DETERMINANTS OF MANUFACTURING OUTPUT IN NIGERIA

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CERTIFICATION

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DEDICATION

This thesis is dedicated to the Lord of Host, the Almighty God and the Greatest Companion.

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I appreciate the Almighty God for His divine assistance to successfully complete this programme.

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ABSTRACT

Over the years, policy makers have sought to identify the determinants of manufacturing output, so as to proffer solution to the persistent decline in output. Several empirical studies have been carried out by researchers, to know what determines the output in Nigeria. Despite the implementation of these studies by policy makers, there seems to be no improvement in the level of aggregate output in the manufacturing subsector. This study, therefore, focuses on identifying the determinants of manufacturing output in Nigeria and also attempt to confirm the validity of the existing empirical literature. In view of this, the major objectives of the research are to identify the determinants of manufacturing output and to know the direction of the impacts of such variables on output. To accomplish the above objectives, we formulated a model that is based on Cobb Douglas production function. The unit root test was conducted to know the behavior of the series over the years. The cointegration test was also carried out to know the long-run relationship among the variables. Based on the outcome of the test, we estimated the short and long run coefficients of the ARDL and tested for the effect of the error correction mechanism that indicates the speed of adjustment to the long-run situation. The stability test was conducted to know the stability of the relationship among the variables used in the study. Annual data used covered between 1981 and 2016. The data were sourced from the National Bureau of Statistics, 2014; Central Bank of Nigeria's Statistical Bulletin, 2016; and the World Bank's World Development Indicators, 2016. From the findings, we observed that, in the short-run, employment in the manufacturing subsector and exchange rate depreciation have a negative impact on the output while trade openness and government capital expenditure have positive effects on manufacturing output. The effects of gross capital formation and inflation rate are not significant. In the long-run, the effect of government capital expenditure, gross capital formation and employment in the manufacturing subsector are positive and significant while the effects of exchange rate depreciation and trade openness are negative. The effect of only inflation is not significant. Recommendations were made based on findings that: Government and manufacturing stakeholders should beef up employment in the subsector and capital expenditure should be increased so as to improve infrastructural development. Government should embark on policies that will stimulate the acquisition of capital stock by entrepreneurs.

Keywords: Manufacturing Output, Cobb Douglas Production Function

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Manufacturing plays a key role in the global economy. The demand for manufactured goods continues to rise as people around the world enter the global consumer class. The manufacturing sector currently contributes 17 percent of the world's US$ 70 trillion economy, and accounts for over 70 percent of global trade (Nigeria Industrial Revolutio.n Plan, 2014). Global manufacturing output grew by about 2.7 percent in developed countries, and 7.4 percent in emerging economies between 2000 and 2007. In advanced economies, manufacturing sector accounts for over 90 percent of R&D spending by the corporate world.

Poor countries start off by employing the bulk of their population in agriculture. However, for these countries to transit into middle income developed markets, they must create robust industrial and services sectors, which are the drivers of mass employment, improved skills, and better wages, providing the foundations for long run sustainable economic growth and development. The transformation from a traditional economy in Sub-Saharan African countries to a modern one where technology and modern production activities in the manufacturing sector assume a significant role has remained a defining characteristic of economic growth and development (Naude & Szirmai,2012).

The role of the manufacturing subsector in the development of any economy cannot be over emphasized. Szirmai (2009) argued that there is an empirical correlation between the degree of industrialization and increase or decrease in per capita income in developing countries. Tybout (2000) maintained that the manufacturing sector is perceived as an engine of growth, a key source of skilled job creation and an avenue for various spillovers to other sectors.

Prior to the oil boom of the 1970's, manufacturing contributed approximately 10% to Nigeria's output. Thereafter, increased revenues from oil caused the sector's relative Gross Domestic Product (GDP) share to decline; growth persisted albeit at a slower rate (NBS 2015). The recession caused by the fall in oil prices in the early 1980's triggered policy attention to turn back to the manufacturing subsector, with steel production gaining prime focus. Prior to this, the Nigerian Enterprises Promotion Decrees of 1972 and 1977 had switched to indigenization. The lack of affordability of imported goods, combined with the absence of foreign capital and technology, encouraged domestic production of basic commodities such as soap and salt. Alongside, price manipulation through export and import subsidies encouraged the importation of intermediary inputs and thus the expansion of assembly based industry (NBS, 2015).

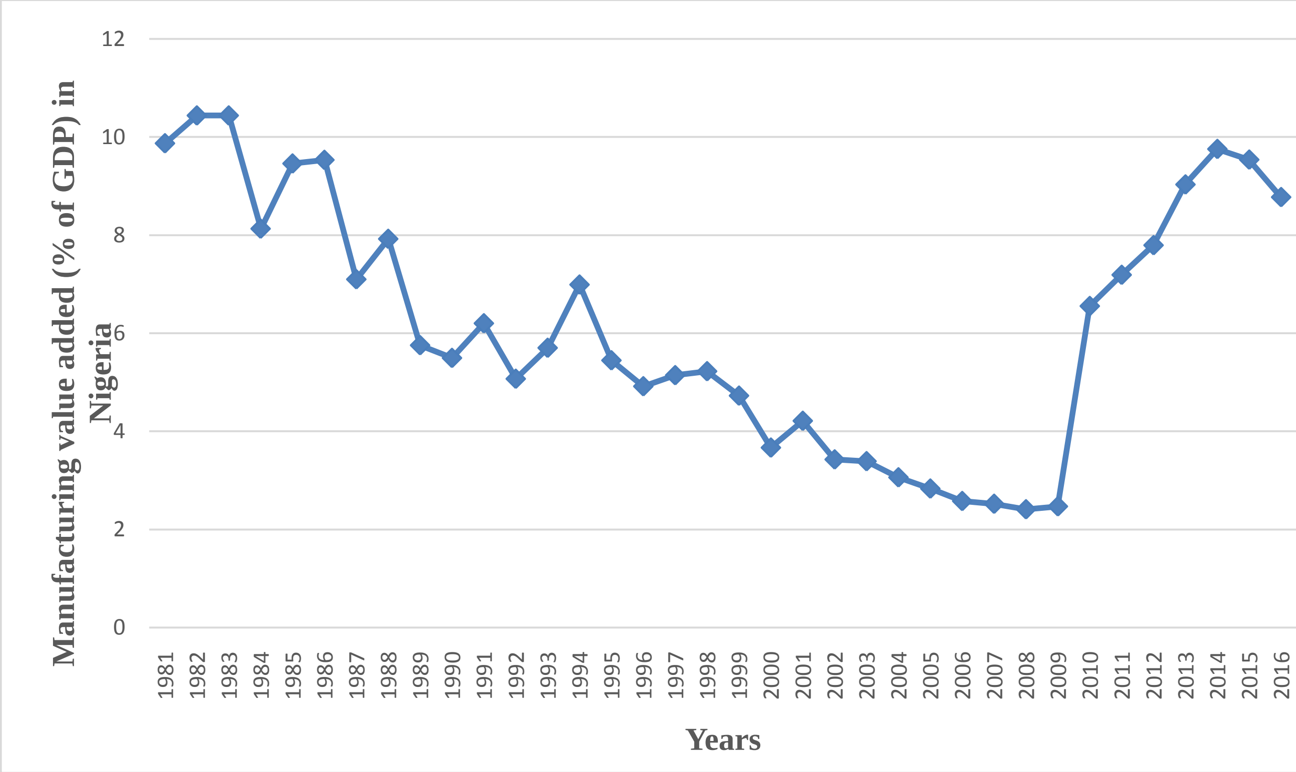
Furthermore, the manufacturing subsector was characterized by increasing cost of production emanating from high tariff cost, increased cost of energy input, reliance on poor infrastructural facilities, rising cost of imported inputs and other factor inputs, etc. This led to a relative decline in manufacturing production for export and, thus, little diversification in production was achieved. Today, Nigeria aspires to join the league of developed nations worldwide but this cannot be achieved if she continues to depend on export of raw materials and intermediate goods majorly. Emphasis must be placed on improving the manufacturing subsector. Manufacturing being a core mover of industrialization plays a unique role because it has strong linkages with all other sectors of the economy and is a fundamental determinant of the economic health and national security.

1.2 Statement of Problem

Manufacturing plays a very crucial role in any developing country of the world as it is the core mover of industrialization. Despite how important it is in aiding economic development, it seems to have a low impact on the Nigerian economy. This is because of its low performance, which has led to the collapse of many manufacturing industries in Nigeria.

We present the chart in Figure 1.1 to show the different levels of fluctuation at a glance, to know the movement in the manufacturing value added over the years.

Figure 1.1: Manufacturing Value Added (% of GDP) in Nigeria



Source: World Bank Development Indicator 2016

It can be observed from the above graph that, between 1981 and 2009, there was a fluctuation in manufacturing growth in Nigeria. Between 2009 and 2010, the growth rate was 6.6%, in 2011, the growth rate also increased to 7.2%, the manufacturing growth rate in 2013 increased to 9% and 9.8%in 2014 respectively. It dropped in 2015 to 9.5% and 8.8% in 2016 respectively (World Development Indicators, 2016).

This decline would have affected the progress of the country. The need for the authorities to fix this problem cannot be overemphasized but before any corrective measure can be taken; there is the need to have a thorough knowledge of factors that affect manufacturing output. This will help policy makers to identify the major factors that can promote manufacturing output and those that can retard or cause a decline in output.

As will be reviewed fully in chapter 2, several studies have tried to identify and evaluate the major determinants of manufacturing output in Nigeria, so as to proffer a lasting solution to its persistent decline. In this connection, Anyanwu (2004) and Adenikiju (2002) just to mention two of such studies identified low level of technology, low utilization of capacity, low investment, high cost of production, inflation and poor performance of infrastructural facilities as factors that determines manufacturing output in Nigeria.

Again, as will be fully discussed in chapter 2, despite the fact that several researches have been carried out on this study, however, there are still some methodological gaps to be filled, which this study intends to fill. How these gaps are addressed will come to light in chapter 3.

1.3 Research Questions

i) What is the impact of capital formation on manufacturing output?

ii) What is the impact of employment in the subsector on manufacturing output?

iii) What is the impact of government capital expenditure on manufacturing output?

iv) What is the impact of exchange rate depreciation on manufacturing output?

v) What is the impact of trade openness on manufacturing output?

vi) What is the impact of inflation rate on manufacturing output?

1.4 Objectives of the Study

The broad objective of this study is to identify the determinants of manufacturing output in Nigeria. The specific objectives are:

- To assess the impact of capital formation on manufacturing output.
- To assess the impact of employment in the subsector on manufacturing output.
- To assess the impact of government capital expenditure on manufacturing output.
- To assess the impact of exchange rate depreciation on manufacturing output.
- To assess the impact of trade openness on manufacturing output.
- To assess the impact of inflation rate on manufacturing output.

1.5 Research Hypotheses

Ho: Capital formation has no effect on manufacturing output.

Ho: Employment in the subsector has no effect on manufacturing output.

Ho: Government capital expenditure has no effect on manufacturing output.

Ho: Exchange rate depreciation has no effect on manufacturing output.

Ho: Trade openness has no effect on manufacturing output.

Ho: Inflation rate has no effect on manufacturing output.

1.6 Significance of the Study

Over the years, policy makers have actually advocated for diversification as a means of broadening the economic base of countries. Diversification from primary sector to industrial, manufacturing or service sector has become inevitable and the focal point for both developing and emerging economies. Evidence from Asian Tiger emerging economies shows that economic diversification is the key factor to sustainable output.

In Nigeria, over the years, resources from both private and public sectors have been tailored towards manufacturing subsector but the output is not commensurate with the inputs. However, several studies have pointed to different factors determining manufacturing output. The outcome of this study will provide direction on which factors have influenced manufactured output in Nigeria over the years.

This research work would serve as enlightenment to both the government and manufacturing stakeholders: the empirical analysis would give insight on identifying the major determinants of output. This will help to determine how to channel firm resources to have a larger productivity. This would contribute immensely to Gross Domestic Product and encourage diversification to industrial sector. It will also help to promote domestic production rather than importation of light goods. This research will also be a useful guide for scholars for further or related research studies.

1.7 Scope of the Study

This study examines the determinants of manufacturing output in Nigeria. The study covers the period from 1981 to 2016. This is because this was the period when relevant data on macroeconomic variables were made available and coupled with the fact that economic stabilization act and the structural Adjustment Programme were both introduced within this period. The study considers only aggregate manufacturing output due to space and time.

1.8 Organization of the Study

The study is organized into five chapters. Chapter one discusses a brief genesis of the entire topic, which includes the background to the study, statement of the problem, research questions, objectives of the study, research hypotheses, significance of the study and scope of the study. Chapter two provides a concise review of relevant literature which is organized into three sections, which includes the review of concepts, theoretical review and empirical review. Chapter three presents the methodology adopted, which includes the theoretical framework, model specification, data sources and postulated effects of the explanatory variables while the analyses and interpretation of the findings are discussed in Chapter four. Chapter five discusses the conclusions, summary of the study, and policy recommendations that will aid the achievement of stated objectives and provide a basis for further research.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 Introduction

This chapter reviews literature on determinants of manufacturing output. It is organized into five sections. In section 2.2, we discuss the conceptual literature, which is a brief discussion on industrialization policy in Nigeria, manufacturing subsector and production function. We also discussed the theoretical literature in section 2.3, which is based on the different types of production function. In section 2.4, we discussed the empirical literature, which we reviewed based on findings of researchers who had earlier conducted similar studies. Finally, the gaps to be filled are identified in the last section.

2.2 Conceptual Review

This section discusses three brief concepts, which are industrialization policy in Nigeria, manufacturing subsector, capacity utilization and production function. Subsection 2.2.1 is a brief discussion on industrial policies in Nigeria while Subsection 2.2.2 is on concept of the manufacturing subsector; subsection 2.2.3 explains the concept of capacity utilization, while subsection 2.2.4 is on the concept of production function.

2.2.1 Industrial Policies in Nigeria

Over the years, different industrial policies/industrialization strategies like import substitution approach, export promotion strategy and foreign private investment led industrialization as well as policy reform measures like indigenization policy, structural adjustment programme, etc. have been formulated and implemented. There had also been huge public investment in the industrial sector.

Import substitution industrialization policy was adopted in Nigeria as far as back as 1960 (Ndebbio, 1994) and till around 1985. It was often described as an inward looking strategy of industrialization; Import substitution industrialization policy refers to domestic production of manufactured goods for domestic markets. It involves processing of raw materials and setting up of manufacturing factories to produce locally manufactured goods which were originally imported by a country thereby saving the country from importation of such commodities into the local markets.

Also, the export oriented industrial policy was meant to achieve a broad objective of accelerating the pace of industrial development in Nigeria. Embedded in this industrial policy package were SAP induced industrial policies like new export promotion decree of 1986, interest rate deregulation policy, the privatization and commercialization policy of 1988, the new export promotion policy/incentives, the new industrial policy of Nigeria of 1989 and debt conversion (equity swap) policy (Nedbbio, 1994). With the new export promotion law, export license requirements for exportation of manufactured goods was abolished, export credit guarantee and insurance schemes was introduced, commodity boards were scrapped to allow the markets forces to be more active and export free zones were established at several locations in the country (Essia and Ibor, 2005).

In 1989, the trade and financial liberalization policy was enacted. A key aim was to stimulate competition among domestic firms and between domestic import-competing firms and foreign firms with the objective of promoting efficiency. The aim was to achieve this through a reduction in both tariff and non-tariff barriers, scrapping the commodity marketing boards and market determination of the exchange rate as well as the deregulation of interest rates, meant to foster financial efficiency and industrial productivity.

2.2.2 Manufacturing subsector

Manufacturing subsector is a very important subsector in the economy. The subsector is concerned with the transformation of raw materials or intermediate goods into finished goods. The manufacturing subsector is a subsector of the industrial sector. The Nigerian manufacturing subsector consist of thirteen activities which includes: Oil Refining, Cement, Food, Beverages and Tobacco, Textile, Apparel and Footwear, Wood and Wood products, Pulp Paper and Paper products, Chemical and Pharmaceutical products, Non-metallic Products, Plastic and Rubber products, Electrical and Electronic, Basic Metal and Iron and Steel, Motor Vehicles Assembly and Other Manufacturing. (National Bureau of Statistics, 2016)

2.2.3 Concept of Capacity Utilization

Capacity utilization has been given various definitions over the years based on individual's view. One of such is the engineering concept which refers to the flows of potential output, per unit of time obtained from a capital stock as capacity output. While the economists view capacity utilization as the actual output expressed as a percentage of potential output. Since potential output is not directly observable it can refer to either maximum output or efficient output (Klein, 1973). It can be expressed mathematically as:

$$\frac{\textit{Total actual output}}{\textit{Potential output}} \times 100$$

Capacity utilization is an important issue in economic analysis. It is frequently employed in empirical studies to help explain investment behavior, productivity measurement, inflation, and inventory behavior, and is often used as an indicator of the strength of aggregate demand (Schultze, 1963). Klein (1960) uses the economist's concept of a production function to illustrate the notion of maximum output. According to him capacity output is the production flow associated with the input of fully utilized manpower, capital and other relevant factors of production. Most often researchers have often seen capacity utilization as a determinant of manufacturing output but this study believes that capacity utilization is not really a determinant of manufacturing output although it may be used as a proxy of output.

2.2.4 Production function

A production function expresses a relation between a flow of output over a defined time interval and a flow of inputs over the same time interval or a relevant previous time interval. But variables are mostly available in stock terms, capital stock in terms of value of machinery and buildings and labor in terms of men employed or land in terms of acres (Besanko, 2004). There are many types of production function and a few of them will be discussed in the next section.

2.3 Theoretical Literature

This section provides a review of production function, particularly the linear production function, the Constant Elasticity of Substitution production function, Leontiff production function and the Cobb Douglas production function.

2.3.1 Linear Production Function

The linear production function is the simplest form of a production function: it describes a linear relationship between the input and the output. The production function is said to be homogeneous when the elasticity of substitution is equal to one. If the function has only one input, the form can be represented as

$$y = ax \quad \text{------------------------} \qquad (1)$$

where: y is the output and x is the input while "*a*" is a constant.

If the function has more than one input, this becomes:

$$y = a_1 x_1 + \ldots + a_n x_n \quad \text{---------------------------} \quad (2)$$

where y is the output ; x_i (i = 1,…..n) is the i^{th} factor input while a_i (i = 1,…..n) is the coefficient associated with x_i.

The linear production function is widely used in different empirical literature because it is easy to estimate. It is used linear programming analysis and input-output analysis. One of the limitations of linear production function as regard this study is that it does not tell us the impact of productivity on output and its scope is limited.

2.3.2 Constant Elasticity of Substitution (CES) Production Function

The CES production function is otherwise known as homohighplagic production function and was developed by Arrow, Chenery, Minhas and Solow. This function traditionally consists of three variables Q, K and L. It may be expressed in the form:

$$Q = A\,[\alpha\, C^{-\Theta} + (1-\alpha)\, L^{-\Theta}]^{-1/\Theta} \quad \text{--------------} \quad (3)$$

where Q is the total output, K is capital, and L is labour. A is the efficiency parameter, indicating the state of technology and organizational aspects of production. It shows that, with technological and/or organizational changes, the efficiency parameter leads to a shift in the production function; *a* (alpha) is the distribution parameter or capital intensity factor coefficient concerned with the relative factor shares in the total output, and Θ (theta) is the substitution parameter which determines the elasticity of substitution between factor inputs. The constraints applying to the parameter are as follows: $A > 0$; $0 < \alpha < 1$; $\Theta > -1$.

According to Pearl (1975), the elasticity of substitution is constant and not necessarily equal to unity. The value of elasticity of substitution depends upon the value of substitution parameter. The marginal products of labour and capital are always positive if we assume constant returns to scale. The marginal product of an input will increase when other factor inputs increase. When the elasticity of substitution is less than unity, the function does reach a finite maximum as one factor increases while the other is held constant. The estimation of the elasticity of substitution parameter requires the assumption of perfect competition. In estimating parameters of a CES production function, we may encounter a large number of problems pertaining to such things like, choice of exogenous variables, estimation procedure and the problem of multicollinearity. As a result of this deficiency usually encountered in using CES production function, we decided to use the Cobb-Douglas production function.

2.3.3 Leontief production function

Leontief production function uses a fixed proportion of inputs that have no substitutability between them. The Leontief production function or fixed proportions production function is a production function that implies that the factors of production will be used in fixed (technologically pre-determined) proportions and represents a limiting case of the constant elasticity of substitution production function. We use it to model relationships between sectors in a national economy (Allen, 1968). The production function can be expressed as follows:

$$Q = \min\left(\frac{Z_1}{a} \quad \frac{Z_2}{B}\right)$$

where, Q = quantity of output produced;
Z_1 = utilized quantity of input 1;
Z_2 = utilized quantity of input 2;
Min = minimum;
a and B = constants

2.3.4 Cobb-Douglas Production Function

The Cobb-Douglas production function is used in microeconomics to study relationships between output and its two traditional inputs, labor and capital. However, the use of such functions in estimating aggregate output of an economy is limited because of theoretical problems it brings in aggregation. Still, with all its problems, the estimation and use of aggregate Cobb-Douglas production function has become a wide-spread practice in macroeconomic analysis (Fisher, 1969). Assuming homogeneity of the aggregate production function, an important element of this relationship is the degree of returns to scale.

It is a production function in which output is related to the inputs of labour and capital in a multiplicative fashion of the following form:

$$Y = AK^{\alpha}L^{\beta}$$

where A is a neutral shift factor called technology, a and β are constant values that represents each input's relative share in the total output Y. The Cobb-Douglas production function is frequently written as a function of homogenous of degree of one, that is, with $\alpha + \beta = 1$ and is characterized by unitary elasticity of substitution. The fact that $\alpha + \beta = 1$ means a constant returns to scale. If $\alpha + \beta > 1$, this means there is increasing returns to scale while, If $\alpha + \beta < 1$, this means there is decreasing returns to scale (Enu et al, 2015).

2.4 Empirical Review

This section reviews empirical findings by researchers on the determinants of manufacturing output in Nigeria. It is subdivided into four segments, viz: a general review of empirical studies on determinants of manufacturing output, empirical review of studies examining the impacts of energy consumption on manufacturing output, review of empirical studies on the impacts of trade openness on manufacturing output, review of empirical studies on the impacts of exchange rate on manufacturing output and, finally, review of empirical studies on the impacts of government capital expenditure on manufacturing output.

2.4.1 A General Empirical Review on Determinants of Manufacturing Output in Nigeria

A number of studies have carried out research on the general performance of manufacturing subsector and have also included some variables as determinants of manufacturing output. A number of such studies are as reviewed below:

One of the studies is that reported by Akinlo (1996), who analyzed the performance of the manufacturing sub-sector before and after SAP. It was observed that manufacturing industries in Nigeria were relatively insignificant at independence in terms of contribution to the Gross Domestic Product (GDP) because most of the earliest manufacturing industries established by the colonial trading companies concentrated on the production of light industrial commodities. He opined that pre- and post-colonial production policy occasioned in the sector was as a result of neglecting research and excessive reliance on foreign input. According to him, distortions adversely affected the performance of output in the manufacturing sector in terms of its contribution to the gross domestic products, employment generation, capacity utilization and value. Despite the economic adjustment reforms initiated in 1986, the manufacturing sector is still characterized by distortion. He concluded that these distortions need to be eliminated if the sector is to experience substantial growth. Despite the good aspect of this study, he however did not test for the determinants of manufacturing output but was based on a less formal analysis of the general performance of the manufacturing subsector.

Another significant general study is that of Arnold, Javorcik, Lipscomb, Mattoo (2008), who studied the impact of service reform on productivity of manufacturing industries. They used main service sectors — banking, telecom, transport and insurance sectors - in their model and they found that there is a significant impact of service reform on manufacturing productivity; service reform benefited both domestic as well as foreign firms but foreign firms benefited more as compared to domestic firms. Their study is based on the impact of service reform on productivity of manufacturing industries. However, they fail to consider other factors that could affect productivity, like employment, among others.

Enimola (2009), examined the determinants of capacity utilization in Nigeria. He used autoregressive distributive lag in evaluating the long run relationship among the variables. Out of the six variables, only inflation rate had a negative impact on manufacturing capacity utilization while exchange rate, imports, federal capital expenditure, foreign direct investment (FDI) and real loans and advances had positive impacts. The findings also revealed that there was a very strong positive and significant relationship between imported manufactures and capacity utilization, showing that Nigeria is import dependent. He concluded that exchange rate, inflation rate, imports, federal capital expenditure, foreign direct investment (FDI) and real loans and advances accounted for 50 percent variation in capacity utilization. However, the study, did not consider other factors that could affect capacity utilization like employment, capital stock among others

Ajayi (2011), studied on the collapse of Nigeria's manufacturing sector, used cross-sectional research design and found out that the main cause of collapse in the Nigerian manufacturing sector is low implementation of Nigerian budget, especially in the area of infrastructure. This means that low implementation of fiscal policy affects growth in Nigerian manufacturing sector. However, this study identified infrastructure as a major determinant of manufacturing output, amidst a number of other factors.

More also, Olorunfemi et al (2013) examined manufacturing performance for sustainable economic development in Nigeria, using panel data analysis covering the period between 1980 and 2008. The results indicated positive relationship between manufacturing and each of capacity utilization and import respectively. However, there was a negative relationship between manufacturing and each of investment, exchange rate, and export. The study showed that investment, capacity utilization and import were major determinants of manufacturing performance for the period. The study concluded that the key to reversing the poor performance of Nigerian manufacturing is to provide incentives for firms to become more export-oriented. However, this study suffers from a conceptual contradiction by positing capacity utilization as a factor determining manufacturing output. Capacity utilization is not supposed to be a determinant of manufacturing output this is because it is an alternative way of measuring manufacturing output. i.e they are proxies for the same thing.

Likewise, Otalu (2015) assessed the determinants of industrial sector growth in Nigeria. The fall in the contributions of the industrial sector to the growth of Nigerians GDP over the years prompted his research work. The need to unravel the problem of the Nigerian industrial sector necessitated studying of the determinants of industrial growth. The variables identified as major determinants of industrial growth in Nigeria were: capital (proxied by gross capital formation), labour (proxied by total labour force in the industrial sector), exchange rate, education (proxy by school enrollment), inflation rate, capacity utilization, trade openness and electricity generation. Co-integration and error correction model technique was adopted and the result shows that all the identified determinants have more of permanent effect on industrial output than transitory effect. Both labour and capital have significant impacts, exchange rate shows a positive and significant impact, indicating that currency appreciation might be inimical to the growth of the industrial sector. From his findings, manufacturing output depends on capacity utilization. However, as previously discussed above, capacity utilization should not be posited as a determinant of manufacturing output. Also, economy-wide labour force cannot be an alternative proxy for employment in the subsector because labour force is the total labour force in an economy as used in his research work.

Another relevant study is that reported by Enu, Hagan and Attah-Obeng (2015), who examined the impact of macroeconomic determinants of industrial production in Ghana. They adopted Cobb-Douglas production function as a theoretical framework. The Ordinary Least Squares estimation technique was used. The study reported that the impacts of real petroleum prices and real exchange rate were negative on industrial production while import of goods and services, government spending have positive impact on industrial production in the country. Based on their findings, they recommend that the government of Ghana should continue to stabilize the macroeconomic environment of Ghana in order to achieve industrial growth and development. Although they adopted Cobb Douglas production function, they did not include either labour or employment in the model specified and estimated in their research work.

Another perspective is that of Ajudua (2016), who analyzed the determinants of output in the Nigerian manufacturing sector from 1986 to 2014. Gross capital formation, bank credit to manufacturing sector, lending rate, employed labour force, foreign direct investment, manufacturing capacity utilization rate, and foreign exchange rate were used as explanatory variables in the equation for manufacturing output (dependent variable). It was recommended, based on the findings, that there is a need for infrastructural development, importation of goods should be discontinued, consumption of local goods encouraged, agricultural production encouraged as a source of raw material for the industries and low lending rate to the manufacturing sector should be implemented. As previously discussed capacity utilization is not a determinant of manufacturing output, contrary to what the author posited in the estimated model.

Along the same line is the study reported by Adeyemi and Olufemi (2016), which analyzed the determinants of capacity utilization in the Nigerian manufacturing sector between 1975 and 2008. Cointegration and Error Correction Model (ECM) were employed as the estimation techniques, so as to study the time series properties of the variables and to ascertain the existence of any long-run relationship between capacity utilization and its determinants. Structured questionnaire was administered to assess the operational materials and the performance of the selected firms. The findings of the study revealed that there is a positive relationship between consumer price index, fixed capital formation in manufacturing sector and capacity utilization. The study also showed that there is a negative relationship between electricity generation, real manufacturing output growth rate and capacity utilization, which resulted in low manufacturing productivity growth rate in Nigeria. It was recommended that government should make adequate provision of infrastructural facilities, especially electricity generation, to boost production. Manufacturing growth rate was included in their model to determine capacity utilization. This ought not to be included because they are proxies of the same thing, as previously discussed.

Modebe and Ezeaku (2016) studied the dynamics of inflation and manufacturing sector performance in Nigeria. The baseline regression results reveal that inflation and interest rate have negative and non-significant effect on manufacturing sector growth while exchange rate appear to positively and significantly influence the growth of manufacturing sector value added. Granger causality test results reveal a unidirectional causality running from exchange rate to output growth. Inflation and interest rate, however, are not causal for manufacturing output growth. Their studies focused on inflation and interest rate as determinant of manufacturing output. However, there are other factors that determine manufacturing output, which are not included in their studies.

2.4.2 Empirical Review on the Impacts of Government Capital Expenditure on Manufacturing Output.

This subsection discusses the empirical review of Falade and Olagbaju (2015) who focus on Government capital expenditure as a major determinant of manufacturing output. It is the only one that has come to our attention and it is reviewed below:

Falade and Olagbaju (2015) studied the relationship between government expenditure and manufacturing output in Nigeria. The study employed time series data from 1970 to 2013. The variables used are capital and recurrent capital expenditure, nominal and real GDP, exchange rate and interest rate. The findings revealed that an increase in government capital expenditure will lead to an increase in manufacturing output. The study, therefore, suggests that larger percentage of government expenditure in the annual budget should be on capital component, coupled with improved implementation of expenditure policies rather than recurrent expenditure that does not really have a significant impact on the manufacturing sector.

2.4.3 Empirical Review on the Impacts of Energy Consumption on Manufacturing Output

Some studies have evaluated the impact of energy consumption on manufacturing output. Among them are Adenikinju and Alaba (2000) ; and Ugoke, Dike and Elekwa (2016) , which are reviewed below:

Adenikinju and Alaba (2000) conducted an empirical study which evaluated the Nigerian manufacturing subsector’s performance with regards to the relationship between productivity, performance and energy consumption and manufacturing productivity. Utilizing an aggregate model, the researchers measured the changes in the total factor productivity of the subsector relative to the change in energy consumption. The research concluded that efficiency and productivity of the Nigerian manufacturing organizations are indeed related to the energy supply and energy price. While the energy resources were found to play a critical role in the manufacturing sector, it was also discovered that energy alone cannot effectively improve the performance of the manufacturing subsector in Nigeria. An important point identified in the research was that the manufacturing subsector is strongly attached to using old technology so that there is need for the adoption of more advanced energy-efficient technological devices and techniques. For this reason, reforms covering the prices of energy options alone do not significantly affect the performance of the sector because it is hindered by the need for improved technology and energy supplies. Thus, the reforms in the energy sector need to happen alongside technological reforms, otherwise the manufacturing organizations cannot entirely enjoy the advantages of the energy resources. They evaluated majorly the productivity in the manufacturing subsector, using the total factor productivity. However, they focused on the impact of energy consumption on manufacturing output without considering other factors that determine output.

Ugoke, Dike and Elekwa (2016) examined the impacts of electricity supply on industrial output in Nigeria. The analyses revealed that electricity supply and trade openness impact industrial production negatively, though insignificant from the statistical perspective, in Nigeria. It was recommended that, having failed to provide electricity even for the present level of industrial production; government should immediately provide tax relief for all privately generated power for industrial output. This will not erode the gains of petroleum products subsidy removal but will improve the economy by effectively checking the excessive production cost, which hinders industrial progress in Nigeria. It was also recommended that future trade treaties should take into account the actual state of Nigeria's industrial sector, in order to obviate the increasing platform for products of other economies.

2.4.4 Empirical Review on the Impacts of Trade Openness on Manufacturing Output

Some of the studies have studied the impact of trade openness on manufacturing output. A few of such studies are discussed below:

Chandran (2009) studied the long-run relationship between trade openness and manufacturing growth and further assesses the causal relationship between these variables. The results suggest that, in the long-run, trade openness is positively related to manufacturing growth in Malaysia. Furthermore, the results also suggest that openness should be viewed as the long term policy initiative for the sector to benefit. Therefore, the policy direction for Malaysian manufacturing sector should focus on long term trade openness policies. Nevertheless, to ensure sustainability, emphasis should be placed on how (which manufacturing sub-sectors) or when openness is actually important. Importantly, policy makers and scholars should understand that leveraging the benefits of openness also depends on whether the liberalized sector has the comparative advantage. The empirical findings considers only trade openness as a major determinant of manufacturing output in Malaysia, leaving all other factors out of consideration.

Onakoya, Fasanya and Babalola (2012) examined the impact of trade openness on manufacturing sector performance in Nigerian economy. It was revealed from their analysis that trade openness has a positive impact on the manufacturing sector performance while exchange rate depreciation and inflation rate have negative impacts on the sector's performance. Another major finding from this study is that there are significant pay-offs from the policy of trade liberalization. They therefore recommended that government should avoid short-term fixes and front-loaded deals with other countries and move beyond arrangements that focus solely on the petroleum sector. It is observed, from their findings, that employment and capital are not considered as determinants of manufacturing output or the sector's performance.

Umoh and Effiong (2013) studied the effect of trade openness on manufacturing sector performance in Nigeria. The study revealed that trade openness has a significant positive impact on manufacturing productivity in Nigeria, both in the short and long run. They concluded that the policy direction for the manufacturing sector in Nigeria should focus more on open policies through trade liberalization, as a long-term plan. Reduction in trade restrictions and implementation of appropriate incentives are vital for resuscitating the performance of the sector. In this aspect, they suggested that policy-makers should leverage the benefits of openness to the comparative advantages in the liberalized sector.

2.4.5 Empirical Review on the Impacts of Exchange Rate on Manufacturing Output

This subsection discusses empirical reviews on the impacts of exchange rate on manufacturing output. Not many studies along this direction have come to our attention and a few that have come to our notice are as reviewed below:

Enekwe, Ordu and Nwoha (2013) studied the effects of exchange rate fluctuations on manufacturing subsector in Nigeria. It was observed that exchange rate depreciation had positive effect on manufacturing value added in Nigeria. Based on their findings, the study recommended that the government should stimulate export diversification in the area of agriculture, agro-investment, agro-allied industries and petroleum industries. The government should restrict the importation of similar products manufactured in Nigeria to increase the buying of Nigerian products.

Lawal (2016) examined the effect of exchange rate fluctuations on manufacturing sector output in Nigeria between 1986 and 2014. It was discovered that exchange rate fluctuations have long-run and short-run relationships on manufacturing output. The result showed that exchange rate depreciation has a positive, though insignificant effect on manufacturing output. Therefore, the paper recommended that the government should implement the policies on export strategies to encourage exports and discourage imports in order to achieve a favourable balance of payments, and that the government should encourage the use of domestic materials in production in order to encourage international competitiveness.

2.4.6 Empirical Studies on Determinants of Manufacturing Output in Different Countries of the World

One of the earliest studies that analyzed the impact of political and economic factors on industrial growth was Story (1980), who examined the role of different factors in explaining the manufacturing industrial growth of five Latin American. Most previous studies like Hoselitz (1961), Temin (1967), and Chenery & Taylor (1968) limited the analysis to just two economic causes: population and per capita income. Moreover, the political factors of economic growth were also ignored by most economists. Keeping into consideration the lack of various economic factors along with political factors in the previous studies, Story (1980) made an effort to expand previous studies by adding distinctions regarding the economic factors and political factors of industrialization. The dependent variable of Industrial growth was defined as industrial value added in dollars, while economic independent variables included income per capita, population, exports, foreign direct investment (FDI). Political factors considered were government expenditure, trade-openness and type of government. The study used 25-year data from 1955 to 1975 of five Latin American countries that were Argentina, Brazil, Chile, Mexico and Venezuela. The methodology employed was pseudo Generalized Least Squares (GLS).

The results of the study confirmed the findings of the previous studies that income and population growth had the most crucial impact on industrial growth. The political variable of government expenditure also exerted a significant impact on industrial growth. This finding of significance of political factors is in line with the study of Holt & Turner (1966) in which the role of political factors in the economic growth had been emphasized. Furthermore, the variables of US foreign investment in manufacturing sector, protectionist policies and the type of government regime showed no significant effect on the industrial development in Latin America. This study highlights that for the formulation of industrial policy it is essential to consider economic as well as political factors. However, the conclusions made in the article were quite simplified which set a path for further research. The variables like government expenditure and exports could be disaggregated to identify specific areas that were contributing most to industrial progress.

Gao (2004) studied industrial development in the light of three broadly defined factors that possibly contribute to regional industrial growth, these were natural advantage and local market conditions, externalities from technological spillovers, exports and FDI. The study used data for twenty nine Chinese provinces from 1985-1993. The results showed that externalities in the long run and market conditions & regional infrastructure in the short run facilitated industrial growth. In addition to that exports and FDI had a great positive effect on the regional industrial growth. The result for FDI contrasted with Story's (1980) findings that FDI had no significant impact on industrial growth. The differences in these results could be because regional factors for Latin American countries and China are considerably different.

One of the most recent studies done on the determinants of industrialization is by Samouel &Aram (2016). Generalized Method of Moments (GMM) methodology was employed in this study to analyze the panel model for 35 African countries from the time period of 1970-2012. This study aimed to fill the void in the context of African countries by describing the linkage between industrialization and several regressors consisting of socio economic indicators as well as institutional and political variables. The results of the study showed that for the whole considered region economic development, labour market flexibility, financial development and the real effective exchange rate (REER) were the key drivers of the industrialization. It was also stated that Foreign Direct Investment (FDI) was the most crucial for the industrial development.

2.5 Research Gap

The need for the study of determinants of manufacturing output cannot be overemphasized as there is an urgent call for economic diversification in Nigeria. This can be achieved by moving from the primitive traditional stage of development to an industrialized stage of development.

A number of previous studies were based on a less formal general performance of the manufacturing subsector. This study seeks to identify the major determinants of manufacturing output. The outcome of this study will provide a platform to identify the factors that have influenced manufacturing output either positively or negatively so as to take a corrective measure.

It was observed from previous empirical literature that most researchers included capacity utilization as a determinant of manufacturing output. This research will not include this variable, because manufacturing output does not depend on capacity utilization. They can only serve as a proxy for each other. Also, previous studies were based on stale and outdated data. By contrast, this study is based on more current data, and this will make the information more current and, hence, reliable when compared to other empirical studies.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter is concerned with the methodology adopted. The chapter is organized into five sections. We commenced this chapter with the theoretical framework in section 3.2, which is the exposition on which this study is based. We specified the model used in section 3.3, in relations to the theoretical framework. We further described the method of estimation, data source and postulated effect of the explanatory variables in section 3.4. Finally, we discussed the estimation techniques in section 3.5.

3.2 Theoretical Framework

The theoretical framework adopted in this study is the Cobb-Douglas production function, which is discussed below. This will form the basis for the model specification.

The Cobb-Douglas functional form of production functions is widely used to represent the relationship between inputs and the output. This functional form was first proposed by Knut Wicksell (1851 - 1926), and developed by Charles Cobb and Paul Douglas in 1928. The Cobb-Douglas production function is often used to analyze the supply-side performance and measurement of a country's productive potential.

The Cobb-Douglas production function can be presented as:

$$Y_t = AK_t^{\alpha} L_t^{\beta} \quad \text{------------------} \qquad (1)$$

where a and β are constant terms that express the responsiveness of output to capital and labour respectively. *A* can be regarded as an exogenous efficiency/technology or productivity.

The degree of return to scale in production can be mathematically described as the sum of α and β .When $\alpha + \beta = 1$, it means there is a constant return to scale. If $\alpha + \beta < 1$, it means that decreasing returns to scale prevails while increasing return to scale occurs if $\alpha + \beta > 1$. Assuming perfect competition, α and β can be shown to be labor and capital's share of output.

Numerous empirical studies suggest that this mathematical form of the production process is a reasonable representation of the activity that occurs within manufacturing firms (see Nto et al., 2012; Oyeranti, 2012). It has been employed in many production function studies utilizing time series as well as cross-section data, and it has been applied at various times to countries, industries, and firms. A Cobb-Douglas production function may be easily estimated using linear regression analysis after taking the logarithm of both sides of the function.

3.3 Model Specification

The model used in relation to the theoretical framework in section 3.2 is specified in this section. Subsection 3.3.1 discusses the postulated determinants of the productivity or efficiency indicator, A, while subsection 3.3.2 is the final equation specified for estimation.

3.3.1 Postulated Determinants of the Productivity or Efficiency Indicator, A

Before we continue, it is very important to identify the determinants of “A” in equation 1 above. Discussed below are the factors that determine productivity as far as this study is concerned:

Government capital expenditure (denoted as CAPEX): This is used as a proxy for infrastructural development. An increase in government capital expenditure is postulated to lead to technological efficiency, while a decrease in government capital expenditure is to reduce productivity.

Exchange rate depreciation (denoted as EXR): This is an important factor that determines productivity. An upward movement of the exchange rate (which stands for depreciation of domestic currency) is posited to cause productivity to increase while exchange rate appreciation should cause a reduction in productivity as will be further discussed later in this chapter.

Trade openness (denoted as TOP): This is also one of the factors that determine technological efficiency. Trade openness should enhance competition and, hence, efficiency.

Also, ***inflation rate (INF):*** is an essential factor that affects productivity. Inflation is generally seen as a factor that distorts resource allocation, thereby impairing efficiency or productivity.

Based on the above discussion, we can specify a productivity function as shown below:

A_t=F(capital expenditure, exchange rate, trade openness and inflation rate) ------------- (2)

By assuming that some of the factors interact with each other in a multiplicative form while others interact addictively, and after representing K and L in the above equation (1) by GCF and EMS replacing, the above equation becomes equation (3) below:

$$A_t = B\,CAPEX^{\lambda}\ e^{\theta EXR}\ e^{\pi TOP}\ e^{\chi\ INF} \quad \text{-------------} \qquad (3)$$

*wh*ere *B* is a constant

3.3.2 Final Equation Specified for Estimation

Substituting the above equation (3) into the earlier equation (1) yields:

$$MAN = B\,GCF^{\alpha}\ EMS^{\beta}\ CAPEX^{\lambda}\ e^{\theta EXR}\ e^{\pi TOP}\ e^{\chi\ INF} \quad \text{---------------} \qquad (4)$$

Taking the log of the above equation (4) and adding the subscript *t* and the error term U_t yields:

$$lnMAN_t = lnB + \alpha lnGCF_t + \beta lnEMS_t + \lambda lnCAPEX_t + \theta EXR_t + \pi TOP_t + \chi INF_t + U_t \quad \text{-----} \qquad (5)$$

MAN = Manufacturing Output
EMS = Employment in the Manufacturing subsector
GCF = Gross Capital Formation
CAPEX = Government Capital Expenditure
EXR = Exchange Rate
TOP = Trade Openness (export+import/GDP)
INF = Inflation

U represents error term and *t* represents time while *B*, β, α, λ, θ, π, χ are the parameters to be estimated.

It is to be noted in the above equations (3), (4) and (5) above that we have changed three symbols. First, for notational convenience, we replaced L (labour force) in equation (1) by EMS, and Y by MAN. Secondly, we replaced K (capital stock) by GCF (Gross Capital Formation in relation to GDP). We decided to proxy K by GCF because of lack of data on K. While recognizing that GCF can, at best, be only a rough proxy for K, it is still the most suitable proxy that we can think of in the absence of data on the actual K.

3.4 Data sources and postulated effects of the explanatory variables

- ***Employment in the Manufacturing Subsector (EMS):*** This is used to measure the total number of people working in the manufacturing subsector in Nigeria, which could be skilled or unskilled labour. The data were sourced from the National Bureau of Statistics, 2014. Data for 2015 and 2016 were extrapolated using weighted average. We posit this to have a positive effect on the manufacturing output because an increase in employment should result in an increase in output. This means that, in the context of our equation (5) above, β should be positive.

- ***Gross Capital Formation (GCF)*****:** This measures the component of the private expenditure in gross domestic product (GDP) that is not for consumption and, thus, it shows how much of the value added in the economy is invested rather than consumed in the private sector. The gross capital formation is used to proxy the capital stock and it is expressed as a percentage of the GDP. The data were sourced from the World Bank's World Development Indicators, 2016.We posit this to have a positive effect on the manufacturing output. This means that, in the context of our equation (5) above, α should be positive.

- ***Exchange Rate (EXR)*****:** This is the value of one country's currency in relation to another currency. The data on it were sourced from Central Bank of Nigeria's Statistical Bulletin, 2016.The exchange rate is measured in nominal terms and in such a way that its upward movement represents a depreciation. It is expected that exchange rate depreciation should cause manufacturing output to increase. This means that, in the context of our equation (5) above, θ should be positive.

- ***Government Capital Expenditure (CAPEX)*****:** This measures the amount spent by the government in the acquisition of fixed (productive) assets (whose useful life extends beyond the accounting or fiscal year), as well as expenditure incurred in the upgrade/improvement of existing fixed assets such as lands, building, roads, machines and equipment, etc, including intangible assets. Expenditure on research also falls within this component of government expenditure. Data on it were sourced from Central Bank of Nigeria's Statistical Bulletin, 2016. Capital expenditure is used to proxy infrastructural spending. It is expected to have a positive impact on manufacturing output because an increase in capital expenditure will result in an increase in output. This means that, in the context of our equation (5) above, λ should be positive.

- ***Trade openness (TOP)*****:** This is measured as addition of imports and exports, both as a ratio of the GDP. Data on this were sourced from the World Bank's World

Development Indicators, 2016. Increased openness facilitates greater integration into global markets. We posit this to have a positive effect on the manufacturing output because an increase in trade openness will result in an increase in efficiency or productivity. This means that, in the context of our equation (5) above, π should be positive.

- ***Inflation Rate (INF)*:** This is the annualized percentage change in a general price index (in the present case, the consumer price index) over time. The data were sourced from the Central Bank of Nigeria’s Statistical Bulletin, 2016. Inflation affects economies in various positive and negative ways but, on the whole, it is likely to be distortive and retard productivity. The postulated effect is, therefore, negative on manufacturing outputs. This means that, in the context of our equation (5) above, χ should be negative.

Summary of Data Sources, Definition of Variables and the Apriori Expectation of the Effects of the Explanatory Variables

Table 3.1 shows the summary of what has just been discussed in connection with the data sources, definition of variables and the apriori expectation of the effects of the explanatory variables.

Table 3.1: **Summary of data sources, definition of variables and the apriori expectation of the effects of the explanatory variables**

Dependent Variables	**Independent Variables**	**Apriori Expectation**	**Data Source**
Manufacturing output		+	Central Bank of Nigeria Statistical Bulletin 2016
	Gross capital formation	+	World Development indicators 2016
	Manufacturing employment	+	National Bureau of Statistic 2014
	Capital expenditure	+	Central Bank of Nigeria Statistical Bulletin 2016
	Trade openness	+	World Development indicators 2016
	Exchange rate depreciation	+	Central Bank of Nigeria Statistical Bulletin 2016
	Inflation rate	-	Central Bank of Nigeria Statistical Bulletin 2016

3.5 Estimation Techniques

This is effected through the use of E-view Econometric software version. Prior to the estimation of the model of primary interest, a number of pre-estimation tests are carried out as follows:

3.5.1 Unit Root Test

To ensure that the outcome of the regression is not spurious, stationary test was conducted using the Augmented Dickey– Fuller test. Since some of the variables are not stationary at the level, the cointegration test is conducted to ascertain the existence of long-run relationship among the variables in the model, using Autoregressive Distributed Lag (ARDL) bound test.

3.5.2 Stability Test

Also, the stability test is conducted to know the stability of the model. The Ramsey Reset test was used to test for the stability of the model.

3.5.3 Test for Heteroskedasticity

Heteroskedasticity test was also conducted. Heteroskedasticity occurs when the variance of error term in a model is not constant; it varies with the independent variables. It causes the estimates of standard error to be biased, leading to unreliable hypothesis testing. White test (1980) is used in this study. The White's test is also a Lagrangier Multiplier test and is seen to be superior to other tests, because it does not assume any prior knowledge of heteroskedasticity and it does not depend on the normality assumption as the Breusch-Pagan test.

3.5.4 Test for Serial Correlation of the Residuals

When a regression model includes lagged value of dependent variable as regressor, the use of Durbin-Waston test to detect serial correlation will be biased in such a model. Therefore Breusch-Godfrey Serial Correlation Lagrangier Multiplier Test will be used to test for serial correlation.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF EMPIRICAL RESULTS

4.1 Introduction

This chapter presents and discusses the empirical results of estimation of the specified equations. First, the unit root test was conducted to know the behavior of the series over the years. Based on the outcome of this test, the cointegration test was carried out to know the long-run relationship among the variables. We then estimated the short and long run coefficients of the ARDL and the error correction mechanism that indicates the speed adjustment in the long-run. In doing this, residual diagnostic tests are conducted to vindicate the robustness of the parameter estimates.

4.2 Pre-estimation Test

4.2.1 *Unit Root Test*

Direct application of OLS to non-stationary data produces regressions that are spurious in nature (Engle and Granger, 1987). The study, therefore, subjected the variables to the unit root test, using Augmented Dickey-Fuller method. Table 4.1below reports the results of Augmented Dickey-Fuller (ADF) unit root test.

Table 4.1: Augmented Dickey Fuller Unit Root Test

VARIABLES	t-statistic	Crit. Val. At 5% level	P-value	Order of Integration
D(LNMAN)	-5.091	-2.951	0.000	I(1)
D(LNEMS)	-5.408	-3.639	0.000	I(1)
LNGCF	-4.458	-2.948	0.001	I(0)
D(LNCAPEX)	-8.772	-2.951	0.000	I(1)
D(EXR)	-3.645	-2.951	0.001	I(1)
D(TOP)	-3.700	-1.637	0.045	I(1)
D(INF)	-5.416	-2.951	0.000	I(1)

In the Table above, MAN means manufacturing output, EMS is employment in the manufacturing subsector; GCF is gross capital formation CAPEX is government capital expenditure, EXR is exchange rate, TOP is trade openness, INF is inflation. "D" denotes difference. All variables are in natural logarithm except exchange rate, trade openness and inflation.

As it can be seen from the above Table 4.2, all the series are stationary after first differencing, except gross capital formation. Thus the variables are a combination of I(0) and I(1) series at a 5% level of significance. The implication of this combination of I(1) and I(0) series is that the condition of using Ordinary Least Squares (OLS) method to estimate the parameters is violated. Otherwise, it will produce spurious regression results. Therefore, it becomes imperative to conduct cointegration test methodology so as to ascertain the existence of long run relationship among the variables in the model. Autoregressive Distributive Lag (ARDL) bound test is a suitable cointegration test when the variables are a combination of I(1) and I(0) order. The application of this is presented and discussed in sub-section 4.2.2 below.

4.2.2 Cointegration Test (ARDL Bound Test)

The existence of a long run relationship among the variables in the estimated model is investigated using F-statistics with two sets of critical values, that is I(1) and I(0), as proposed by Pesaran et al. (2001).

If the estimated F-statistic is greater than the upper bound critical values (that is I(1) bound value) at 5% significance level, the null hypothesis of absent of long run equilibrium relationship between manufacturing output and its explanatory variables will be rejected. If the estimated F-statistic is below the lower bound critical value (that is I(0) bound value), the null hypothesis cannot be rejected at 5% significance level. Also, if the estimated F-statistic falls within upper and lower bound critical values, the test is regarded as being inconclusive.

The relevant parameter estimates and statistic for conducting this test are as presented in Table 4.2 below.

Table 4.2 ARDL Bounds Test

ARDL Model		
ARDL Bounds Test		
Sample: 1981 2016		
Included observations: 36		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	**4.051784**	**6**
Critical Value Bounds		
Significance Level	**I(0)Bound**	**I(1) Bound**
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

The result of ARDL Bound Test in Table 4.2 above, shows that the null hypothesis of no long- run relationship at 5% significance level will be rejected because the value of F-statistic (4.051) is greater than I(1) upper bound value (3.61). Therefore, it can be concluded that there exists a long run relationship between manufacturing output and its explanatory variables. Since ARDL Bound test reveals a long run relationship, the study estimated the short-run and long-run parameter coefficients of the ARDL and the error correction mechanism (that shows the speed of adjustment to the long-run).

4.3. Short Run and Long Run Estimates of Manufacturing Output

4.3.1 Presentation of the Estimates

This section presents the empirical results on determinants of manufacturing output in Nigeria. The dependent variable in this analysis is manufacturing output, and the independent variables are employment in the subsector, gross capital formation, government capital expenditure, exchange rate, trade openness and inflation. The Autoregressive Distributed Lags method was adopted and its cointegrating short-run and long-run coefficients are used to analyze the effects of the above named variables on manufacturing output in Nigeria.

Table 4.3 presents the short-run ARDL while Table 4.4 presents the long-run ARDL below:

Table 4.3: Short Run ARDL

Selected ARDL Model			
ARDL Short run Coefficient			
Variable	Coefficient	Std. Error	Prob.
D(LNMAN(-1))	0.544	0.094	0.004
D(LNMAN(-2))	0.535	0.104	0.007
D(LNMAN(-3))	0.673	0.066	0.001
D(LNCAPEX)	0.044	0.009	0.007
D(LNCAPEX(-1))	0.006	0.005	0.304
D(LNCAPEX(-2))	-0.012	0.007	0.155
D(EXCH)	-0.001	0.000	0.022
D(EXCH(-1))	0.002	0.001	0.119
D(LNGCF)	-0.003	0.003	0.388
D(LNGCF(-1))	-0.008	0.003	0.051
D(LNGCF(-2))	-0.025	0.003	0.002
D(INF)	0.001	0.001	0.296
D(INF-1)	-0.002	0.001	0.023
D(INF-2)	0.001	0.000	0.107
D(LNEMS)	-0.505	0.107	0.009
D(LNEMS(-1))	-0.355	0.124	0.046
D(LNEMS(-2))	-1.268	0.233	0.006
D(TOP)	0.063	0.022	0.047
D(TOP(-1))	-0.002	0.020	0.941
D(TOP(-2))	0.043	0.023	0.143
CointEq(-1)	-0.526	0.065	0.001
Cointeq = LOGMAN - (0.062*CAPEX -0.006*EXCH + 0.088*GCF -0.000*INF + 2.519*EMS-0.160*TOP -1.3870)			

R-squared= 0.8998
Adjusted R-squared= 0.8792
F-statistic= 1467
Prob(F-statistic)=0.000001

In the table, MAN means manufacturing output, EMS is employment in the manufacturing subsector; GCF is gross capital formation CAPEX is government capital expenditure,
EXR is exchange rate, TOP is trade openness, INF is inflation, All variables are in natural logarithm except exchange rate, trade openness and inflation. The Schwarz Information Criterion (SIC) is used in selecting the optimum number of lags in the ARDL equation because it has more parsimonious specification than other criteria (Pesaran & Smith, 1998). Table 1of the Appendix shows that two hundred and one models were evaluated and the best model is selected for this study.

Table 4.4: Long Run ARDL Model
Selected ARDL Model
Long Run Coefficients

Variable	Coefficient	Std. Error	Prob.
LNCAPEX	0.062	0.016	0.019
EXCH	-0.006	0.002	0.035
LNGCF	0.088	0.004	0.000
INF	-0.000	0.001	0.924
LNEMS	2.519	0.305	0.001
TOP	-0.160	0.058	0.051
C	-1.387	0.963	0.223

In the table, MAN means Manufacturing Output, EMS is employment in the manufacturing subsector; GCF is gross capital formation CAPEX is government capital expenditure, EXR is exchange rate, TOP is trade openness, INF is inflation.

4.3.2 Discussion of the Short-run and Long-run Estimates

The estimated model has an R-squared of 0.899 which shows that the explanatory variables accounted for 89.9% change in the manufacturing output. The model is also of a good fit because the Prob(F-statistic) value of 0.000001 is less than 5% significant level.

- ***Speed of Adjustment Term:*** As can be seen from the above Table 4.3, the lag error correction term, CointEq (-1), which measures the speed of adjustment to restore long-run equilibrium in the dynamic model, has the expected negative sign with a coefficient value of 0.526(52.6%). It is statistically significant at 1%, which means that the speed of adjustment to long run equilibrium is possible if there is deviation in the short run and it is at the pace of 52.6% per annum.

- ***Employment in the Manufacturing Subsector (EMS)*****:** From the findings above, the coefficient of employment in the manufacturing subsector is -0.505, with p-value of 0.009 in the short-run. This means that employment in manufacturing subsector exerts a negative but significant effect in the short-run. i.e an increase in employment lead to a decrease in manufacturing output. This could be as a result of redundancy and presence of ghost workers among the employee. While in the long run it becomes positive and significant, with a 1% rise in employment in the manufacturing sector producing a 2.5% rise in manufacturing output. This implies that an increase in employment strengthens the manufacturing output in the long-run. This is in line with the apriori expectation stated in chapter 3 that an increase in employment will increase manufacturing output.

- ***Gross Capital Formation (GCF)*****:** It is observed, that the coefficient of gross capital formation is -0.003 with p-value of 0.388 in the short-run. A 1% increase in GCF will lead to a decrease of 0.003 in manufacturing output. In the long run, its effect is positive and significant at 1%. Accordingly, a 1% rise in gross capital formation produces 0.088 rises in manufacturing output in Nigeria. This implies that an increase in investment will lead to an increase in manufacturing output. This conforms to the apriori expectation that gross capital formation should affect manufacturing output positively. This is in line with the findings of the empirical studies of Otalu (2015) that an increase in capital will increase manufacturing output.

- ***Government Capital Expenditure (CAPEXP)*****:** It is found, that the coefficient of government capital expenditure is 0.044 in its contemporaneous value with p-value as 0.007.The positive coefficient of government capital expenditure implies that a rise in the government capital expenditure will beef up manufacturing output in the short-run while, in the long-run, the results show that 1% rise in government capital expenditure is expected to strengthen manufacturing output by 0.06. This is in line with the apriori expectation that government capital expenditure should increase output. This is also in line with the empirical study of Falade et al (2015), who studied the relationship between government expenditure and manufacturing output in Nigeria and confirm a very significant positive relationship between the variables.

- ***Exchange Rate (EXR)*****:** It is found, that the coefficient of exchange rate is -0.001 in its contemporaneous value and has a p-value of 0.022, in the short-run. This means that an upward movement of the exchange rate will lead to a decrease in manufacturing output in the short-run. Also, in the long-run, the value of exchange rate is -0.006 with a p-value of 0.035. This means that a1% upward movement of exchange rate is expected to reduce manufacturing output by 0.006 in the long run. This does not conform to the expectation that exchange rate depreciation should increase manufacturing output. The negative effect of exchange rate depreciation may be because of high dependent on intermediate input and high cost of such inputs. This can be as a result of high cost of importation of intermediate inputs. This is contrary to the conclusion reached by Lawal (2016) that exchange rate depreciation will increase manufacturing output.

- ***Trade Openness (TOP):*** From the presentation above, it can be seen that the coefficient of trade openness is 0.063 in its contemporaneous value, with a p-value of 0.07, in the short-run. This means that the effect of the degree of trade openness (TOP) is positive and significant in the short-run. This is in line with the finding reported by Umoh and Effiong (2013), who concluded from their empirical study that there is a positive, significant relationship between manufacturing output and trade openness**.** On the other hand, in the long-run, the coefficient of trade openness is -0.1595, in its contemporaneous value with a probability value of 0.0509. This means that an increase in the degree of trade openness will cause manufacturing output to decrease in the long-run. This could be as a result of high exposure to foreign trade which adversely affects manufacturing output. This is not in line with the apriori expectation that trade openness should have a positive impact on manufacturing output.

- ***Inflation Rate (INF):*** It is observed from the result that the coefficient of inflation rate is 0.001 in its contemporaneous value with a p-value of 0.296, in the short-run. It is not significant in the short-run, which implies that inflation rate does not determine manufacturing output in Nigeria. Also, in the long-run, the estimated coefficient of inflation is -0.000, with a probability value of 0.9243. This means that inflation is not a short-run and long-run determinant of manufacturing output in Nigeria.

4.3.3 Residual Diagnostic Test

(a) Stability Test

According to Brook (2014), the existence of cointegration does not necessary imply that the estimated coefficients are stable. Therefore, there is the need for stability test because, if the coefficients are unstable, the result will be unreliable. Thus, this study examines the overall stability of the short-run and long-run coefficients of the estimated ARDL model, using Ramsey Reset test methodology, the outcome of which is presented in Table 4.5 below. If the p-value is greater than 5% accept the null hypotheses and if it is less than 5% reject the null hyphotheses. The result of applying this method is as presented below:

Table 4.5 Ramsey Reset Test

Selected ARDL Model				
Ramsey RESET Test				
Equation: UNTITLED				
Specification: LNMAN LNMAN(-1) LNMAN(-2) LNMAN(-3) LNMAN(				
-4) LNCAPEX LNCAPEX(-1) LNCAPEX(-2) LNCAPEX(-3) EXCH EXCH(-1) EXCH(-2)				
LNGCF LNGCF(-1) LNGCF(-2) LNGCF(-3) INF INF(-1) INF(-2) INF(-3)				
LNEMS LNEMS(-1) LNEMS(-2) LNEMS(-3) TOP TOP(-1) TOP(-2) TOP(-3) C				
Omitted Variables: Squares of fitted values				
	Value	Df	Probability	
t-statistic	0.281	3	0.797	
F-statistic	0.079	(1, 3)	0.797	

When the probability of the t-statistic and F-statistic are greater than 5% it means that the estimated coefficients are stable. Given that the probability value of both t-statistic and F-statistic(79%) is greater than 0.05, Table 4.5 shows that the estimated coefficients are stable over time.

(b) Testing for Serial Correlation

It is paramount that the errors of this model are serially independent. If not, the parameter estimates will not be consistent. When a regression model includes lagged value of the dependent variable as regressor (as in the present case), the use of Durbin-Waston test to detect serial correlation will be biased in such a model. As a result, we resort to a different methodology that does not have this weakness and this technique is the serial correlation test. According to the technique, the hypothesis of the test is stated as:

H_0= Error terms are serially independent.

H_1= Error terms are serially dependent.

If the P-value is greater than 5% significant level, accept $H_{0,}$ which means that the errors of the model are serially independent or there is no serial correlation. Otherwise, accept $H_{1.}$ The result of applying this method is as presented below:

Table 4.6: Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	4.605	Prob. F(2,2)	0.126
Obs*R-squared	1.350	Prob. Chi-Square(2)	0.079

As can be seen from the above Table 4.6, the result shows that H_0 cannot be rejected because the P-value of Obs*R-squared and F-statistic is greater than 0.05 significant level. This implies that the estimated model is void of serial correlation.

(c) Testing for Heteroskedasticity

Heteroskedasticity occurs when the variance of error term in a model is not constant but varies with the independent variables. It causes the estimates of the standard error to be biased, leading to unreliable hypothesis testing. There are many tests to detect heteroskedasticity in a model but White's test (1980) is used in this study because of its superior advantage over other test methodologies. This is because it does not assume any prior knowledge of heteroskedasticity. It also does not depend on the normality assumption as the Breusch-Pagan test. According to this technique, the hypothesis of the test is stated as:

H_0= There is homeoskedasticity.

H_1= There is heteroskedasticity.

If the P-value is greater than 5% significant level, accept H_0, which means that there is homeoskedasticity or there is no heteroskedasticity in the model. Otherwise, accept H_1. The result of applying this method is as presented below:

Table 4.7:Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	2.119	Prob. F(27,4)	0.244
Obs*R-squared	29.909	Prob. Chi-Square(27)	0.318
Scaled explained SS	0.293	Prob. Chi-Square(27)	1.000

As it can be seen from the above Table 4.7, the result shows that all the criteria (F-statistic, Obs*R-squared and Scaled explained SS) agreed that the model is free from the problem of heteroskedasticity because the P-value (0.244, 0.318 and 1.000) is greater than 0.05 significance level.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter is organized into four major sections. Section 5.1 is the introduction of the chapter while section 5.2 is the summary which highlights the objectives, the methodology adopted and findings from the study. In section 5.3, conclusions emanating from the summary of the findings are stated. Finally, in section 5.4, the findings-based recommendations are fully discussed.

5.2 Summary

Over the years, policy makers have sought to identify the determinants of manufacturing output so as to proffer solution to the persistent decline in output and guide policy makers in taking measures to arrest and/or reverse the decline. Several empirical studies have been carried out by researchers to know what determines the output in Nigeria. Despite the implementation of these studies by policy makers, there seems to be no improvement in the level of aggregate output in the manufacturing subsector. This could be due to the gaps in the existing studies. This study, therefore, tries to fill such gaps by focusing on identifying the determinants of manufacturing output in Nigeria and adopting more appropriate methodology.

To accomplish the above objectives, we formulated a model that is based on Cobb -Douglas production function. The unit root test was conducted to know the behavior of the series over the years. The cointegration test was also carried out to know the long-run relationship among the variables. Based on the outcome of the test, we estimated the short and long run coefficients of the ARDL model and tested for the effect of the error correction mechanism that indicates the speed of adjustment to the long-run situation. The stability test was conducted to know the stability of the relationship among the variables used in the study. The annual data used covered between 1981 and 2016. The data were sourced from the National Bureau of Statistics, Central Bank of Nigeria’s Statistical Bulletin and World Bank’s World Development Indicators.

From the findings, we observed that, in the short-run, employment in the manufacturing subsector and exchange rate depreciation have negative impacts on manufacturing output while trade openness and government capital expenditure have positive effects on the output. The effects of gross capital formations and inflation rate are not significant. In the long-run, the effect of government capital expenditure, gross capital formations and employment in the manufacturing subsector are positive and significant while the effects of exchange rate depreciation and trade openness are negative. The effect of only inflation is not significant.

5.3 Conclusion

Based on the findings highlighted above, the effects of government capital expenditure and gross capital formation are positive on manufacturing output in the short-run. On the other hand, the effects of exchange rate depreciation, employment in manufacturing subsector and trade openness are negative on manufacturing output in the short-run. There are also positive effects of gross capital formation, government capital expenditure; employment in manufacturing on manufacturing subsector's output in the long-run. Employment in the manufacturing subsector has the highest effect on manufacturing output while it is followed by gross capital formation. The long-run effects of exchange rate and trade openness are negative on manufacturing output. Inflation rate was not significant at all both in the long-run and short-run.

5.3 Recommendations

Recommendations are made here based on the findings from this study. There are two major characters in this study: the government and the manufacturing firms. Hence, the recommendations will be made both to the government and the manufacturing firms.

If there is an intention to bring improvement to the Nigerian manufacturing subsector, it is expedient that these stakeholders engage in revolutionary changes in their policies, activities and strategies.

- It is observed that employment has a significant positive impact on the output of the manufacturing subsector. The government and manufacturing stakeholders should beef up employment in the subsector to promote manufacturing growth.
- It is found that the effect of inflation rate is not significant; i.e inflation rate does not have an impact on manufacturing output. Therefore, government and other stakeholders should not worry about inflation rate in their quest to promote manufacturing output.

- Government capital expenditure has a positive impact on manufacturing output such that an increase in government capital expenditure will cause manufacturing output to increase. Therefore, government should increase capital expenditure so as to improve infrastructural development. Infrastructural development will trigger a large increase in manufacturing output.
- Gross capital formation, which is used to proxy capital stock is found from this study to be an important factor in promoting the manufacturing subsector. Therefore, the government should embark on policies that would stimulate acquisition of capital stock by the entrepreneurs.
- Trade openness is found to have a negative influence on the output. Government should, therefore, take measures to reduce the country's exposure to foreign trade.
- Exchange rate depreciation has a negative impact on manufacturing output. Since most of the intermediate inputs are imported, exchange rate depreciation will cause the cost of intermediate inputs to be more expensive. Thus, exchange rate depreciation should be discouraged.

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APPENDIX I

Null Hypothesis: LOGMAN has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.697106	0.9903
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGMAN)
Method: Least Squares
Date: 06/06/18 Time: 18:30
Sample (adjusted): 1983 2016
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGMAN(-1)	0.033789	0.048470	0.697106	0.4909
D(LOGMAN(-1))	0.044558	0.197318	0.225818	0.8228
C	-0.223215	0.368204	-0.606227	0.5488

R-squared	0.026298	Mean dependent var	0.037436
Adjusted R-squared	-0.036521	S.D. dependent var	0.121363
S.E. of regression	0.123560	Akaike info criterion	-1.260090
Sum squared resid	0.473276	Schwarz criterion	-1.125411
Log likelihood	24.42153	Hannan-Quinn criter.	-1.214161
F-statistic	0.418633	Durbin-Watson stat	1.338897
Prob(F-statistic)	0.661610		

Null Hypothesis: D(LOGMAN) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.091069	0.0002
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGMAN,2)
Method: Least Squares
Date: 06/06/18 Time: 18:31
Sample (adjusted): 1983 2016
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGMAN(-1))	-0.894960	0.175790	-5.091069	0.0000
C	0.032983	0.022301	1.478998	0.1489

R-squared	0.447504	Mean dependent var	-0.004952
Adjusted R-squared	0.430239	S.D. dependent var	0.162373
S.E. of regression	0.122563	Akaike info criterion	-1.303359
Sum squared resid	0.480695	Schwarz criterion	-1.213573
Log likelihood	24.15711	Hannan-Quinn criter.	-1.272740
F-statistic	25.91899	Durbin-Watson stat	1.340886
Prob(F-statistic)	0.000015		

Null Hypothesis: GROSS_CAPITAL_FORMATION_ has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.458398	0.0011
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGGROSS_CAPITAL_FORMATION_)
Method: Least Squares
Date: 06/06/18 Time: 18:32
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGGROSS_CAPITAL_FORMATION_(-1)	-0.302429	0.067834	-4.458398	0.0001
C	3.277581	0.946936	3.461251	0.0015

R-squared	0.375914	Mean dependent var	-0.529450
Adjusted R-squared	0.357002	S.D. dependent var	3.019871
S.E. of regression	2.421548	Akaike info criterion	4.662137
Sum squared resid	193.5086	Schwarz criterion	4.751014
Log likelihood	-79.58739	Hannan-Quinn criter.	4.692817
F-statistic	19.87732	Durbin-Watson stat	1.515859
Prob(F-statistic)	0.000090		

Null Hypothesis:LOG EMS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.831423	0.7976
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGEMS)
Method: Least Squares
Date: 06/06/18 Time: 18:35
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGEMS(-1)	-0.017255	0.020753	-0.831423	0.4117
C	1.575479	0.817824	1.926428	0.0627

R-squared	0.020518	Mean dependent var	0.930571
Adjusted R-squared	-0.009164	S.D. dependent var	1.526379
S.E. of regression	1.533357	Akaike info criterion	3.748241
Sum squared resid	77.58902	Schwarz criterion	3.837118
Log likelihood	-63.59421	Hannan-Quinn criter.	3.778921
F-statistic	0.691264	Durbin-Watson stat	1.920757
Prob(F-statistic)	0.411711		

Null Hypothesis: D(LOGEMS) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.407634	0.0001
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGEMS,2)
Method: Least Squares
Date: 06/06/18 Time: 18:36
Sample (adjusted): 1983 2016
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EMS(-1))	-1.015539	0.187797	-5.407634	0.0000
C	0.956410	0.330526	2.893597	0.0068

R-squared	0.477487	Mean dependent var	-0.077647
Adjusted R-squared	0.461159	S.D. dependent var	2.141521
S.E. of regression	1.572001	Akaike info criterion	3.799598
Sum squared resid	79.07799	Schwarz criterion	3.889384
Log likelihood	-62.59317	Hannan-Quinn criter.	3.830218
F-statistic	29.24250	Durbin-Watson stat	1.884323
Prob(F-statistic)	0.000006		

Null Hypothesis: LOGCAPEX has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.185679	0.6692
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGCAPEX)
Method: Least Squares
Date: 06/06/18 Time: 18:37
Sample (adjusted): 1983 2016

Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGCAPEX(-1)	-0.158007	0.133263	-1.185679	0.2448
D(LOGCAPEX(-1))	-0.326800	0.175399	-1.863180	0.0719
C	0.393805	0.509585	0.772795	0.4455

R-squared	0.206005	Mean dependent var	-0.103584
Adjusted R-squared	0.154779	S.D. dependent var	1.424922
S.E. of regression	1.310015	Akaike info criterion	3.462051
Sum squared resid	53.20031	Schwarz criterion	3.596730
Log likelihood	-55.85487	Hannan-Quinn criter.	3.507981
F-statistic	4.021528	Durbin-Watson stat	1.888439
Prob(F-statistic)	0.028001		

Null Hypothesis: D(LOGCAPEX) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.772282	0.0000
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CAPEX,2)
Method: Least Squares
Date: 06/06/18 Time: 18:37
Sample (adjusted): 1983 2016
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGCAPEX(-1))	-1.412109	0.160974	-8.772282	0.0000
C	-0.148121	0.226754	-0.653224	0.5183

R-squared	0.706295	Mean dependent var	0.004487
Adjusted R-squared	0.697117	S.D. dependent var	2.395385
S.E. of regression	1.318296	Akaike info criterion	3.447579
Sum squared resid	55.61291	Schwarz criterion	3.537365
Log likelihood	-56.60884	Hannan-Quinn criter.	3.478199
F-statistic	76.95292	Durbin-Watson stat	1.932910
Prob(F-statistic)	0.000000		

Null Hypothesis: TOP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.039911	0.2693
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOP)
Method: Least Squares
Date: 06/06/18 Time: 18:38
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TOP(-1)	-0.249302	0.122212	-2.039911	0.0494
C	12.15465	6.559356	1.853025	0.0728

R-squared	0.111978	Mean dependent var	-0.588777
Adjusted R-squared	0.085068	S.D. dependent var	12.36922
S.E. of regression	11.83142	Akaike info criterion	7.834840
Sum squared resid	4619.422	Schwarz criterion	7.923717
Log likelihood	-135.1097	Hannan-Quinn criter.	7.865520
F-statistic	4.161236	Durbin-Watson stat	2.322859
Prob(F-statistic)	0.049430		

Null Hypothesis: D(TOP) has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.700124	0.0408
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOP,2)

Method: Least Squares
Date: 06/06/18 Time: 18:39
Sample (adjusted): 1990 2016
Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TOP(-1))	-1.190173	0.727160	-1.636743	0.1190
D(TOP(-1),2)	0.102853	0.663507	0.155014	0.8785
D(TOP(-2),2)	0.069456	0.646508	0.107433	0.9156
D(TOP(-3),2)	-0.083716	0.586561	-0.142723	0.8881
D(TOP(-4),2)	-0.245265	0.484139	-0.506600	0.6186
D(TOP(-5),2)	-0.031230	0.386534	-0.080794	0.9365
D(TOP(-6),2)	0.289263	0.314784	0.918923	0.3703
D(TOP(-7),2)	-0.155418	0.218114	-0.712555	0.4853
C	-1.234892	1.917952	-0.643860	0.5278

R-squared	0.857897	Mean dependent var	-0.685852
Adjusted R-squared	0.794740	S.D. dependent var	21.29423
S.E. of regression	9.647474	Akaike info criterion	7.632471
Sum squared resid	1675.328	Schwarz criterion	8.064417
Log likelihood	-94.03836	Hannan-Quinn criter.	7.760911
F-statistic	13.58361	Durbin-Watson stat	1.872557
Prob(F-statistic)	0.000003		

Null Hypothesis: EXCH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.320067	0.9983
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCH)
Method: Least Squares
Date: 06/06/18 Time: 18:45
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH(-1)	0.056511	0.042809	1.320067	0.1959
C	3.189583	4.140477	0.770342	0.4466

R-squared	0.050157	Mean dependent var	7.224988
Adjusted R-squared	0.021374	S.D. dependent var	16.70055
S.E. of regression	16.52111	Akaike info criterion	8.502600
Sum squared resid	9007.249	Schwarz criterion	8.591477
Log likelihood	-146.7955	Hannan-Quinn criter.	8.533280
F-statistic	1.742577	Durbin-Watson stat	1.495480
Prob(F-statistic)	0.195897		

Null Hypothesis: D(EXCH) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.644591	0.0099
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCH,2)
Method: Least Squares
Date: 06/06/18 Time: 18:45
Sample (adjusted): 1983 2016
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH(-1))	-0.760503	0.208666	-3.644591	0.0009
C	6.084641	3.116168	1.952604	0.0597

R-squared	0.293334	Mean dependent var	1.794001
Adjusted R-squared	0.271250	S.D. dependent var	19.70747
S.E. of regression	16.82364	Akaike info criterion	8.540470
Sum squared resid	9057.118	Schwarz criterion	8.630256
Log likelihood	-143.1880	Hannan-Quinn criter.	8.571089
F-statistic	13.28304	Durbin-Watson stat	1.751710
Prob(F-statistic)	0.000940		

Null Hypothesis: INF has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.816479	0.0662
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF)
Method: Least Squares
Date: 06/06/18 Time: 18:46
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.388239	0.137846	-2.816479	0.0081
C	7.507825	3.650097	2.056884	0.0477

R-squared	0.193796	Mean dependent var	-0.146171
Adjusted R-squared	0.169365	S.D. dependent var	15.81789
S.E. of regression	14.41629	Akaike info criterion	8.230040
Sum squared resid	6858.374	Schwarz criterion	8.318917
Log likelihood	-142.0257	Hannan-Quinn criter.	8.260721
F-statistic	7.932552	Durbin-Watson stat	1.600938
Prob(F-statistic)	0.008133		

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.416306	0.0001
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(INF,2)
Method: Least Squares
Date: 06/06/18 Time: 18:46
Sample (adjusted): 1983 2016
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	-0.949116	0.175233	-5.416306	0.0000
C	0.252920	2.764662	0.091483	0.9277

R-squared	0.478287	Mean dependent var	0.582184
Adjusted R-squared	0.461983	S.D. dependent var	21.97245
S.E. of regression	16.11671	Akaike info criterion	8.454613
Sum squared resid	8311.951	Schwarz criterion	8.544399
Log likelihood	-141.7284	Hannan-Quinn criter.	8.485233
F-statistic	29.33637	Durbin-Watson stat	1.868798
Prob(F-statistic)	0.000006		