Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.7, No.22, 2016

Manufacturing and Economic Growth in Africa: A Panel Test of Kaldor's First Growth Law

Olumuyiwa Olamade* Oluwasola Oni
Department of Economics, Caleb University. PMB 21238, Ikeja, Lagos, Nigeria

Abstract

This paper examines the importance of the manufacturing sector for economic growth in African countries. Although many African countries have posted impressive growth performance in last one decade. A notable fact of this growth is the declining share of manufacturing in the gross domestic product (GDP). Will the contraction of the manufacturing sector hurt African economic growth in the long-run? We approach this question by testing Kaldor's first law of economic growth using panel data for a sample of 28 African countries over the period 1981-2015. Results obtained from pooled Ordinary Least Squares, Fixed Effects, and System Generalized Method of Moments provides current evidence to support manufacturing as the engine of growth in Africa. The Fagerberg-Verspagen (1999) criteria show that despite the falling share of manufacturing in the GDP, the difference between the coefficient of manufacturing output growth and share of manufacturing in GDP is positive and significant. We conclude that de-industrialisation will adversely affect both the growth rate of the non-manufacturing sectors and of the whole economy in African countries.

Keywords: Economic growth, manufacturing, non-manufacturing, productivity, value added

1. Introduction

Since Clark (1941) a wide range of literature, especially those associated with the post-Keynesian and evolutionary economists, have empirically confirmed that structural change is the necessary process of economic growth. The expansion of the manufacturing sector is generally viewed as the most significant engine of the growth process. Kaldor (1966, 1967) posits a strong positive causal relationship between the growth of manufacturing output and that of the GDP. This relationship rests on certain special characteristics of the manufacturing sector, which makes it the engine of GDP growth and of living standards. First, manufacturing is characterised by both static and dynamic increasing returns to scale, while other non-manufacturing activities are subject to diminishing returns. Secondly, manufacturing output growth draws labour from non-manufacturing activities where there are diminishing returns resulting in productivity growth in these activities because the average product of labour is above the marginal product. The manufacturing sector's characteristics with regard to GDP growth is the foundation of what now is known as the Kaldor's growth laws. The laws state that: (1) manufacturing is the engine of GDP growth (2) the productivity of the manufacturing sector is positively related to it's on growth (also known as the Verdoorn's law), and (3) the productivity of the non-manufacturing sector is positively related to the growth of the manufacturing sector. Thus, the post-Keynesian development paradigm based on Kaldor's 'engine of growth' hypothesis advance the strengthening of the manufacturing sector, even if the sector offers no comparative advantage in the initial stage of development. The special characteristics of the manufacturing sector will enhance its competitiveness over time and spread positive externalities to other important sectors of the economy (Cantore, Clara and Soare, 2014).

Developments in structural transformation paths of some developing countries in the last two decades appear to question the role of manufacturing as engine of growth or the sole engine of growth. Dasgupta and Singh (2006) outline certain long-term structural tendencies observed in some developing countries which prima facie challenges the Kaldor's theses. These tendencies include the onset of de-industrialisation at a much lower level of per capita income than historically observed in the advanced countries during their period of industrialisation; the phenomenon of jobless growth in the formal manufacturing sector in both slow-growing and fast-growing economies; and a faster long-term growth of services than manufacturing. Drawing from the experience of India, Amirapu and Subramanian (2015) posit that any sector of the economy could lead growth if it features a high level of productivity, dynamic productivity growth, extensive backward and forward linkages, exportability, and comparative advantage for the home country. Thus, services or any other sector or branches thereof could displace manufacturing as engine of growth.

With developments in information and communications technology (ICT) and the emergence of services as the leading growth sector in many developing countries the debate on the best way to stimulate growth in developing countries remains unsettled. The question then arises as to whether African countries need to industrialize in order to grow and prosper. Put differently, should manufacturing remain the focus of industrial policy in developing countries, and Africa in particular? This paper attempts to answer this question by examining the GDP-manufacturing growth relationship. If we find significant evidence that, the influence of manufacturing output expansion on economic growth transcends the percentage share of manufacturing in the GDP, we conclude that the manufacturing as engine of growth hypothesis is still relevant to Africa. The manufacturing sector in Africa offers opportunities for economic growth through economy-wide diffusion of technological progress believed to originate principally from the manufacturing sector. The rest of the paper is organized as follows; review of relevant literature comes up section 1, while the description of the data used and the source is in section 2. The theoretical foundation of the work, the regression equations, and estimation methodologies are set out in section 3. We report the findings and conclude in sections 4 and 5, respectively.

2. Review of literature

There appear to be two major definitive consensuses in the empirical literature regarding the pattern of growth in developed and developing economies. First is that the major sources of economic growth for developed and developing economies are completely different. Secondly, that the linear structural change from agriculture to manufacturing, and then from manufacturing to services that characterized the economic transformation of the developed economies may not generally apply to developing economies. In addressing the economic growth concerns of developing economies, two key and somehow divergent strands of literature are identifiable. On the one hand is the neoclassical paradigm which emphasises that countries ought to specialise in those sectors they have comparative costs advantage than competitors. On the other hand, the post-Keynesian and evolutionary economists argue that countries ought to specialise in those strategic sectors that can stimulate economy-wide productivity and innovation, even if such sectors confers no comparative advantage at the initial stages of development (Cantore et al, 2014).

While both paradigms are appropriate for developed economies largely driven by rapid technological changes based on efficient accumulation of physical and human capital, they pose different development challenges for low-income and middle-income developing countries. According to the comparative advantage paradigm, developing countries ought to focus on agriculture and successively transit from agriculture to the modern sectors following the linear structural transformation path. Su and Yao (2016) identified the challenge posed by the neoclassical paradigm for low-income developing countries as the lack of a driving force to transfer resources from agriculture to the modern sectors. Where the driving force is available and activated, research has empirically shown that the structural change bonus resulting from such transfer has been a major source of growth in developing countries (Timmer and Szirmai, 2000; Temple and Woessmann, 2006; Rodrik, 2009 and Timmer and de Vries, 2007). For the middle-income countries, the challenge is how to transit from middle-income to high-income countries or avoid the supposed 'middle-income trap' (Agenor, Canuto and Jelenic, 2012). For countries experiencing income growth slowdowns, Krugman (1994) identified labour productivity growth as a veritable new source of long-term economic growth. Thus, breaking out of income trap and catching up with developed economies is actually a process of eliminating the productivity gap. Eichengreen, Park and Shin in a 2011 paper also advanced the productivity argument as a fundamental development challenge of developing countries. To Eichengreen et al, slowdown in the rate of total factor productivity (TFP) growth may result in prolonged slow output growth, and freezes income growth. Which route should developing economies take to ensure sustained long-term income growth? According to the neoclassical growth model, it is the way of efficient accumulation of physical and human capital. The post-Keynesians and evolutionary economists point to the way of continual productivity growth.

The essential contribution of the Kaldor's engine of growth hypothesis is the proposition of a theoretical foundation for a development strategy, which locates manufacturing output growth as the fulcrum for both efficient physical and human capital accumulation (neoclassical theses) , and factor productivity growth (post-Keynesians prescription). If productivity growth in both the manufacturing sector and non-manufacturing sector of the economy is positively related to output growth in the manufacturing sector as proposed by Kaldor (1966, 1967), then a transfer of resources from other sectors to manufacturing will result in more rapid aggregate growth (Szirmai, 2011; Cantore et al, 2014). Evidence of this dynamic shift effect in developing countries is unambiguous as productivity growth in manufacturing has been more rapid than in the primary sector (Szirmai, 2011). Further, the manufacturing sector compared to other sectors has a higher demand for capital and investment thereby providing opportunities for capital accumulation and increase in the private saving ratio (Su and Yao, 2016). The neoclassical growth theory regards savings as one the most important factors for long-run economic growth.

The manufacturing sector, more than other sectors, offer superior opportunities for embodied and disembodied technological progress crucial for the development of developing countries. Rapid capital accumulation puts into operation in firms new machines that incorporate the latest technological advances that drive productivity growth in firms and in the economy. Greenwood, Hercrwitz, and Krusell (1997) estimated that 60% of labour productivity growth is directly attributable to embodied technological progress. It is logical that if new machines embody technology that is more productive than that of older machines, then a sustained investment in new machines should lead to an increase in TFP growth. The positive effects of embodied technological progress are also positive for advanced economies. Stiroh (2001) inquiring into recent changes in the US economy attributes accelerated aggregate productivity growth to a combination of accelerating technical progress in high-tech industries and corresponding investment and capital deepening. Sakellaris and Wilson (2002) evaluated the impact of embodied technological change on US manufacturing productivity growth between 1972 and 1996, and concluded that the role of investment-specific technological change as an engine of growth is even larger than previously estimated.

The manufacturing sector allows for faster growth rate in both embodied and disembodied technological progress. Cornwall (1977) argued that embodied and disembodied technological progress largely originates in the manufacturing sector and diffused to other sectors therefore making manufacturing the locus of technological progress in the economy. Manufacturing generates more extensive and stronger linkages with, and spillovers into, the economy than nonmanufacturing activities (Herzer, 2007). While linkages can create economies of scale, spillovers create an environment for new product and process technologies ideas resulting in further expansion of both the manufacturing and nonmanufacturing sectors.

Empirical economic growth literature using different econometric models had tested and confirmed the validity of manufacturing as engine of growth. Studies at national and regional levels largely agreed that output growth in the manufacturing sector is uniquely important to the process of national economic growth as aggregate economic growth positively relates to both output growth and productivity growth in the manufacturing sector. At the level of individual countries, the U.S. Department of Commerce (1995) finds the manufacturing sector a powerful source and a principal arena of growth and change. Other country level studies include the works done for the United Kingdom (Stoneman, 1979), Australia (Whiteman, 1987), Greece (Drakopoulos and Theodossiou, 1991) and Turkey (Bairam, 1991).

Wells and Thirlwall (2003) evaluated Kaldor’s law across African countries. Dasgupta and Singh (2005) evaluated the engine of growth hypothesis for 30 developing countries. In a 2006 work, Dasgupta and Singh analysed a sample of 48 developing countries. Szirmai (2009) worked with a panel of 63 developing countries and 16 advanced countries for the period 1950-2005. Lavopa and Szirmai (2012) used a sample of 92 countries for the period 1960 – 2010. Libanio and Moro (2013) applied panel data for 11 largest economies in Latin America during the period 1980-2006. All these studies find strong evidence to support the engine of growth hypothesis for manufacturing. Pacheco-Lopez and Thirlwall (2013) reinterpreted Kaldor´s first law. Starting with a premise that the model in its original form is essentially ‘closed-economy’ hypothesized that export growth drives GDP growth, and export growth itself is a positive function of manufacturing output growth. Using a dataset comprising 89 open developing economies for the period 1990-2011, the authors show that manufacturing growth translates into economic growth through international trade.

Eguez (2014) applied Kaldor’s first law to a world panel of 119 countries over the period 1990 – 2011. The study confirmed that manufacturing continues to be an engine of growth in both low and middle-income countries. Manufacturing activities with higher technology component generate more space for technological progress, human capital development and productivity increase, which ultimately contribute positively to a faster economic growth. For a sample of 80 countries, Cantore et al (2014) decomposed manufacturing sector growth into intensive and extensive industrialisation. They affirm the validity of Kaldor’s law of manufacturing as engine of growth while concluding that intensive rather than extensive industrialisation more closely relates to GDP growth. In a more recent study, Su and Yao (2016) in a sample of 180 middle-income countries for the period 1950-2013 found that compared with other sectors, manufacturing development can better utilise human capital and economic institutions, improve the incentives of savings, enhance the technological accumulation.

In conclusion, empirical literature undeniably is divided on the engine of growth hypothesis. While some supports the engine of growth hypothesis for manufacturing others argued that the recent surge in service sector expansion in some developing countries and early de-industrialisation experienced by others appears to suggest that manufacturing is not the only engine of growth. For instance, Eguez (2014) found that manufacturing and services both turn out to be engines of growth for middle-income countries, though manufacturing is the stronger source of growth. The result suggests that for these countries manufacturing is not the only route to achieving economic growth. While strongly validating the manufacturing as engine of growth hypothesis, Cantore et al (2014) showed that not every dollar of additional manufacturing value added contributes to growth.

3. Data description and source

The variable representing manufacturing output growth is the growth rate of the manufacturing value added. The non-manufacturing sector is made up of the valued added of both the agriculture and services sectors. This follows the practice well established in the literature. As the influence of manufacturing value added growth rate on economic growth might not be significantly visible in a single year, we work with a 5-year average of the growth rate of real GDP, manufacturing value added growth rate, and non-manufacturing value added growth rate. Based on data constraint we select a sample of 28 African countries for which continuous data are available for the period 1981 – 2015. All the data used are from the 2016 edition of the World Bank's World Development Indicators (WDI). All computations were done on Eviews 9.5.

4 Empirics

4.1 The equations

Kaldor's first law of growth often referred as the 'engine of growth hypothesis' posits that the growth rate of GDP is positively related to the growth rate of manufacturing output. Kaldor expressed the hypothesis as:

$$q = a_1 + a_2 m, \qquad (1)$$

where q and m represent growth of GDP and manufacturing output, respectively. The regression coefficient (a_2) should be positive and less than a unity suggesting that the overall growth rate of the economy is associated with the excess of the growth rate of manufacturing output over the growth rate of non-manufacturing output.

Kaldor premised the explanation for the correlation between the growth rate of manufacturing output and the aggregate economic performance on two possible reasons. The first relates to the fact that the expansion of manufacturing output leads to the transfer of labour to the manufacturing sector from the low productivity non-manufacturing sector. The result is an increasing economy-wide productivity with little or no negative impact on the output of the non-manufacturing sector, given the existence of surplus labour. The second reason relates to the existence of static and dynamic increasing returns in the manufacturing sector. While static returns relate essentially to economies of scale internal to the firm, dynamic returns refer to increasing productivity derived from learning by doing, 'induced' technological change, and external economies in production.

As regards equation (1) Kaldor made the important point that the correlation between q and m is not only due to manufacturing output constituting a large component of GDP, rather that high economic growth rates is positively related to the excess of manufacturing output growth over non-manufacturing output growth. He demonstrated that countries that exhibit GDP growth rates over 3% a year, present a manufacturing growth rate output higher than the growth rate of the non-manufacturing sector. Kaldor expressed this claim in equation form as:

$$q = a_3 + a_4(m - nm) \qquad (2)$$

where *nm* refers to the growth of non-manufacturing output, and $(m - nm)$ the excess of manufacturing output growth over non-manufacturing output growth. We will simply denote this excess as (λ) and rewrite equation (2) as: $q = a_3 + a_4(z)$. To further support his first law of growth Kaldor showed that non-manufacturing output growth also responds positively to the growth of manufacturing output resulting in overall economic performance growth. This he expressed as:

$$nm = a_5 + a_6m \qquad (3)$$

Equation (1) essentially is the culmination of the manufacturing as engine of growth hypothesis. The other two equations offer support for the hypothesis and abate the endogeneity problem, which characterises equation (1). We will subject equations (1) – (3) to pooled OLS and Fixed Effects (FE) regression. The system generalised method of moments (system GMM) will test only equation (1). For each of the estimation techniques, appropriate transformation of the three original equations is made to suit the assumptions of the technique.

4.2 Empirical methodology

Empirical research has shown that the traditional ordinary least squares (OLS) estimation (the technique used by Kaldor) is incapable of handling the problems of highly correlated regressors, country heterogeneity, reverse causality, etc often associated with empirical growth regression analyses. Kaldor's own results for his first law suffer from endogeneity bias, which may arise from the independent variable (*m*) being correlated with the error term, omitted variables in the regression, and simultaneity bias. In the relations between GDP growth (*q*) and manufacturing growth (*m*) both variables could be reciprocally correlated. In the face of reciprocal causality, the OLS technique produces biased estimates. To circumvent this concern researchers have employed alternative econometric models to test the engine of growth hypothesis. In this paper, we employed the pooled OLS, FE model and the system GMM. The pooled OLS is simply the conventional least squares method fitted to a panel sample. In the face of heterogeneity across countries and the likelihood that the country-specific effects may be correlated to the regressors, the FE model provides improvements to pooled OLS results and thus address the concern of spurious correlation. We chose system GMM over the difference GMM because it offers better results. It improves difference GMM by introducing instruments in differences for equations in levels. We therefore expect that our results would progressively improve as we proceed from pooled OLS to FE, and to system GMM.

4.2.1 Pooled OLS

For the pooled OLS regression equation (1) which describes the relationship between GDP growth and manufacturing output expansion is transformed as:

$$q_{it} = b_{1t} + b_{2i}(m_{it}) + \lambda_t + \varepsilon_{it}, \qquad b_{2>0} \qquad (4)$$

where λ is the time-specific effects introduced to check if the influence of manufacturing growth on GDP growth changes during the study period. Similarly, equation (2) which predicts the GDP growth rate by the difference between the growth rates of manufacturing value added and non-manufacturing value added is transformed as:

$$q_{it} = b_{3t} + b_{4i}(z_{it}) + \lambda_t + \varepsilon_{it,} b_{4>0} \quad (5)$$

In the same vein, equation (3) which posits that non-manufacturing value added growth positively responds to growth of manufacturing value added is transformed for pooled OLS regression as

$$(nm_{it}) = b_{5t} + b_{6i}(m_{it}) + \lambda_t + \varepsilon_{it,} \qquad b_{6>0} \quad (6)$$

The pooled OLS model estimates equations (4) – (6) without regard to country-specific income effects.

We conduct heteroscedasticity and autocorrelation tests to check the validity and reliability of the estimates obtained by pooled OLS. Tests of the null hypotheses of no cross-section random effect, and of the combined cross-section and time random effect conducted with the Breusch-Pagan, Honda, King-Wu, Standardized Honda and Standardized King-Wu statistics overwhelmingly supports the acceptance of the null at 5%. However, the Pesaran scaled LM, Biased-corrected scale LM, and Pesaran CD all fail to accept the null of no cross-section dependence in residuals.

4.2.2 Fixed Effects model

The main assumption of the FE model is that the error term is divided into two distinct components as: $\varepsilon_{it} = f_i + \mu_{it.}$ Where μ_{it} is the conventional idiosyncratic random error and f the country-specific effects. In this model, f depends on the regressors and is therefore a random variable. Like in the Pooled OLS, we estimate the FE model without regard to country-specific effects often captured by the introduction of income category dummies. To implement the FE model, the following transformation of equations (1) – (3) apply:

$$q_{it} = c_{1t} + c_{2i}(m_{it}) + \lambda_t + f_i + \mu_{it}. \quad (7)$$

$$q_{it} = c_{3t} + c_{4i}(z_{it}) + \lambda_t + f_i + \mu_{it}. \quad (8)$$

$$(nm_{it}) = c_{5t} + c_{6i}(m_{it}) + \lambda_t + f_i + \mu_{it.} \quad (9)$$

Combinations of the Pesaran scaled LM, Biased-corrected scale LM, and Pesaran CD tests provide strong support to accept the absence of residuals correlation at 5% in the FE model. We therefore, assume the validity and reliability of the estimates of the three equations under the pooled OLS and FE model.

4.2.3 System GMM

Researchers have also estimated equation (1) by including the lagged values of the dependent variable (q) as a way to capture possible autocorrelations as in Holland et al (2012).

There is a consensus that when such a dynamic model is regressed with either the OLS or FE techniques the coefficient of the lagged dependent variable may bias upwards in case of individual-specific effects or downwards in the case of FE (Nickell, 1981). In this situation, the GMM is helpful to correct the bias. The GMM is a modern econometric technique to deal with endogeneity bias with or without lagged dependent variable.

There are different alternatives to perform the GMM technique. Arellano and Bond (1991) proposed the difference GMM estimator that transforms the regressors, usually by differencing them in order to remove country specific FE, which are the source of endogeneity. Then the first difference of the dependent variable is instrumented with lagged values of the regressor in level. Nevertheless, the past values in levels may turn out to be poor instruments for first differences (Blundell and bond 1998). Consequently, Arellano and Bover (1995), and Blundell and Bond (1998) proposed the system GMM estimator that builds a system using the original equation with the dependent variable in first difference and the transformed equation. In this model, the transformed equation has a dependent variable in levels that is instrumented with suitable lags of their own first differences based on the assumption that the first differences of instrument variables are uncorrelated with country FE. According to Roodman (2006), this process allows the introduction of more instruments, and can dramatically improve efficiency. Equation (1) is expressed for system GMM regression as follows:

$$q_{it} = \alpha_{1t} + \varphi(q_{it-1}) + \alpha_{2i}(m_{it}) + \lambda_t + f_i + \mu_{it} \qquad (10)$$

For consistency and asymptotic normality, GMM relies on the correct specification of the model and, given the model, on the specification of correct moment conditions (Andrews and Lu, 2001). Thus, when fitting a model by GMM, it is required that a check is made to see whether instruments used are uncorrelated with the errors (orthogonality condition). In GMM estimation, the Hansen's *J* statistic is the most common test statistic. The test statistic has a χ^2 distribution under the null hypothesis that the instruments are valid. If the equation, excluding suspect instruments, is exactly identified the J-statistic will be zero. A J-statistic of less than 0.1 is acceptable to satisfy the orthogonality condition (Benchimol, 2013).

Finally, we apply the Fagerberg-Verspagen criteria to the coefficient estimate of the system GMM to obtain additional evidence in support or against the manufacturing as engine of growth hypothesis. The criteria test whether the coefficient of manufacturing value added growth is positive, and if positive, whether it is significantly greater than the share of manufacturing value added in the GDP. If the difference is positive and significant, it is interpreted as support for the engine of growth hypothesis.

4. Empirical findings and discussion

The results of pooled OLS, FE and system GMM regressions are presented in Tables 1, 2 and 3 respectively. The pooled OLS and FE model returned the same result for equation (1) which tests the direct relationship between GDP growth (*q*) and manufacturing output growth (*m*). In the two models, the constant terms (b_1 and c_2) and the coefficient of manufacturing output growth (b_2 and c_2) are (0.023) and (0.31) respectively, and are significant. Under the pooled OLS and FE regressions the constant terms vary within the range 0.22 and 0.34. The implication is that when manufacturing valued added remain unchanged, on the average, GDP grows within the range captured by the constant term. The coefficients of manufacturing output growth (b_2 and c_2) and of the excess of manufacturing output growth over non-manufacturing output growth (b_4 and c_4) lie between 0.23 and 0.31. This means that when manufacturing output and the excess of manufacturing output over other sectors output grows by 1%, the GDP growth rate increases within the range of 0.23% and 0.31%. It is notable that these coefficient values are considerably less than one, which suggests that the greater the manufacturing output growth and the excess of manufacturing growth over other sectors, the greater the GDP growth. Also, we found that the lowest coefficient of the manufacturing output growth (27% in the pooled OLS regression) is higher than the average share of manufacturing value added in the GDP (13.05%) computed for the 28 countries for the period covered in the analysis. Results obtained for equations (4) and (5) with the pooled OLS and FE supports manufacturing as engine of economic growth for Africa. As manufacturing output increases and in excess of output growth in the non-manufacturing sector, it drives growth in the GDP via growth of output in other sectors of the economy. Equation (6) which shows the effect of manufacturing output growth on the growth performance in non-manufacturing sector produced a coefficient value of 1.15 suggesting that a 1% increase in manufacturing output induces more than a 1% increase in non-manufacturing output.

Journal of Economics and Sustainable Development www.iiste.org
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.7, No.22, 2016

Table 1: Pooled OLS results

	Equation 4	Equation 5	Equation 6
	(b_2)	(b_4)	(b_6)
Coefficient	0.31	0.27	1.15
	(0.0000)	(0.0000)	(0.0000)
Constant	0.023	0.034	0.022
	(0.0000)	(0.0000)	(0.0000)
R^2	0.35	0.09	0.66
DW	1.24	1.35	1.71
LM tests for random effects (cross-section)			
Null hypothesis: No cross-section effect			
Breusch-Pagan	4.56	0.86	0.12
	(0.0328)	(0.3543)*	(0.7282)*
Honda	2.13	0.93	-0.347542*
	(0.0164)	(0.1771)*	
King-Wu	2.13	0.93	-0.347542*
	(0.0164)	(0.1771)*	
Standardized Honda	2.29	1.08	-0.230429*
	(0.0111)	(0.1404)*	
Standardized King-Wu	2.29	1.08	-0.230429*
	(0.0111)	(0.1404)*	
LM tests for random effects (cross-section and time)			
Null hypothesis: No cross-section and time effects			
Breusch-Pagan	16.07	5.83	3.56
	(0.0001)	(0.0158)*	(0.0591)*
Honda	3.91	2.23	1.07
	(0.0000)	(0.0128)*	(0.1432)*
King-Wu	3.98	2.41	1.53
	(0.0000)	(0.0079)	(0.0630)*
Standardized Honda	-0.01922*	-1.83625*	-3.108506*
Standardized King-Wu	0.92	-0.809213*	-1.782791*
	(0.1797)*		
Residual cross-section dependence test			
Null hypothesis: No cross-section dependence (correlation) in residuals			
Breusch-Pagan LM	537.71	489.84	473.23
	(0.0000)	(0.0001)	(0.0006)
Pesaran scaled LM	4.79	3.04	2.45
	(0.0000)	(0.0023)	(0.0145)
Pesaran CD	7.05	5.19	2.65
	(0.0000)	(0.0000)	(0.0081)

Period included :7, Cross-section included: 28, Total panel (balanced) observations: 196

The result shows that the non-manufacturing sector in African countries responds positively to output growth in the manufacturing sector. More importantly, the result reinforces the commanding role of the manufacturing sector as the locus of technological progress because of its more extensive and stronger linkages with, and spillovers into, the economy. Manufacturing spillovers create an environment for new product and process technologies ideas resulting in further expansion of both the manufacturing and nonmanufacturing sectors (Cornwall, 1977; Herzer, 2007). Thus, manufacturing drives economic growth both by its own output expansion and by the induced output growth in other sectors of the economy. The manufacturing sector drives GDP growth both by its own output growth and by the induced growth of output in other sectors. Consequently, there appears a great latitude for manufacturing sector expansion to drive growth in Africa.

Table 2: Fixed effects regression results

	Fixed effects (cross-section and period fixed)		
	Equation 7 (c_2)	Equation 8 (c_4)	Equation 9 (c_6)
Coefficient	0.31 (0.0000)	0.23 (0.0002)	1.15 (0.0000)
Constant	0.023	0.034	0.022
R^2	0.56	0.32	0.72
DW	1.68	1.61	1.99
Residual cross-section dependence test			
Null: No cross-section dependence (correlation) in residuals			
Pesaran scaled LM	1.84 (0.0656)*	2.53 (0.0114)	5.88 (0.0000)
Bias-corrected scaled LM	-0.49 (0.6225)*	0.19 (0.8429)*	3.55 (0.0004)
Pesaran CD	-1.76 (0.0788)*	-1.59 (0.1107)*	0.74 (0.4616)*
Period included :7, Cross-section included: 28, Total panel (balanced) observations: 196			

The diagnostics in terms of cross-section heteroscedasticity and combined cross-section and time heteroscedasticity conducted for the pooled OLS are all satisfactory at 5% when testing the positive relationship between excess of manufacturing growth over non-manufacturing output growth as a predictor of GDP growth (equation 5). We therefore accept the null of no heteroscedasticity effect. We cannot accept at 5% the null of no effect on the test of the positive relationship between manufacturing output growth and GDP growth (equation 4). Also, the OLS regression failed the test of no correlation in residuals. Expectedly, we can accept the null of no correlation in residuals at 5% for FE regression. The four test statistics largely supports the acceptance of the null at 5%. We therefore hold our regression coefficient values are valid and reliable to predict the growth rate of GDP.

Table 3: System GMM regression and Fagerberg-Verspagen test results

GMM		Fagerberg-Verspagen test			
	Equation 10 (α_2)	Share of *m* in GDP (η)	Difference (α_2 - η)	Wald test statistic value	P value
Coefficient	0.56 (0.0584)*	0.1303	0. 43	t-sta. 1.4771 F-sta. 2.1817 Chi-sq. 2.1817	0.1439 0.1439 0.1397
J-Statistic	0.00 (0.9212)*	-	-	-	-
GMM: Period included 3, Cross-section included: 28, Total panel (balanced) observations: 84. White period instrument weighting matrix, white period standard errors & covariance (d.f corrected). Instrument rank 11.					

We apply the system GMM to test the principal model of the engine of growth hypothesis represented by equation (1). The system GMM provides a higher value of manufacturing output growth coefficient than the pooled OLS and FE. A 1% rise in manufacturing output growth increases the growth rate of the GDP by 0.56% as compared to a maximum 0.31% obtained in pooled OLS and FE. The higher value of *(m)* under the GMM estimation compared to OLS and FE implies that the traditional techniques, which do not properly handle the problem of endogeneity, bias the coefficient estimate of manufacturing value added downwards. This result is consistent with other studies like Acevedo (2009), Cantore et al (2014), Eguez (2014), and Su and Yao (2016).

In the analysis of the pooled OLS and FE regressions, we found ample support for the claim of manufacturing as the engine of growth by simply looking at the sign and magnitude of the coefficient of the regressors. A further test of the hypothesis is the criteria of Fagerberg and Verspagen (1999). The criteria test whether the coefficient of the manufacturing output growth *(m)* is positive and significantly higher than the share of manufacturing output in GDP (η). Essentially, we test the null hypothesis ($\alpha_2 = \eta$) against the alternative ($\alpha_2 > \eta$). The result of the Wald test reported in Table 3 showed the value of each of the test statistic greater than (α_2 - η) and having significant p-values. There is therefore no reason to accept the null hypothesis of no difference between α_2 and η. There is thus empirical evidence to suggest that the positive influence of manufacturing on economic growth in Africa is not due to manufacturing output share in total GDP but principally resulting from the excess of manufacturing growth rate over non-manufacturing activities.

5 Conclusion

This paper analysed the relation between manufacturing output growth and economic growth in 28 African countries during 1981-2015 from the perspective of the Kaldor's first law of economic growth. We analysed the relation between manufacturing output growth and GDP growth by examining the effects of manufacturing value added growth on overall economic performance, and the output growth of non-manufacturing sector. The results presented uphold the "manufacturing as engine of growth" hypothesis, and suggest that the economic growth process of African countries is in a significant way positively correlated to the growth of the manufacturing sector. This result agrees with similar studies for low and middle-income developing countries. We therefore conclude that a prolonged contraction of manufacturing output (de-industrialisation) will be harmful to the economic growth of African countries.

The Economic development of African countries has suffered severally because of their vulnerability to low agriculture terms of trade and resource price volatility. Sustained economic growth in African countries can result from a process of growth-enhancing structural change. Ocampo (2005) recommends two key mechanisms to drive this process: a shift toward high-productivity manufacturing, and the creation of new inter-sectoral linkages that leads to a more intensely integrated production structure. Structural change towards higher productivity and sophisticated manufacturing activities can lower the vulnerability of African countries to external shocks and bring benefits from the positive externalities that the manufacturing sector transmits in the rest of the economy. The task for policy makers is to decide the type of manufacturing activities that will trigger sustainable economic growth in Africa. Evidence shows that manufacturing activities with higher technology component generate more opportunity for technological progress, human capital development and productivity increase, which ultimately contribute positively to a faster growth. However, it is unlikely that developing countries with limited technological capabilities can initiate an advanced industrialisation process (Egüez, 2014). Thus, African countries could start by developing basic and labour intensive industries that optimally exploits the comparative advantage in agriculture, and progressively move up to medium and advanced technology manufacturing, which demands the inputs of specialised services. With industrialisation as the focus of economic development, well-articulated and integrated industrial policies, effective macroeconomic management, and strong commitment to policy implementation will ensure that productivity growth and technological change originating from the manufacturing sector engender spillover mechanisms that benefit other sectors of the economy.

Reference

Acevedo, A., Mold, A. and Caldentey, E. (2009). The analysis of leading sectors: A long term view of 18 Latin American economies'. Paper No. 15017, Munich Personal RePEC Archive (MPRA), http://mpra.ub.umi-muenchen.de/15017.

Agenor, P., Canuto, O., and Jelenic, M. (2012). Avoiding middle-income growth traps. *Economic Premise*, 98. The World Bank. Retrieved from http://www.siteresources.worldbank.org/EXTPREMNET/Resources/EP98.pdf

Amirapu, A., and Subramanian (2015). Manufacturing or services? An Indian illustration of a development dilemma. Center for Global Development Working Paper 409. Washington DC: Centre for Global Development.

Andrews, D. W. K. and Lu, B. (2001). Consistent model and moment selection procedures for GMM estimation with application to dynamic panel data models. *Journal of Econometrics*, *101*, 123-164

Arellano, M. and Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies* (Oxford University Press) 58(2), 277-297.

Arellano, M. and Bover, O. (1995). Another look at the instrumental-variable estimation of error components models. *Journal of Econometrics* 68, 29-52.

Bairam, E. (1991). Economic growth and Kaldor's law: The case of Turkey 1925-1978. *Applied Economics* 23, 277-280.

Benchimol, J. (2013). Memento on Eviews output. Available at http://www.jonathanbenchimol.com/data/teaching/eviews-training/memento.pdf

Blundell, R. and Bond, S. (1998). GMM estimation with persistent panel data: An application to production functions. Working Paper No.W99/4, The Institution for Fiscal Studies.

Cantore, N., Clara, M., and Soare, C. (2014). Manufacturing as an engine of growth; which is the best fuel? Working Paper 01/2014. Development Policy, Statistics and Research Branch. UNIDO, Vienna. Retrieved from http://www.unido.org//fileadmin/user_media/services/PSD/WP/_eBook.pdf

Clark, C. (1941). *The conditions of economic progress*. London: Macmillan.

Cornwall, J. (1977). *Modern Capitalism: Its Growth and Transformation*. London: Martin Robertson.

Dasguptan, S. and Singh, A. (2005). Will services be the new engine of Indian economic growth? *Development and Change* 36(6), 1035-56.

Dasguptan, S. and Singh, A. (2006). Manufacturing, services and premature deindustrialization in developing countries: a Kaldorian analysis. UNU-WIDER Research Paper No. 2006/49

Drakopoulos, S.A. and Theodossiou, I. (1991). Kaldor's approach to Greek economic growth. *Applied Economics* 23, 1683-1689.

Egüez, M. E. A. (2014). Manufacturing the only engine of growth? An extension of Kaldor´s first law. Universitat Wien. Available at repositorio.educacionsuperior.gob.ec/bitstream/28000/.../1/**T**-SENESCYT-00632.pdf

Eichengreen, B., Park, D., and Shin, K. (2011). When fast economies slow down: international evidence and implications for China. Working Paper No.16919, National Bureau of Economic Research, Cambridge, MA.

Fagerberg, J. and Verspagen, B. (1999). Modern Capitalism' in the 1970s and 1980s. Modern Capitalism in the 1970s and 1980s. Working Paper No.1999002, Centre for Technology, Innovation and Culture, University of Oslo.

Greenwood, J., Hercowitz, Z., and Krusell, P. (1997). Long-run implication of investment-specific technological change. *American Economic Review* 87, 342-362

Herzer, D. (2007). How does trade composition affect productivity? Evidence for Chile. *Applied Economics Letters,* 14, 909-912.

Holland, M., Vieira, F., da Silva, C. and Bottecchia, L. (2012). Growth and exchange rate volatility: a panel data analysis. *Applied Economics*, 45, 3733-3741

Kaldor, N. (1966). Causes of the slow rate of economic growth of the United Kingdom. An Inaugural Lecture. Cambridge University Press, Cambridge.

Kaldor, N. (1967). Strategic factors in economic development. Cornell University Press, Ithaca.

Krugman, P. (1994). The myth of Asia's miracle. *Foreign Affairs*. November/December, 62-78

Lavopa, A., and Szrmai, A. (2012). Manufacturing growth, manufacturing exports and economic development 1960-2010. 14th ISEE Conference, Brisbane, http://www.aomevevents.com/media/files/ISS%202012/ISS%20SEssion%209/Lavopa%281%29.pdf

Libanio, G. and Moro, S (2013). Manufacturing industry and economic growth in Latin America: A Kaldorian approach. *Minas Gerais*: Federal University of Minas Gerais.

Nickell, S. (1981). 'Biasses in dynamic models with fixed effects'. *Econometrica*, 49, 1417-1426noy

Ocampo. J. A. (Ed.) (2005). *Beyond Reforms – Structural Dynamics and Macroeconomic Vulnerability.* Stanford University Press and the World Bank.

Pacheco-Lopez., and Thirlwall, A. P. (2013). A new interpretation of Kaldor's first law for open developing economies. ftp://ftp.ukc.ac.uk/pub/ejr/RePEc/ukc/ukcedp/1312.pdf

Rodrik, D. (2009). Growth after the crisis. Harvard Kennedy School, Cambridge, MA.

Roodman, D. (2006). How to do xtabond2: An Introduction to "Difference" and "System" GMM in Stata. Working Paper No. 103, Center for Global Development.

Sakellaris, P. and Wilson, D. J. (2002). Quantifying embodied technological change. European Central Bank. Working Paper No. 158.

Stiroh, K. J. (2001). What drives productivity? *FRBNY Review*, March

Stoneman, P. (1979). Kaldor´s law and British economic growth. *Applied Economics* 11, 309-319

Su, D. & Yao, Y. (2016). Manufacturing as the key engine of economic growth for middle-income economies. ADBI Working Paper Series No. 573. Retrieved from http://www.adb.org/sites/default/files/publication/184350/adbi-wp573.pdf

Szirmai, A. (2011). Industrialisation as an engine of growth in developing countries, 1950-2005. *Structural Change and Economic Dynamics*, 23, 406-420. DOI:10.1016/j.strueco.2011.01.005.

Temple, J. and Woessmann. L. (2006). Dualism and cross-country growth regressions. *Journal of Economic Growth* 11(3), 187-228

Timmer, M. P. and de Vries, G. J. (2007). 'Structural change and economic accelerations in Asia and Latin America: a new sectoral data set'. *Cliometrica,* 3(2), 165-190.

Timmer, M. P. and Szirmai, A. (2000). Productivity in Asian Manufacturing: the structural bonus hypothesis examined. *Structural Change and Economic Dynamics* 11(4), 371-392.

U. S. Department of Commerce (1995). Engines of growth: manufacturing industries in the U. S. economy. Economics and Statistics Administration Office of Business and Industrial Analysis. Available at www.esa.doc.gov

Wells, H. and Thirlwall, A. P. (2003). Testing Kaldor's growth laws across the countries of Africa, *African Development Review*, 15 (2/3): 89-105.

Whiteman, J. L. (1987). Productivity and growth in Australian manufacturing industry. *Journal of Post Keynesian Economics* 9, 576-592.

Appendix

List of countries used in the analysis covering the period 1981 - 2015

5. Algeria
6. Benin
7. Botswana
8. Burkina Faso
9. Cameroon

10. Central African Republic
11. Comoros Island
12. Congo D. R.
13. Congo Republic
14. Gabon
15. Gambia
16. Kenya
17. Lesotho
18. Malawi
19. Mauritius
20. Morocco
21. Namibia
22. Nigeria
23. Rwanda
24. Senegal
25. Seychelles
26. South Africa
27. Sudan
28. Swaziland
29. Togo
30. Tunisia
31. Zambia
32. Zimbabwe