97</td>
</tr>
<tr>
<td>Domestic credit to private sector (%GDP)</td>
<td>1077</td>
<td>19.57</td>
<td>13</td>
<td>21.46</td>
</tr>
<tr>
<td>Oil rent (%GDP)</td>
<td>1103</td>
<td>6.12</td>
<td>0</td>
<td>14.74</td>
</tr>
<tr>
<td>Mining rent (%GDP)</td>
<td>1134</td>
<td>1.19</td>
<td>0</td>
<td>3.45</td>
</tr>
<tr>
<td>Natural gas rent (%GDP)</td>
<td>1120</td>
<td>0.54</td>
<td>0</td>
<td>2.10</td>
</tr>
<tr>
<td>Coal rent (%GDP)</td>
<td>1124</td>
<td>0.04</td>
<td>0</td>
<td>0.54</td>
</tr>
<tr>
<td>Forest rent (%GDP)</td>
<td>1109</td>
<td>6.71</td>
<td>0</td>
<td>8.46</td>
</tr>
<tr>
<td>Log of population</td>
<td>1188</td>
<td>15.63</td>
<td>15.95</td>
<td>1.56</td>
</tr>
<tr>
<td>Age dependency ratio (Old)</td>
<td>1188</td>
<td>6.38</td>
<td>5.9</td>
<td>1.58</td>
</tr>
<tr>
<td>Age dependency ratio (Young)</td>
<td>1188</td>
<td>80.16</td>
<td>85.1</td>
<td>15.45</td>
</tr>
<tr>
<td>Mobile cellphone subscriptions (per 100 people)</td>
<td>1160</td>
<td>14.24</td>
<td>0.80</td>
<td>26.34</td>
</tr>
<tr>
<td>Log of fixed telephone subscriptions</td>
<td>1144</td>
<td>0.09</td>
<td>-0.11</td>
<td>1.39</td>
</tr>
<tr>
<td>Institutional democracy (Polity2)</td>
<td>1120</td>
<td>-0.001</td>
<td>-1.0</td>
<td>5.50</td>
</tr>
<tr>
<td>Log of Primary energy use intensity</td>
<td>1154</td>
<td>2.08</td>
<td>1.97</td>
<td>0.69</td>
</tr>
<tr>
<td>Civil violence</td>
<td>1109</td>
<td>0.03</td>
<td>0</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Source: Author’s calculations, using estimation data.

5. EMPIRICAL RESULTS

We investigate the role of human capital, proxied by education (primary school enrolment ratio, secondary school enrolment ratio, and tertiary school enrolment ratio) in manufacturing development in African countries, using the pooled OLS and IV-2SLS estimation techniques. Coefficient estimates of MVA (as % of GDP) equation are presented in Table 2.

Table 2. OLS and IV-2SLS Estimates of the Role of Education and Other Key Drivers of MVA (%GDP) in Africa (with sub-regional and time fixed effects), 1990-2011

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Regression Results</th>
<th>Regression Results with Full Control Variables and Robustness Check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled OLS (1)</td>
<td>IV-2SLS (2)</td>
</tr>
<tr>
<td>Primary education</td>
<td>0.323 (4.71***</td>
<td>0.357 (4.26***</td>
</tr>
<tr>
<td>Primary education squared</td>
<td>-0.002 (-4.04***</td>
<td>-0.005 (-3.45***</td>
</tr>
<tr>
<td>Secondary education</td>
<td>-0.077 (-2.92**</td>
<td>-0.092 (-2.51**</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>0.251 (2.93***</td>
<td>0.266 (2.71***</td>
</tr>
<tr>
<td>Log of scientific &amp; technical journals</td>
<td>0.251 (2.93***</td>
<td>0.266 (2.71***</td>
</tr>
</tbody>
</table>
### Table 1: Coefficients and Standard Errors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Real GDP per capita</td>
<td>-292.952</td>
<td>(-4.02)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log Real GDP per capita squared</td>
<td>38.112</td>
<td>(4.11)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log Real GDP per capita cube</td>
<td>-1.626</td>
<td>(-4.16)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic investment (%GDP)</td>
<td>-0.085</td>
<td>(-2.55)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government consumption expenditure (%GDP)</td>
<td>-0.241</td>
<td>(-3.90)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade openness</td>
<td>0.107</td>
<td>(0.75)***</td>
<td>0.120</td>
<td>(8.56)***</td>
</tr>
<tr>
<td>FDI stock (%GDP)</td>
<td>-0.066</td>
<td>(-2.93)***</td>
<td>-0.108</td>
<td>(-5.12) ***</td>
</tr>
<tr>
<td>Social Globalization Index</td>
<td>-0.167</td>
<td>(-2.49)***</td>
<td>-0.198</td>
<td>(-3.40) ***</td>
</tr>
<tr>
<td>Domestic credit to private sector (%GDP)</td>
<td>0.0465</td>
<td>(1.07)***</td>
<td>0.069</td>
<td>(2.66)***</td>
</tr>
<tr>
<td>Oil rent (%GDP)</td>
<td>-0.377</td>
<td>(-8.40)***</td>
<td>-0.379</td>
<td>(-9.80) ***</td>
</tr>
<tr>
<td>Mining rent (%GDP)</td>
<td>-0.129</td>
<td>(-2.08)***</td>
<td>-0.188</td>
<td>(-3.50) ***</td>
</tr>
<tr>
<td>Natural gas rent (%GDP)</td>
<td>-0.167</td>
<td>(-0.85)</td>
<td>-0.062</td>
<td>(-0.36)</td>
</tr>
<tr>
<td>Coal rent (%GDP)</td>
<td>11.897</td>
<td>(3.61)***</td>
<td>10.780</td>
<td>(3.75)***</td>
</tr>
<tr>
<td>Forest rent (%GDP)</td>
<td>-0.072</td>
<td>(-0.69)</td>
<td>-0.061</td>
<td>(-0.65)</td>
</tr>
<tr>
<td>Log of population</td>
<td>0.264</td>
<td>(0.37)</td>
<td>-0.525</td>
<td>(-0.84)</td>
</tr>
<tr>
<td>Age dependency ratio - Old</td>
<td>1.357</td>
<td>(3.85)***</td>
<td>1.345</td>
<td>(4.29)***</td>
</tr>
<tr>
<td>Age dependency ratio - Young</td>
<td>0.203</td>
<td>(4.88)***</td>
<td>0.211</td>
<td>(5.69)***</td>
</tr>
<tr>
<td>Mobile phone subscriptions (%)</td>
<td>-0.013</td>
<td>(-0.51)</td>
<td>0.001</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Log of fixed telephone subscription</td>
<td>0.704</td>
<td>(1.07)</td>
<td>0.173</td>
<td>(0.30)</td>
</tr>
<tr>
<td>Institutional</td>
<td>-2.163</td>
<td>(-7.12)***</td>
<td>-2.034</td>
<td>(-7.18) ***</td>
</tr>
<tr>
<td>Democracy (Polity2)</td>
<td>0.101</td>
<td>(7.09)***</td>
<td>0.096</td>
<td>(7.30) ***</td>
</tr>
<tr>
<td>Democracy (Polity2) squared</td>
<td>3.399</td>
<td>(3.53)***</td>
<td>4.331</td>
<td>(5.06) ***</td>
</tr>
<tr>
<td>Log of primary energy use intensity</td>
<td>2.031</td>
<td>(-1.15)</td>
<td>-2.444</td>
<td>(-1.65)</td>
</tr>
<tr>
<td>Constant</td>
<td>1159.427</td>
<td>(6.82)***</td>
<td>1159.427</td>
<td>(6.86)***</td>
</tr>
<tr>
<td>Sub-regional and Year Dummies</td>
<td>734.225</td>
<td>(3.98)***</td>
<td>734.225</td>
<td>(3.98)***</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.3567</td>
<td></td>
<td>0.3304</td>
<td></td>
</tr>
<tr>
<td>F-stat/Wald chi²</td>
<td>6.17</td>
<td>156.07</td>
<td>16.49</td>
<td>1306.25</td>
</tr>
<tr>
<td>Prob &gt; chi²</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>N</td>
<td>401</td>
<td>335</td>
<td>332</td>
<td>311</td>
</tr>
</tbody>
</table>

**Notes:**
- t-values are in parentheses; *** = 1% significant level; ** = 5% significant level; * = 10% significant level.
- Source: Author’s Estimations.

Columns (1) and (2) respectively present the pooled OLS and IV estimates of the role of human capital and level of economic development only – our baseline estimates. In Columns 4 and 5, we present the pooled OLS and IV estimates of the role of human capital and other key (control) drivers of MVA in the continent – full controls and robustness check.
5.1. Baseline Results

In our baseline OLS and IV results (columns (1) and (2) of Table 2), the education effects estimates are similar in size and statistical level of significance. They show that primary education has a significant inverted U-shaped relationship with manufacturing value added development. While the level of primary education is significantly (at 1 percent) and positively associated with higher manufacturing value added development in Africa, its quadratic term has a significant negative association with the same. Our IV estimates suggest that, on average, increase in primary enrolment ratio by one is associated with about a 0.34 increase in MVA in Africa, but an opposite effect kicks in at levels of primary enrolment ratio beyond 100 (see Figure 8).

The result suggests that although higher levels of primary education is positively associated with manufacturing value added, the effect is not constant. Rather, for levels of primary education, above a certain point, higher levels of education act to decrease manufacturing value added, holding other factors constant. This relationship suggests also that the marginal effect of primary education exhibits decreasing returns for manufacturing value added in African countries. Our results resemble those of Anyanwu and Ozurumba (2017) for chemical manufacturing value added development in Africa.

Secondary education enrollment is negative and statistically significantly correlated with MVA in Africa. The result of the quadratic level of primary education somewhat dovetails into secondary education effect. The IV estimates indicate that an increase in secondary enrolment ratio by one is associated with a reduction of only 0.092 of MVA. Thus, the secondary education result shows that the skills provided at this level are insufficient for higher value addition, especially as manufacturing becomes relatively more sophisticated. The finding by Anyanwu and Ozurumba (2017) of a significant negative association between secondary education and food, beverages and tobacco and “other” manufacturing value added conforms to our finding here. It is also in conformity with the findings of Dabla-Norris et al. (2013) in their quantile regressions (quantiles 10, 25, 50, and 75) for the manufacturing sector.

The level of tertiary education has a significant positive relationship with manufacturing value added development in Africa. Our IV estimates suggest that, on average, increase in tertiary enrolment ratio by one is associated with about a 0.27 increase in MVA in Africa. This result is in tune with that of Dabla-Norris et al. (2013) who find positive and statistically significant relationship between secondary education and above-median real value added manufacturing shares, which suggests that more sophisticated manufacturing products require higher levels of education. They also find positive and statistically significant relationship between tertiary education and real...
value added manufacturing shares in quantile regressions (quantiles 75 and 90) for a panel of 168 countries over the period, 1970-2010.

As observed earlier, it has been noted that the stage of economic development is the most fundamental force of structural change as the differences in supply and demand capabilities associated with changing income levels drive the emergence of certain industries. What does the evidence show for African countries? Both the OLS and IV coefficient estimates of the economic development (real GDP per capita) in our baseline results (Table 2) show that indeed the level of economic development of a country is a fundamental factor in shaping its manufacturing development. The relationship between MVA in Africa and the level of economic development (log of real GDP per capita) is approximated by a third degree polynomial, all significant at 1 percent significant level. There is a negative significant relationship between the level of real GDP per capita and MVA while there is a significant positive relationship between the quadratic real GDP per capita and MVA. The cubic real GDP per capita has a significant negative relationship with MVA in the sub-region. Thus, a one percent increase in the level of real GDP per capita is associated with 4.12 percent reduction in MVA in the continent. However, a further increase in real per capita GDP beyond US$1097 (Exponent of 7) is associated with an increase in MVA by 0.53 percent. Still, a further increase in real per capita GDP beyond US$8013 (Exponent of 9) is associated with decrease in MVA by 0.02 percent. Figure 9 illustrates that relationship.

These confirm that in the long term, manufacturing industries in Africa follow a pattern of a cubic function. Our results resemble those of Bah (2007) for the industry sector of 9 developed countries and 12 Latin American countries. They are also in conformity with the results of Haraguchi and Rezonja (2013) for the following sectors: food and beverages; textiles; coke and refined petroleum; basic metals; fabricated metals; machinery and equipment; precision instruments; and motor vehicles, trailers, semi-trailers and other transport equipment.

5.2. Full Controls and Robustness Check

In columns (3) and (4) of Table 2, we investigate the robustness of our results when all key controls are included in the equation (that is, equation (5)). The estimates show that the results of our baseline estimates for education effects remain robust when we simultaneously control for all key variables. Interestingly, in accordance
with the OLS results, our IV-2SLS estimates in the third last column indicates a strong support for a non-monotonic inverted U-shaped relationship between primary education and manufacturing value added development in Africa. Also, secondary education enrollment is negative and statistically significantly correlated with MVA in the continent, a result consistent with the findings of Anyanwu and Kponnou (2017) with respect to food, beverages and tobacco value-added manufacturing in Sub-Saharan Africa. But Anyanwu (2017) and Anyanwu and Kponnou (2017) show that secondary education has strong positive association with both overall MVA and food, beverages and tobacco MVA development in North Africa. The last column of Table 2 also shows that the level of tertiary education has a significant positive association with manufacturing value added development in Africa. This shows that that more sophisticated manufacturing products require higher levels of education. Thus, the effects of human capital (education) do not appear to be driven by other drivers of MVA in Africa.

In addition, the relationship between MVA in Africa and the level of economic development (log of real GDP per capita) is approximated by a third degree polynomial, with a negative leading coefficient. That is, there is a negative significant relationship between the level of real GDP per capita and MVA while there is a significant positive relationship between the quadratic real GDP per capita and MVA. The cubic real GDP per capita has a significant negative relationship with MVA in the continent.

Domestic investment rate has negative and statistically significant effect on MVA in Africa. As seen in Table 2 (columns (3) and (4), domestic investment rate is negative in sign and significant at the 5 percent level. Our estimates from the IV results, suggest that, on average, a one percentage increase in the share of domestic investment rate is associated with will lead to about 0.06 percentage decrease in MVA in African countries. Our result agrees with those of Anyanwu and Kponnou (2017) for food, beverages and tobacco in Africa. It also agrees with those of European Commission (2009a) which concludes that investment is an important driver (in terms of the magnitude of the industry-specific elasticities) for secondary industries in comparison to tertiary and primary industries. According to their findings, the industries with the largest coefficients for the investment variable (furniture and recycling, machinery and equipment, sale maintenance and repair of motor vehicles, construction) are those that produce traditional capital goods.

Government expenditure as a percent of GDP, a government policy variable, appears to significantly (at 1 percent significant level) reduce MVA in Africa. Our IV estimates suggest, for example, that a one percentage point increase in government consumption expenditure is associated with a decline in MVA by 0.27 percentage points in the continent. This finding is conformity to that of Tkalec and Vizek (2009) in their study of output in 22 manufacturing sectors in Croatia. Our results, therefore, mean that increase in government consumption spending crowds out manufacturing value added in African countries.

We investigated aspects of globalization that have been implicated as key drivers of MVA. Our results show that increases in trade openness are very significantly associated with increases in MVA in Africa in line with the results of Dabla-Norris et al. (2013). From our IV results, a one percent increase in trade openness is associated with a 0.12 percent increase in MVA in the continent. On the other hand, our results indicate that increases in inward stock of foreign direct investment (FDI) are associated with significantly decreases in to MVA in the continent. Dabla-Norris et al. (2013) using FDI as a percentage of GDP, find significant positive effect in their OLS regression but no effects in their quantile regressions.

One of the innovative aspects of this paper is the inclusion of other aspects of globalization, namely social and political globalization. Our results show that social globalization is negatively and significantly associated with MVA in African countries. This shows that African countries’ international personal contacts, information flows and cultural proximity help to generate influences that decrease MVA in the continent. However, political globalization is positively but insignificantly associated with MVA in African countries in our IV results though it is weakly positively significant in the OLS results.
The credit variable in our estimation has a positive and statistically significant (at the one percent level) effect on MVA in Africa. Our IV estimates indicate that a one percentage point increase in domestic credit to the private sector is associated with an increase in MVA by 0.07 percentage points in the continent. Dabla-Norris et al. (2013) find significantly positive effect for domestic credit in their quantile 10 regression but a weakly significant effect in their quantile 90 regression results – other quantile results are insignificant. Also, Haraguchi and Rezonja (2011) find that the availability of credit is only positive and significant for the lower end of the manufacturing distribution.

With respect to the role of natural resources, our results indicate that oil and mineral resource dependence have significant negative association with MVA in Africa. These results agree with those of McMillan and Rodrik (2011); UNIDO (2012) and Dabla-Norris et al. (2013). The positions of countries like Nigeria, Congo Republic, Angola, Botswana, Gabon and Libya in Figure 9 evidently confirm these findings. However, dependence on coal has very positive and significant association with increases in manufacturing value added in continent. In Figure 9, it is not surprising that South Africa, a major coal producer, is among the top countries on MVA.

Age dependencies (old and young) have positive and significant association with manufacturing value added in the continent. This likely reflects high demand for manufactured products resulting from the needs of old and young populations. Our results, however, are at odds with those of Dabla-Norris et al. (2013) who find negative significant effects for these two dependency indicators.

We next assess whether the quality of political institutions affects manufacturing development in Africa. Our estimates show that institutional democracy has a significant (at one percent level) U-shaped relationship with manufacturing value added in Africa. Thus, while institutionalized democracy may hinder manufacturing value added, it eventually promotes it as countries mature in institutional democracy. Dabla-Norris et al. (2013) find significant negative relationships with respect to quantiles 25, 50, 75, and 90. Lastly, our IV results indicate that civil violence in African countries is significantly (however, just at 10 percent level) negatively associated with MVA in the continent. Our results agree with Chauvin and Rohner (2009) who find that increases in the conflict level are associated with a reduction in the share of manufacture in the GDP in developing countries at the same significant level.

6. SOME POLICY RECOMMENDATIONS

What are the implications of these results for African countries? First, there is need for education beyond the primary and secondary levels to tertiary level for increased and sustained manufacturing value added development in the continent. Indeed, it is necessary to complement lower levels of education with higher education with the necessary skilled workforce capable of operating state-of-the-art technologies in manufacturing. This calls for explicit incentives such as vocational or engineering scholarships and demand-driven courses to train workers in the technical standards in the manufacturing sector. In addition, skill policies have to be aligned with Africa's broader socioeconomic development agenda. This requires strong coordination between stakeholders engaged in policy-making, both public and private sectors. Also, stronger university-industry linkages are essential. This can be done by including private sector representatives in national education and training policy bodies and on academic boards involved in curriculum development. No doubt this will also facilitate private sector funding for research, scholarships, internships and apprenticeships.

African higher education requires drastic upgrading. Though African countries generally spend relatively large proportions of their national resources on education, higher education enrolment remains extremely low by international standards. Worse still, the areas of higher education undertaken by a majority of African students are not in the fields of science, engineering technology and business as is the case in rapidly growing economies such as Korea and China, but more often in social sciences and the humanities. The result is a skills mismatch – university graduates remain unemployed, while African countries continue to face shortages of skilled labor. Addressing this
in the short-run will require improved training programs and closer links between tertiary and vocational educational institutions on the one hand, and the private sector on the other. Training programs should include on-the-job initiatives targeting those already working, as well as graduates with a general education who lack specific work skills (Anyanwu, 2012).

Second, our results confirm that higher levels of prosperity (higher economic development of up to between US$1097 and US$8013 per capita) are associated with higher MVA in African countries. Therefore, African countries must take measures to increase their national incomes and check rapid population increase. To increase real per capita income, African countries must deepen macroeconomic and structural reforms to increase their competitiveness, create increasing and more quality jobs and hence increase participation in economic activity, dismantle existing structural bottlenecks to private and public investment, and scale-up investments in hard and soft infrastructure to enhance local production and regional integration. Other measures include structurally transform the economy for increased trade competitiveness in knowledge-intensive manufacturing, and increase productivity, especially in agriculture, through creating incentives and opportunities for the private sector and increasing government support to small farm holders in terms of finance, formalization of land ownership, and technical advice.

On the other hand, to check population growth (highest globally at 2.55 percent), there is urgent need to intensify family planning services efforts and activities in African countries so as to improve knowledge, acceptance and practice (KAP) of family planning. This will involve not only increased financial outlay but also research on fertility determinants as well as decentralized planning, delivery and supervision of family planning services (Anyanwu, 1998a;1998b). African governments at various levels need to address the problems of low access to contraceptives by married couples and high child mortality. A clear focus on healthcare and the structural issues, with free or subsidized contraceptives for married couples who lack access and scaled up public health education will go a long way in checking Africa’s population explosion.

The issue of rapidly rising population has become more pertinent given increased international and expert attention in recent times. This is in the light of the rapid increase in the continent’s population from 228.67 million in 1950 to about 1.26 billion in 2017 with a projection to hit 2.53 billion in the year 2050.

Third, given our finding that domestic investment rate is associated with reduction in MVA in Africa, effectiveness of domestic must remain an active goal of governments in the continent. Adoption of high level best practice principles in investment is therefore imperative. Those broad principles should include the following key elements: a nationally coordinated approach to the development of significant strategic projects and programs; and the promotion of competitive markets. Others relate to decision-making based on rigorous cost-benefit analysis to ensure the highest economic and social benefits to the nation over the long term; a commitment to transparency at all stages of the decision-making and project implementation processes; and a public and private sector financial management regime with clear accountabilities and responsibilities.

Fourth, to make government consumption expenditure work for MVA in Africa, efforts to reform the fiscal system for consolidation by both the executive and legislative arms of government are imperative to avoid wastes, corruption and crowding out resources for public sector investment. In addition, public spending on education (as well as on health and other human capacity), when targeted at the poor, can produce a quadruple dividend, increasing MVA and industrializing Africa in the short- and medium-term.

Fifth, to make globalization work for increased MVA, local resources need to be deployed in adequate quantities to produce goods for the external market. In addition, domestic production capabilities have to be put into place in order to exploit trade opportunities (especially intra-regional trade), increase response to international competition, and improve technology. Indeed, African countries need to promote increased regional trade, especially through the removal of cross-border barriers and infrastructure bottlenecks.
Sixth, since inward FDI inflows is associated with declines in MVA in the continent, African countries should regulate the inflow of foreign capital to ensure local value addition to manufacturing is not displaced by globalization. Efforts should also be made to improve the efficiency and effectiveness of public institutions, while increasing investment in the quality of human capital so as to generate the requisite skills required in a competitive global environment and make FDI stock more productive. In addition, governments should respect private property rights, allow the rule of law to prevail as well as improve the legal, judicial, and regulatory, and infrastructural environment that make for more productive FDI stock.

Seventh, for domestic credit to work for the sectoral MVA, lending rates reduction is imperative, especially through a more financial competitive environment while developing the requisite lending expertise, mechanisms for monitoring, and supervisory and regulatory skills of operators of the African financial system.

Eight, for long-term sectoral MVA development, African countries with abundant natural resources need prudent institutions to manage revenues from resource rents so as to avoid undue currency appreciation and underinvestment in physical and human capital that will eventually undermine manufacturing value addition. Indeed, efficient management of natural resources in Africa requires actions throughout the value chain. In particular, a new natural resources management framework is needed for better governance, sectoral linkages, economic growth and human, capacity and infrastructure development – with strong parliamentary legislation, oversight, and representation throughout the resources value chain. Given that oil, mineral resources and natural gas are non-renewable resources, it is vital to negotiate more beneficial and transparent contracts with oil/mining Multinational Corporations operating in Africa, and ensure that these companies do not evade taxes. For greater returns to African countries in terms of royalties/rents, for example, the governments should engage in auctions for oil/mining/natural gas/forest rights. In this regard, international financial institutions like the African Development Bank have a critical role to play in helping these countries acquire the much-needed capacity not only to negotiate beneficial contracts but also for effective management of natural resource rents. Other measures to promote efficient and effective allocation of public expenditure include promoting high levels of transparency, ensuring that the political system has a centralized system of financial authority and control, and the legislation of a ‘fiscal constitution’ that imposes ceilings (and perhaps also floors) on public spending from resource rents.

Ninth, the promotion of effective liberal (not just electoral) democracy and prevent civil violence will help in the design of policies friendly to MVA development. This requires political will, commitment, good governance (including the control of corruption, transparency and accountability, the rule of law, government effectiveness, and political stability), inclusive development, collaborative spirit to formulate and faithfully implement the requisite policies, strategies, plans and collective action as well as the institutional changes needed for increased gender equality in education. Other critical measures to promote liberal democracy (contrary to the prevailing “anocracies”) and check civil violence in Africa include promoting and maintaining effective rule of law, deepening macroeconomic and structural reforms and increasing investments to raise national income, and implementing greater economic and political inclusion. Democracy will thrive and will be sustained and stable when there is the willingness to lose (contestation) and when there are capacities to challenge and enforce the rules of the game. Contestation means that parties are able to win but are willing to lose. In other words, opposition parties have to be able to compete effectively with incumbents, with the credible potential to hold incumbents accountable while voters and parties must be willing to lose elections. Also, laws must be effectively enforced. This means that a sturdy, thriving, durable and stable democracy requires a government with the capacity to enforce both the rules of the game and the policies produced through those rules against violation or nullification either by abusive agents of the government itself or by private actors, whether common criminals, would-be warlords or the military.

Lastly, our results show that higher primary energy (coal, oil, gas, biomass, other renewables and nuclear) use intensity is highly significantly associated with higher manufacturing value added in African countries. This agrees with the established idea that energy intensity of industry is far higher than that of the service sector, especially
when there is the dominance of energy-intensive sectors such as food, pulp and paper, basic chemicals, refining, iron and steel, nonferrous metals (primarily aluminum), and nonmetallic minerals (primarily cement) as in Africa. This finding has double policy implications: increase energy supply and promote energy efficiency.

Incidentally, Africa’s energy requirements are huge. For example, according to estimates by McKinsey (see Castellano et al. (2015)) if every country in Sub-Saharan Africa builds what it needs, the region would require about US$490 billion of capital for new generating capacity, plus another US$345 billion for transmission and distribution, giving a total of US$835 billion. At the same time, Sub-Saharan Africa is incredibly rich in potential power-generation capacity. According to Castellano et al. (2015) excluding solar, the estimate is 1.2 terawatts of capacity while including solar, there is a staggering 10 terawatts of potential capacity or more. Promotion of renewable generation, and regional integration, such as power pools, are potential game changers that could shape the energy landscape in sub-Saharan Africa over the next 25 years. For example, if these countries aggressively promote renewables, they would have a 35 percent higher installed capacity base. Also, significantly increasing regional integration could save more than US$40 billion in capital spending, and save the African consumer nearly US$10 billion per year by 2040, as the “levelized” cost of energy falls from US$70 per megawatt-hour to US$64 per megawatt-hour (Castellano et al., 2015).

It is against this background that Africa Development Bank’s High Five priority of “Light Up and Power Africa” is highly commendable and needs international support. The AfDB has therefore launched a New Deal on Energy for Africa, which is built on five inter-related and mutually reinforcing principles: (i) raising aspirations to solve Africa’s energy challenges; ii) establishing a Transformative Partnership on Energy for Africa; (iii) mobilizing domestic and international capital for innovative financing in Africa’s energy sector; (iv) supporting African governments in strengthening energy policy, regulation and sector governance; and (v) increasing African Development Bank’s investments in energy and climate financing. To achieve this priority objective, the African Development Bank (AfDB) is investing US$12 billion in the power sector by 2020 and seeks to mobilize US$50 billion from the private sector, especially through co-financing arrangements. The Africa Renewable Energy Initiative, jointly developed by African Union Commission and the G7 and hosted by the Bank, is now operational. It will mobilize US$10 billion for renewable energy in African countries.

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