THE KALDOR -VERDOORN'S LAW ON MANUFACTURING: 
TEST OF THE NIGERIAN EXPERIENCE 

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Abstract  
This study is to determine the applicability or otherwise of the relationship between the labour productivity and the output of the manufacturing sector of Nigeria using annual data from 1970 to 2012. The dynamic model of the Verdoorn's Law was tested given that Augmented Dickey-Fuller (ADF) and Philips-Perron tests showed non stationarity when expressed in their level form. The outcomes of the Engle-Granger and Johansen tests provide evidence of cointegration between the two variables at order (1, 1). The results of the Error Correction Model (ECM) show that in the long run, a positive relationship exists between both variables. This confirms that Kaldor- Verdoorn's Law is applicable to Nigeria during the forty years research period. The computed impulse response function further corroborates the co-integrated nature of the variables. Indeed, a shock in one variable largely influences the other positively. This study recommends enhanced growth generating policies for manufacturing sector in order to engender sustainable economic development in Nigeria.  

Keywords: Economic growth; Error Correction Model (ECM); Kaldor- Verdoorn's- Law; Labour productivity; Manufacturing sector.  

1.0 INTRODUCTION  
The Various schools of economic thought have either been silent or have assigned equal weights to all the economy sectors in explaining the macroeconomic productivity (Grossman & Helpman, 1991; Lucas, 1988 and Romer, 1986, 1990). Kaldor, (1956, 1966) however posits that the industrial sector is responsible for majority of the aggregate productivity. The main empirical rationalization being that the manufacturing sector operates more under both static and dynamic economies of scale when compared with the agriculture and the service.  

In congruence, Amakom (2012) ascribes the economic efficiency of a country the virility of its manufacturing sector. The original Verdoorn's (1949) Law, which had assumed that labour productivity growth determines output growth has been given a novel explanation by Kaldor's (1966) second law. The basic premise is that as a result of static and dynamic increasing returns to scale, a positive relationship subsists between the increase of labour productivity in manufacturing and manufacturing output growth. Kaldor contends that the impact of labour productivity on economic productivity growth is not only due to increased economies of larger production but is also a consequence of the benefits derivable from technical progress. The synthesis of the refined thought which posits that industrial growth (both static and dynamic) is subject to increasing returns to scale is known as the Kaldor-Verdoorn's Law.  

In Nigeria, the contributions of the manufacturing sector to the nation’s output have widely fluctuated. It rose from 4.8% in 1960 to 7.4% in 1975 fifteen years later. The contribution to GDP
however fell to 5.4% by the second decade in 1980. The peak was attained was 10.7% in 1985. However, the share of manufacturing had been on the decline since 1992 (7.9%), 1997 (6.3%) crashed furthest to 3.4% in 2001. It however gained some traction at 4.21% GDP in 2009 and 4.16% in 2012 (Central Bank of Nigeria, 2012; Manufacturers Association of Nigeria, 2010). The rebasing of Nigeria’s GDP from 1990 to 2010 have however ascribed greater contribution level to the manufacturing sector: 6.46% and 6.83% of the GDP in 2011 and 2013 respectively (NBS, 2014).

The essence of this paper is to find out if the much vaunted Kaldor-Verdoorn's Law on positive relationship between the labour productivity in manufacturing and growth is applicable in the Nigerian case. This should be of help to policymakers in the formulation and implementation of appropriate measures for sustainable economic development. The rest of the study is organised as thus: in the next section, the review of related literature is presented. The third section covers the methodology; while in section four, the results of estimation and validity tests are presented. The fifth section concludes and recommends.

2. REVIEW OF RELATED LITERATURE

This section is in two parts: the review of related literature and the theoretical underpinning of the study.

2.1: Literature Review

Several studies have been conducted specifically testing the industrial employment- output relationship postulated by Kaldor-Verdoorn. Destefanis (2001) who deployed a non-parametric frontier methodology and data from Penn World Table traversing 27 years (1965–92) for 52 countries, finds an insidious existence of growing returns to scale both in the developed and the developing countries. It is noteworthy that the result obtained, using the same data, with traditional parametric estimates was different. The study of 30 developing countries by Ute (2003) which deploys the non-linear statistical method provides a Kaldorian explanation at the sectoral level of the economy. The result shows employment elasticities which are significantly less than unity, for all sectors, including manufacturing. This is indicative of strong substantiation for increasing returns at the sector level of the economy.

The evidence obtained by McCombie and De Ridder (1984) using United States of America data shows a Verdoorn coefficient value of 0.34 which is consistent with the Verdoorn’s law. This is however at variance with the Okun’s law. The 32 States of Mexico were examined by Alicia, Manuel, Juan, and Karla (2013) using the Ordinary Least Square method (OLS) and the pool data technique for an added analysis at subsector levels of the manufacturing industry. The estimate of Verdoorn’s coefficients for the years1985-2004 were consistent with Kaldor -Verdoorn’s Law. The study detects increasing returns in the manufacturing industry in the both the regions and subsectors. Indeed, the states with the higher returns to scale (lower Verdoon’s coefficients) were those with the higher growth rates.

Across the Northern Atlantic, Fingleton and McCombie in 1998 studied manufacturing companies from the European Union regions and finds substantial internal and external economies of scale and increasing returns. This is supported by another study using data from 109 European Union regions (1977–2005). The findings by Stiliano, and Dimitrios (2009) suggest that, although cumulative causation holds over this period, the slowdown of its pace is, nonetheless, apparent post 1992. Evidence provided from Greek disaggregated manufacturing time series data estimation using OLS
method by Apergis and Zikos (2003) is in conformity with the law of Kaldor-Verdoorn. A reappraisal of the applicability of the law on the Italian economy between 1951 and 1997 was conducted by Bianchi (2001). The study applied the Ordinary Least Squares, for different sectors and found increasing returns to scale at the macro and sectoral levels. Indeed, with the inclusion of the capital growth in the model, the increasing returns to scale was manifest in the industrial sector. A research by Fazio, Maltese and Piacentino (2011) utilised micro data of Italy and the aggregation at the NUTS-3 level in the evaluation of both the augmented and the original versions of Verdoorn’s Law. The conclusion drawn showed increasing returns to scale for manufacturing at both levels.

Mata, Ponciano and Souza (2006) scrutinized the dynamics of inter-regional and inter-sectoral economies, as designated by the Kaldor-Verdoorn Law. They obtained estimates of the elasticities which corroborate the law in the case of the Brazilian economy for all sectors save in the case of the service sector. On the African continent, Wells and Thirlwall (2003) reviewed the K-V Law across 45 of the 55 countries in Africa. The researchers regressed employment growth on output growth. Their findings support the Kaldor’s growth laws.

In terms of methodology, McCombie (2003) identifies the static-dynamic Verdoorn paradox. He submits that estimation results from cross-sectional logged level data are not significantly different from the constant returns to scale. However, the result obtained by applying the same set of data as growth rates reveal significant growing returns to scale. Jian (2014) explains this paradox as being caused by spatial aggregation bias. An alternative validity test of the law was proposed by Martinho (2011) who added labour concentration, capital accumulation and trade flows as variables to the original specification of Verdoorn’s Law. These additional variables included have little impact on the earlier result. Following from the preceding discussions, we present a review of the conjectural basis in the next section.

2.2 Theoretical review
The theoretical underpinning of the study is predicated on the Kaldor-Verdoorn's Law. The Verdoorn’s Law (1949) in its pristine form, is about the statistical relationship between the long-run rate of growth rate of labour productivity and the rate of growth rate of output of the manufacturing sector of an economy. Rowthorn (1979) expressed the Verdoorn's equation in equation (1) below:

\[ e = \frac{u}{p} + \frac{1}{p} \cdot q \]  
(1)

where:
- \( e \) = growth rate manufacturing employment
- \( p \) = growth rate manufacturing productivity
- \( q \) = growth rate of industrial output

Therefore, manufacturing output growth = \( e + p \) which can be expressed as:

\[ e = \frac{u}{1+p} + \frac{p}{1+p} \cdot q \]  
(2)

The linearity relationship between \( u \) and \( p \) is manifest from equation (2). The Verdoorn’s coefficient is obtained by regressing \( p \) on \( q \).
The postulation of second Kaldor’s Law (1966) on the existence of a noteworthy affirmative relationship between manufacturing sector output and the growth rate of labour productive is depicted in equation (3):

\[ p_i = f(g_m) + e_i \]  

(3)

where:

- \( p_i \) = labour productivity growth in industry and
- \( g_m \) = manufacturing output growth

The law states that the positive increase in productivity in the macro economy is caused by the synergistic rise in manufacturing labour productivity which engenders sustained economic development (McCombie, Pugno & Soro, 2002). Also critical to this long term industrial growth are the diversification and size of the industrial sector.

The Kaldor's Law is a refinement of Verdoorn’s Law is synthesized and known as Kaldor-Verdoorn's Law. The amalgamated equations (2) and (3) can be restated as equation 4 below:

\[ PM_i = \alpha_1 + \beta M_i + u_i \beta > 0 \]  

(4)

Where:

- \( PM_i \) = labour manufacturing productivity growth
- \( M_i \) = growth rate of manufacturing output
- \( \beta \) = Verdoorn’s coefficient
- \( u_i \) = error term

However, there is a problem in estimating Verdoorn’s Law as a result of the strong correlation between dependent and independent variables which can give biased results of Verdoorn’s coefficient. To solve this possible autocorrelation error, let \( e_i \) be the rate of growth of labour employment in manufacturing sector expressed as:

\[ e_i = M_i - PM_i \]  

(5)

Substituting (5) in (4) and rearranging to yield equation (6):

\[ e_i = \alpha_2 + (1 - \beta_2) M_i + u_2 \beta > 0 \]  

(6)

A positive Verdoorn’s coefficient, is indicative of a rise in output as a result in the of productivity labour. The validity test conducted by Kaldor (1966) on Verdoorn’s hypothesis reveals marginal elasticity of labour productivity of about 0.5. This is a complement of Verdoorn’s coefficient with respect to output showing that a percentage increase in the growth of output can be wrought almost equally by rise in employment and in productivity. In effect, through increasing returns to scale, one percent increase in output leads to 0.5% productivity growth. At the same time, employment is grown by half-a-percentage point. The import of Kaldor-Verdoorn's Law is the manifestation of static and dynamic increasing returns to scale in the industry. The static return occurs when the larger the size of the sector results in the lower the average costs. The dynamic impact arises from the induced consequence of output growth on capital accumulation and technical progress.

The sustained economic development ignites the synergies between the rise in manufacturing industry productivity leading to positive changes in aggregate productivity of the economy and total output. This is in line with the dynamic economies of scale law of Verdoorn (1949) and technical
knowledge learning by doing (Arrow, 1962). The growth of the economy is not constrained by supply in both the long and indeed, the short run. This also supports the hypothesis of Keynesian (1936) which ascribed the nature of the aggregate demand in the short-run to the business cycles, and the lack of effective demand to economic recessions.

In line with the endogenous growth theory, the engendered growth for this sector is achieved through the capacity of the industrial sector to generate innovation and spewing out of economy-wide technological spillovers. The consequence of these lead to the stimulation of productivity and economic growth. Kaldor (1975) contends that economic development can only be sustained through changes in its structure and components. It is considered to be process of structural change wherein productive resources are reallocated from the agricultural to the manufacturing sector. Labour intensive technologies, science and engineering techniques, natural resource-based inputs, and knowledge-based practices with greater technological sophistication are critical ingredients for structural growth. The suggestion of Rowthorn (1979) is that an alternative specification of the law is required. He contends that since restriction exists in the supply of labour as per neoclassical theory, linking the growth of productivity directly to the exogenously determined employment may be a better way to test the Verdoorn’s Law.

The fundamental assumption of the Kaldor-Verdoorn’s Law is the nonexistence of external constraints to growth. For an open economy like Nigeria, Kaldor (1967) posits that in order to finance the require resources, the net exports should increase at a rate faster than imported capital goods. The reason can be ascribed to the elastic nature of supply in responding to the long-run increase of demand. A balance of payment constraint would arise if the rate of growth of imports exceeds the rate of growth of exports. The other possible constraint is the drying up of excess of labour being transferred from the agricultural sector (Lewis, 1954). The service sector also being less sensitive to demand fluctuations is unable to support the mopping of the excess of labour supply to demand. The income elasticities for service are greater than for food and manufacturing goods as the economy enters into a higher level of development (Jacoby, 2013; Onakoya, 2013 & World Bank, 2004). This partially explains de-industrialisation in developed economies. As the economy tends to maturity, the composition of both manufacturing and employment in overall economic output (real GDP) tends to shrink.

The absence of external constraints to growth is a key assumption of the Kaldor-Verdoorn Law. This means that the supply in the long run can react to the rise in demand elastically, within limits. In this respect, Kaldor (1970) identifies the slow response of supply to the rise in demand for raw materials and production as being responsible. The balance of payment constitutes yet another constraining factor. Yet another limit is the inability of the manufacturing sector to completely absorb the labour force growth as the economy develops. This condition is exacerbated by the inability of the service sector to also employ the excess labour given its less sensitivity to demand fluctuations.

The constraints to the soundness of Kaldor-Verdoorn’s Law lie partially in the direction of causality and possible simultaneity between the two variables. In addition, the question arises as to the contribution of capital. The law overlooks the possible substitutability of labour with capital. This, as pointed out by Harris & Liu (1999) can render the Verdoorn coefficient unstable as a result of the changing elasticity of capital with respect to labour. In a review of the law, McCombie (1982) ascribes such variability to the usual linearity assumption of Cobb–Douglas production function, which may not reflect the true design of the underlying static model. Such function may indeed be nonlinear, as in the case of technical progress. Next, we present the research methodology.
3 METHODOLOGY, DATA AND ANALYSIS

3.1 Empirical Model

The use of investment climate data as the measure of labour productivity has been canvassed by Chete, Adeoti, Adeyinka and Ogundele (2014). This measure is derived from the division of the total annual sales of firms by the total number of employees in both full and part-time employment. This method requires the compilation of micro economic figures which in this clime is rather challenging. The measurement of productivity for the total economy and the manufacturing sector are complemented with measures of unit labour cost, which is the labour cost per unit of output. Labour productivity can also be measured in physical productivity, as the output per employee. Yet another measurement of labour can be in terms of the output per man-hour, expressed in money value which is the economic productivity. The productivity of labour in effect is the value-added per employee. In other words, labour productivity is described as output (GDP) per unit of labour input. This study adopts the measurement of labour productivity in terms of the index of real output per capita. The sectoral GDP of manufacturing serves as the measurement of its output.

The Kaldor's -Verdoorn’s Law to be tested is depicted as equation 5:

$$e_i = \alpha_2 + (1-\beta_2)M_i + u_2/\beta > 0$$

(5)

The a priori expectation is that the Verdoorn’s coefficient is significantly different from one for the increasing returns to scale to be accepted, since Kaldor (1975) contends that the critical source of differences in productivity growth rates can be ascribed to the increasing returns to scale.

3.2: DATA SOURCES AND ESTIMATION PROCEDURE ISSUES

3.2.1: Data and Sources

The challenge data availability in developing economies has been highlighted by Goldsbrough, Adovor and Elberger (2007). Nigeria is no exception. This research had to source for the requisite data from several sources. The National Bureau of Statistics (NBS) for employment data in the manufacturing sector. The Central Bank of Nigeria's Statistical Bulletin (CBN, 2012) provided data on the output manufacturing.

3.2.2: Procedure for Data Analysis

The argument by Torero, Chowdhury and Bedi (2002) is that in the context of time-series data analysis, the estimated coefficient value may reflect a spurious correlation between manufacturing output and the productivity of manufacturing.

Prior to the estimation of the model, using the Ordinary least squares (OLS) which is simple and gives the best linear unbiased estimates, the stationarity test had to be conducted. method cannot be applied. In order to prevent spurious regression results since unit root problem is a common feature of most time series data, the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root tests are deployed. The next test utilised is the Breusch-Godfrey Serial Correlation for possible autocorrelation. The variables are all I (1) variables; first-differenced series. To use them for estimation will only give us short-run estimates. In order to obtain a consistent relationship between the rate of labour productivity and the growth rate of manufacturing sector output in long-run, this research deploys the Error Correction Term (ECT) estimation method. Gujarati, (2003) contends that the ECT technique which highlights the speed of adjustment to equilibrium is, mathematically simpler than other econometric techniques. The introduction of a dynamic ECT model helps to estimate both long run and short run relationships. So we need to conduct a co-integration test needed for meaningful representation of long-run equilibrium between the two variables (Engle & Granger, 1987).
Johansen test on the presence of co-integrating vectors is deployed. The a priori expectation are co-integrated variables and the existence of Granger-causality in at least one direction. Consequently, and in order to test the implications of the model, an aggregate data on labour productivity and manufacturing output in Nigeria during the study period is estimated.

In order to augment the result of the Granger-causality test, it is important to know the response of one variable to an impulse in another variable in a higher dimensional system. If there is a reaction of one variable to an impulse in another variable we can establish causality in that direction. The impulse response functions, also known as the forecast error impulse response is modeled in the context of a Vector Autoregression to illustrate the reaction economy over time to exogenous impulses, endogenous macroeconomic variables and time (Lütkepohl, 2008 & Hamilton, 1994). Asymmetric impulse response functions have been suggested by Hatemi (2014) as a tool for discerning the nature and direction of responses. In order to test the robustness of the relationship between the two variables, the impulse response functions will be calculated.

4. FINDINGS, ANALYSIS AND RESULTS

4.1 Unit Root Tests

The need for unit root to test the stability of each variable test has been explained in the previous section. The Augmented Dickey-Fuller (ADF) and Phillip Peron tests results are as follows:

Table 1. Unit Roots Tests on Manufacturing Output and Labour Productivity

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF</th>
<th>Philips - Perron</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level</td>
<td>First Difference</td>
</tr>
<tr>
<td>Labour Productivity</td>
<td>-1.5968</td>
<td>-5.3720*</td>
</tr>
<tr>
<td>Manufacturing Output</td>
<td>-2.6078</td>
<td>-5.1036*</td>
</tr>
</tbody>
</table>

Note: * denotes rejection of null hypothesis of presence of unit root at 1% Significance Level
Source: Author's computation (2014)

From Table 1, unit root status using both the Augmented Dickey-Fuller (ADF) and Phillip Peron tests manifests instability of the variables when tested at level. The null hypothesis of non stationarity is therefore rejected. At the first difference however, the trending instability condition appears to vanish. This makes it necessary to analyse the Verdoorn’s dynamic law using the log values which is an approximation of the growth rate.
4.2 Autocorrelation Test
The Durbin–Watson Statistic is the traditional test for the presence of first-order auto-correlation. In order to cover higher orders auto-correlation and regressors with lags of the dependent variable, the Breusch–Godfrey Test is more appropriate.

The Breusch-Godfrey Test (Table 2) confirms the absence of serial correlation in the residuals since the estimated p-value (0.89) is greater than 0.10 at 10% significance level.

Table 2. Breusch-Godfrey Serial Correlation LM Test

<table>
<thead>
<tr>
<th>F-statistic</th>
<th>0.119910</th>
<th>Prob. F(2,22)</th>
<th>0.8876</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obs*R-squared</td>
<td>0.377418</td>
<td>Prob. Chi-Square(2)</td>
<td>0.8280</td>
</tr>
</tbody>
</table>

Note: df is degrees of freedom for (approximate) chi-square distribution.
Null Hypothesis: No residual autocorrelations up to lag h

Having settled the issue of auto correlation conditions, the next section examines in the long-run, the connection between manufacturing output and the labour productivity.

4.3 Co-Integration Analysis
Given the same order integration of the variables (first difference), the Johansen co-integration test deployed to study the long run relationship between labour productivity and manufacturing output vectors are presented in Table (3)

Table 3. Johansen test for Cointegration (Trace-$\lambda_{trace}$ and Max-eigen-$\lambda_{max}$)

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Alternative Hypothesis</th>
<th>Value</th>
<th>10% Critical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace statistics ($\lambda_{trace}$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r = 0</td>
<td>r &gt; 0</td>
<td>13.1450</td>
<td>13.42078</td>
</tr>
<tr>
<td>r ≤ 0</td>
<td>r &gt; 1</td>
<td>3.3490***</td>
<td>2.7055</td>
</tr>
<tr>
<td>Max Eigen Statistics ($\lambda_{max}$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r = 0</td>
<td>r &gt; 0</td>
<td>9.7950</td>
<td>12.2965</td>
</tr>
<tr>
<td>r ≤ 0</td>
<td>r &gt; 1</td>
<td>3.3490***</td>
<td>2.7055</td>
</tr>
</tbody>
</table>

Note: *** denote rejection of null hypothesis of presence of co-integration critical value at 10%
Source: Author's computation using E-views® (2014)

Since the value of the Trace statistics ($\lambda_{trace}$) (3.35) exceeds the critical value (2.71) at 10%, the null hypothesis (no co-integration vectors) is hereby rejected. Similar rejection of the null and the consequential acceptance of the alternative hypothesis also holds using the Max-Eigen statistics, where the value statistic ($\lambda_{max}$) is greater than its critical value at 10%. The next presentation is on the Error Correction Model and the Impulse Response Function. The latter is the time profile of the effect of a shock in the variable on the other variable in the model.
4.4 Error Correction Models and Impulse Response Function
Since differencing the variables gives a model which cannot explain the expected long run relationship between, estimating with an error correction model becomes necessary. With the ECM, it is easy to uncover both short and long run relationship of the variables. As shown in Table 4, Beta ($\beta$) which is the Error term coefficient is statistically significant at 10%. This substantiates the presence of a long run relationship between manufacturing output and labour productivity in line with the Kaldor-Verdoorn’s Law. The negative, sign is not unexpected for the error correction term which, is indicative of the adjustment from the long-run equilibrium relationship between the variables.

Table 4. Error Correction Model (ECM)

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta ($\beta$)</td>
<td>-0.204</td>
</tr>
</tbody>
</table>

Source: Author’s computation using Eviews® (2014)

Castiglione (2011) argues that if this $\beta$ adjustment is smooth, then $|\beta| < 1$. This means that a rise in the manufacturing output is capable of causing an increase in labour productivity in the manufacturing sector in the long run.

As earlier mentioned, the Impulse Response Function (IRF) is computed in order to identify the time profile of the endogenous effect of a shock in one variable on the other. The submission of Jin-Lung (2006) is that where unit roots and/or co-integration exist, the estimated IRF is inconsistent at long run in unrestricted VARs. Only Error correction model produces consistent IRF and optimal predictions. In order to estimate the IRF, the Error Correction Model (ECM) is converted into a Vector Error Correction model (VECM). It is important to note that although the ECM is similar to a VECM model, the conversion is a necessary condition for the computation of IRF (Hatemi, 2014 and Den Haan, 2013). The evaluated relationship by means of impulse response analysis is presented as Figure 1.
Where:

The reading from Figure 1 is that consistent with the a priori expectation, the impulse-response functions for \( LPROD \rightarrow MQ \) and \( MQ \rightarrow LPROD \) are positive except for some years and demonstrate a linear or increasing trend. Eventually, the IRF converges back to zero. The safe conclusion to be drawn is that labour productivity variables and manufacturing output are indeed co-integrated and a shock in one variable largely has a positive influence on the other.

The findings of this research attest to the result a recent study by Millemaci and Ofria (2014) across some developed countries in the European Union, Australia, Canada, Japan and United States with data covering 1973-2006. The result is also in conformity with work of Marconi, Reis and Araujo (2013) which, using dynamic panel data for a sample of 63 middle and high-income countries between 1990 and 2011.

5. CONCLUSION

The objective of this study is to determine the applicability of the Verdoorn–Kaldor’s Law which is about the relationship between the labour productivity and output of the manufacturing sector of Nigeria. The co-integration approach with yearly data from 1970 to 2012 is deployed.
Prior to the estimation of the OLS regression model and in line with the theory, the variables were tested for stability using Augmented Dickey-Fuller (ADF) and Philips-Perron tests. The null hypothesis of non-stationarity could not be rejected for both variables when expressed in their level form. At first differencing however, the variables were found to be stationary. Consequently the cointegration computation at the heart of this empirical was conducted. The outcomes of Engle-Granger and the Johansen tests provide evidence of co-integration between the two variables.

In order to find out both the short and long run relationships of the variables, estimating with an error correction model becomes essential. The results obtained show a positive relationship in the long run between the growth in manufacturing labour productivity and the growth in the output of the manufacturing sector. The impulse response function shows that the variables are indeed co-integrated. A shock in one of the variables largely influences the other positively.

This study recommends enhanced capacity building for manufacturing workers in order to improve on their productivity and consequential growth in the output of manufacturing sector and the Nigerian economy as a whole.

References


