

## Employment Effect of Exchange Rate Volatility in Nigeria's Manufacturing Sector

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**Abstract:** In the recent years, unemployment has been a serious challenge to the government at all levels and policy makers in Nigeria. Employing a Generalized Autoregressive Conditional Heteroscedasticity (GARCH) Modelling, this study examines the employment effect of real exchange rate volatility in Nigeria's manufacturing sector between the year 1970 and 2008, via two well-defined transmission channels, namely; export orientation channel and import penetration channel. The empirical analysis suggests that exchange rate volatility has a significant positive effect on manufacturing employment through the export orientation channel where as has an insignificant effect through the import penetration channel. This therefore calls for proper diversification of the country's economy to accommodate and improve the role of other sectors particularly manufacturing that can contribute to employment generation than the dominant oil sector.

**Key words:** Exchange rates volatility, manufacturing employment, GARCH, export orientation channel, import penetration channel

### INTRODUCTION

Evidently, no country lives in absolute autarky. The economies of the world are connected directly or indirectly through asset or goods markets. This linkage is made possible through trade and foreign exchange which makes the free flow of goods and services possible. The price of foreign currencies in terms of a local currency (i.e., exchange rate) is therefore important to understand the growth path of all countries of the world.

The consequences of substantial misalignments of exchange rates can lead to output contraction and extensive economic hardship. Moreover, there is reasonably strong evidence that the alignment of exchange rates has a critical influence on the rate of growth of per capita output in low income countries (Umar and Soliu, 2009). Therefore, Nigeria as one of the low income open economies is expected to be vulnerable to misalignments of exchange rate.

Most studies on exchange rate have always argued that the type of exchange rate systems adopted by a country have implications on the economy through their effects on international trade, output, financial markets inflation, employment and investment (both domestic and foreign) (Aliyu, 2008; Oyejide, 1985). These are more reasons why study of exchange rates and their volatility is very important for any open economy. Employment is an important subject of concern for any economy in the world.

This makes it a necessity to establish useful insights on the various channels through which these macroeconomic objectives can either be enhanced or

shattered. Among the various studies on employment in economics particularly in Africa, analysis of exchange rates and employment has received negligible attention. Some of the studies that have been carried out on relationship between exchange rate and employment concentrated mostly on the developed countries with very little being done on less developed countries. This is surprising since, there appears to be a number of well-defined transmission channels through which exchange rates impact on employment. Therefore, this study focuses on Nigeria as its scope of study for the purpose of establishing how Nigeria can improve her deteriorating state of employment in the manufacturing sector through exchange rate adjustment.

Employment situation in Nigeria has been a major concern in the recent years. This is evidenced as government at all levels and policy makers try in their own capacity to alleviate employment situation in Nigeria. Unemployment rate has been on the increase in Nigeria from 1970-2008 (Fig. 1). As seen from Fig. 1, unemployment rate rose from 1.93% in 1970-3.6% in the

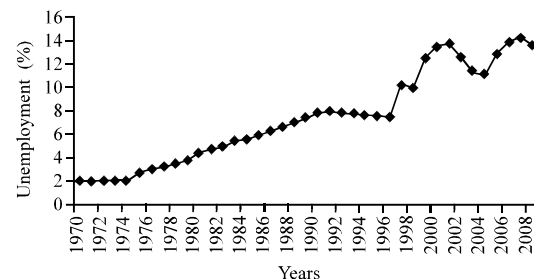


Fig. 1: Unemployment rate in Nigeria (1970-2008)

year 2008 in Nigeria with its peak marked at 14.2% in 2007. This awkward situation calls for an urgent and in-depth investigate for ways through which Nigeria will experience again the mild unemployment rate of the early 1970's. This study consequently examines the form of relationship between exchange rate volatility and employment in Nigeria particularly in the manufacturing sector knowing it is one of the major sectors that can alleviate employment in Nigeria. Ngandu (2008) identified number of channels through which exchange rate affects employment. The summary of these channels basically is that a devaluation or depreciation of currency raises the price of imports in comparison to that of its exports and this causes the trade balance to improve. This situation leads to an improvement in the real (export) sector of the economy. This improvement is expected to raise output and employment in the overall economy. In another way, changes in currency imply changes in relative production costs which sequentially have a significant impact on the allocation of labour within and across industries. Fall in the real exchange rate implies growing international competitiveness and a rise means falling international competitiveness. Hence, currency depreciation will lead to a fall in the real exchange rate and thus to an increase in international competitiveness and vice versa.

In the literatures, the effect of exchange rate movements on the labour market is uncertain. On one hand, currency devaluation lowers the price of domestically produced goods and thus increases firms' output because households substitute local input for foreign input in response to the change in domestic currency. This raises firms' marginal product of labour and thus encourages firms to increase their demand for labour and wages (Mo, 2009; Campa and Goldberg, 1999; Klein *et al.*, 2003).

However, this might not necessarily be the case. According to Mo (2009) and Bahmani-Oskooee *et al.* (2007), currency depreciation simultaneously increases a firm's cost of imported input as well as uncertainty in the foreign exchange and financial markets; the former factor increases a firm's cost of production whereas the latter factor generates loss in its profitability. These eventually contract the manufacturing sector's size. This study investigates to what extent the real exchange rate variability can be responsible for the development of employment in the Nigeria's manufacturing sector (According to conclusion in their research study of the Mexican economy. If the currency is not devalued growth will not keep pace with the growth of the labour force; the divisions in Mexican society will widen and national stability will be threatened). When investigating the

potential growth of employment in Nigeria, the real exchange rate and its impact on the traded sector appear as a factor that might affect the economy's ability to create jobs. Despite various policies adopted in the past on exchange rate and a number of reform measures carried out by successive government however, the extent to which these policies have been effective in promoting export has remained unascertained.

This is because despite government efforts, the growth performance of Nigeria's non-oil export has been very low. It grew at a mean of 2.3% during 1960-90 period while its contribution to total export decline from about 60.0% in 1960 to about 3.0% in 1990 (Adewuyi and Adeoye, 2005).

As a result, Nigeria's manufacturing sector has been continually battling with fall in real output, accounting for <1% in total export and 5% in total output of the economy in recent years of this study and unstable rate of growth of employment. Nigeria has tried both fixed and flexible exchange rate regimes in order to attain an appropriate exchange rate management system. She adopted the Structural Adjustment Programme (SAP) 1986 which has exchange rate market deregulation as one of its major instrument to move the nation forward. However, the major objectives of SAP which include among others the attainment of price and exchange rate stability and sustainable growth has not been fully realized. Therefore, this study focuses on investigating and answering conceptual and policy questions such as: Do exchange rate and its volatility really matter in determining the level of employment in the manufacturing sector in Nigeria? Through which specific transmission channels do exchange rate impact on employment? An appropriate understanding of these questions can help policy makers in their attempts to improve the level of employment in Nigeria via exchange rate stabilization policies.

#### **Manufacturing sector performance in Nigeria:**

Manufacturing activities have significant impact on the economy of a nation as their contributions which account for a substantial proportion of total economic activities play a crucial role in the development process of any economy. In 2008, Nigeria manufacturing accounted for 4.13% of the Gross Domestic Product (GDP) down from 11.05% in 1980.

In terms of employment generation, manufacturing activities accounted for about 12% of the labour force in the formal sector of the nation's economy but aggregately, accounted for about 6.77% of the labour force in year 2008. Before independence, Nigeria with its large population notwithstanding had very little industrial

development; a few tanneries and oil crushing mills that processed raw materials for export. During the 1950's and 1960's, a few factories including the first textile mills and food-processing plants, opened to serve Nigerians. During the 1970's and early 1980's industrial production increased rapidly, principally in Lagos, Kaduna, Kano and Port Harcourt. Factories also appeared in smaller, peripheral cities such as Calabar, Bauchi, Katsina, Akure and Jebba due largely to government policies encouraging decentralization.

Nigeria's major manufactures are food and beverages, cigarettes, textiles and clothing, soaps and detergents, footwear, wood products, motor vehicles, chemical products and metals. Smaller-scale manufacturing businesses engage in weaving, leather making, pottery making and woodcarving.

The smaller industries are often organized in craft guilds involving particular families who pass skills from generation to generation. In an attempt to broaden Nigeria's industrial base, the government invested heavily in joint ventures with private companies, since the early 1980's. The largest such project is the integrated steel complex at Ajaokuta, built in 1983 at a cost of \$4 billion. The government has also invested heavily in petroleum refining, petrochemicals fertilizers and equipments for assembling automobiles and farm equipment. In terms of the manufactured goods used within the Nigerian economy, it is of interest to examine the level of indigenous production as oppose to the imported manufactured goods as this shows the pattern of employment in the country. In Nigeria from independence to date, importation has been on the increase in which export has not for 1 year catch up with the level of import. Nigeria has aspired equilibrium in trade balance in the past by designing different forms of trade and exchange rate policies.

A number of reform measures have been carried out by successive government, however the extent to which these policies have been effective in promoting non-oil export has remained unascertained. This is because despite government efforts, the growth performance of Nigeria's non-oil export has been very slow. Generally speaking, manufacturing is underdeveloped in Nigeria. Much of the nation's modern industrial activity involves the processing of raw materials; processed foods which are largely consumed by Nigeria's expanding urban populations while raw materials such as minerals, petroleum and timber are processed almost entirely for export. The bulk of the rest of Nigeria's manufacturing output consists of consumer goods such as textiles, footwear beverages and soap which are largely sold and used within the country rather than being exported. The

technology used in manufacturing ranges from rudimentary tools used in small-scale cottage industries to large-scale factories. Although, its impact on the national economy is frequently underestimated, the cottage industry sector of the economy produces significant amounts of goods both for local consumption and for the tourist trade.

Textile and footwear plants on the other hand can be sizable, often requiring modern machinery. Heavy industry such as the production of metal cars, motorcycles, bicycles and household appliances is limited in Nigeria. Nigeria manufacturing grew in the 1960's and 1970's as the real manufacturing output rose from ₦114 million in 1960 and ₦15634 million in 1982 but declined in the 1980's and 1990's as it dropped from ₦15634 million in 1982 and ₦14935 million in 2001.

After this period of fall in output, real manufacturing output started rising as it moved from ₦16431 million in 2002 and ₦27905 million in 2008. The reflection of this is shown in Table 1 as manufacturing real output contributed 6.98% to total output but decline in its contribution during both SAP and post SAP periods to 5.78 and 4.23%, respectively.

In terms of employment generation, manufacturing contributes mean value of 12% to total employment in the pre SAP period increased to 13.45% during the SAP period but later decline to 10.06% during the post SAP period. Talking about the employment growth experienced, the pre SAP period is characterised with a mean growth of 2.6% year<sup>-1</sup> while the SAP period experienced a declining growth of 0.9% and the post-reform period is characterised with a fall of 3.94%. Referring to its export growth performance more volatility is observed than real output and employment. It increased from a mean growth of 20.74% year<sup>-1</sup> during pre SAP to 121.95% during the post SAP reform period. In terms of its aggregate contribution to export, it is of little importance as the economy till today solely depends on oil as its major source of income (Annual budgets are prepared in Nigeria based on the present and projected price of crude oil).

After the dominance of agriculture in the early 1960, Nigeria's economic progress continued to be dominated by the remarkable oil boom. Oil revenue rose from 4.4 million in 1960 to 489 million in 1971 when it accounted for 73% of export earnings and to \$6.1 billion in 2008. In order to mitigate the problems facing the manufacturing industry in Nigeria, various measures have been put in place. Beginning from the period of independence, Imports Substitution Industrialisation (ISI) strategy was pursued as a means of transforming the real sector, particularly the industrial sector. This strategy

Table 1: Indicators of manufacturing sector performance in Nigeria.

Indicator	Pre SAP reform period (1970-1985) (%)	SAP reform period (1986-1993) (%)	Post SAP reform period (1994-2008) (%)
Contribution to total output (RGDP)	6.9800	5.780	4.2300
Output growth performance	40.6500	2.800	4.4800
Contribution to total export	0.3000*	0.450	0.3200
Contribution to non-oil export	8.0000*	14.600	16.7000
Export growth performance	20.7400*	23.160	121.9500
Contribution to employment	12.0000	13.450	10.0600
Employment growth performance	2.6000	0.900	-3.9400
Exchange rate (₦ to \$)	0.6681	9.373	86.6410

Figures computed from data generated from CBN Statistical Bulletin, United Nations Statistics Division-national Accounts, National Bureau of Statistics, National Account of Nigeria and National Rolling Plan. \*Shows that the result is derived from 1980-1985

requires that some goods that hitherto being imported be produced locally. This is to make the economy to be self reliant thereby, reduce vulnerability of the economy to negative external shocks and promote balance of payments viability. This strategy was also aimed at promoting activities in the manufacturing sector with the intention that it will have backward linkages with the agricultural sector in terms of input sourcing and forward linkage with the external sector in terms of promoting export of manufactured goods (Egwaikhide, 1997). Among other objectives of the strategy were to promote small and medium scale industries and persuasion for consuming locally produced goods and services.

To make the strategy work effectively, import was discouraged throughout the period covered by the strategy. In 1972 and 1977, the government of Nigeria implemented another strategy to promote indigenous and private participation in the manufacturing sector through the Nigerian Enterprises Promotion Decree (Indigenisation Decree). These strategies are characterised with the reservation of certain activities exclusively for Nigerians and specified others in which indigenous ownership can be a minimum of 40%. The government provided incentives such as tax holidays, high rate of protection (through tariffs and non-tariff barriers) etc., with a view to inducing foreigners to invest in real sector activities.

In 1986, Nigerian government adopted the Structural Adjustment Programme (SAP) against the conditions of persistence macroeconomic crises in the mid 1980's. SAP was an economic reform programme which contains macroeconomic adjustment and stabilisation measures such as trade liberalisation, currency devaluation, etc. The post-SAP reform period features mixed trade policy stance. While the promotion of export continues some controls were exercised on imports. Against the upward trend of the parallel market premium, foreign exchange market witnessed various reforms in terms of determination of the official exchange rate.

**Review of some empirical literature:** In the past, many researchers have explored the relationship between real

exchange rate volatility and manufacturing employment. Different methodologies employed have resulted in different results some contradictory to past evidences where some in support as the case may be. The empirical results of these studies however were ambiguous and mixed (Campa and Goldberg, 1999) therefore, a conclusive remark as not been reached. This is not surprising as output effect of exchange rates (which is expected to be highly correlated with employment) (Changes in employment are linked to changes in output via a production function) is transmitted via the trade balance and the foreign trade multiplier. Because the conclusions of the theoretical models of the trade effect of exchange rate movement are ambiguous, this abates the possibility of concluding a significant systematic relationship between the exchange rate and employment. Most of the empirical works on the subject of this study concentrated more on the disaggregated level.

The concern has mostly been with the manufacturing sub-sector where most of the work done has concentrated on a particular country. The presumed relationship in these studies is negative that is an appreciation of the currency is expected to lead to a decrease in employment and vice versa. Some empirical studies established that exchange rate fluctuations have significant negative effect on employment (Alexandre *et al.*, 2009; Demir, 2008; Frenkel, 2004; Nucci and Pozzolo, 2004; Goldberg and Tracy, 1999; Burgess and Knetter, 1996; Revenga, 1992; Branson and Love, 1987). Some studies on the other hand, found weaker implications of exchange rates for employment but more pronounced effects for wages (Campa and Goldberg, 1999; Goldberg and Tracy, 1999). Some studies established positive relationship between exchange rate and general employment (Ngandu, 2008). While study like Adewuyi (2005) has even established that trade policy variables have no significant effect on the manufacturing wage and employment in Nigeria during the SAP reform period.

According to Alexandre *et al.* (2009) in their study of 20 manufacturing sectors in Portugal between 1988 and 2006, they established the role of degree of openness and

the technology level as factors that mediate the impact of exchange rate movements on labour market developments. According to their estimations whereas employment in high-technology sectors seems to be relatively immune to changes in the real exchange rates these appear to have sizable and significant effects on highly open low-technology sectors. In order to assess the roles of openness and technology in the sensitivity of employment to exchange rate movements they computed exchange rate elasticities of employment for different degrees of trade openness. They found out that the interaction between the exchange rate and openness is statistically significant and positive. The analysis of job flows according to the study suggests that the impact of exchange rates on these sectors occurs through employment destruction. This result seems to support the result of a study titled Job Creation, Job Destruction and the Real Exchange Rate by Klein *et al.* (2003) where it was established that the effect of the exchange rate on employment is magnified by trade openness. In their study, they measured industry openness using a 5 years moving average of the ratio of total trade to total market sales.

Demir (2008) specifically pay attention to exchange rate volatility and employment growth in developing countries, making Turkey his evidence. The study suggested that exchange rate volatility has a statistically and economically significant employment growth reducing effect on manufacturing firms. Using point estimates, the results suggested that for an average firm, a one standard deviation increase in real exchange rate volatility reduces employment growth by 1.4-2.1% points. In further discussion, the study explains that increasing (appreciating) real exchange rate can reduce employment growth through decreasing export competitiveness or increasing import competition. It can also have a positive effect through falling cost of imported intermediate and capital goods. Frenkel (2004) presents a study with two main issues. The first one is the relationship between the Real Exchange Rate (RER) and employment in Argentina, Brazil, Chile and Mexico. The second one is the viability of macroeconomic policies intended to preserve a stable and competitive RER. The results show that both GDP and RER have an expected negative effect on the change in the national unemployment rates in the period covered (1980-2003). This result is also consistent with the findings of Ros (2004). All coefficients are highly significant (at 1%). On average in the 4 countries, a 10% increase in GDP is associated with a 14.9% unemployment rate fall, a 10% appreciation(depreciation) of the RER is associated with a 5.6% increase (fall) in the unemployment rate with a 2 years lag. Nucci and Pozzolo

(2004) in their study use firm level panel data drawn from two high-quality sources to study the relationship between exchange rate fluctuations and labour inputs in Italy. The results of the study confirm that exchange rate fluctuations have a significant effect on employment and hours worked. The coefficient measuring the effect of exchange rate variations through changes in the proceeds from foreign sales is negative and significantly different from zero; the estimated coefficient measuring the effect through the change in the cost of imported inputs is positive and it also statistically significant. Therefore, exchange rate depreciation causes an expansion in the number of hours worked in the subsequent year through the revenue side and a contraction through the cost side. Moreover, the effect stemming from the revenue side increases in absolute value with the share of foreign sales in total revenues while the effect on the cost side is increasing in the share of the firm's expenditure on foreign inputs in total costs. It is also established from the study that the effects of exchange rate fluctuations on labour inputs also depend on the degree of monopoly power of the firm. Nucci and Pozzolo (2004) also note that there are at least five ways in which firms with some degree of market power can adjust in response to a change in the exchange rate. Besides adjusting employment such firms can adjust output prices, wages and investment. This underscores the fact that intervening variables mediate the effect of changes in exchange rates on employment. According to Revenga (1992) both employment and real wages in US manufacturing industries are significantly affected by the real exchange rate fluctuations however, the implication of real exchange rates for real wages is less than for employment but still significant. In her viewpoint, the possible explanation for this result may lie in the characteristic of mobility across industries that labour possesses. As Hall (2005) points out, the behaviour of the labour market is inclined to both wage stickiness and an efficient link between recruitment and job-seekers which probably explains the weak effect of real exchange rate movements on real wages.

In addition, exchange rate volatility can directly affect firms' employment decisions through its effects on sales, profits and investment risk and planning of firms (Federer, 1993; Aizenman and Marion, 1999). It can also discourage international trade (assuming risk-averse investors) by raising the risk in international transactions (Kenen and Rodrik, 1986; Qian and Varangis, 1994). On the other hand, some studies found weaker implications of exchange rates for employment but more pronounced effects for wages. According to Campa and Goldberg (1999) in a research titled Employment versus Wage Adjustment and the US\$, explore the links between real exchange rates and

employment, wages and overtime activity in specific US manufacturing industries. The study established as oppose to the literatures reviewed above that exchange rate movements do not have large effects on numbers of jobs or on hours worked. More substantial effects are picked up in industry wages, especially for industries characterized by low price-over-cost markup ratios and in overtime wages and overtime employment. According to Campa and Goldberg industries with low price-over-cost markups and those with a less skilled workforce exhibit relatively larger employment elasticities but lower wage elasticities. Evidence in the study supports a statistically significant response of industry wages to exchange rate changes and a very weak statistical relationship between numbers of jobs and employment and dollar movements.

Goldberg and Tracy (1999) study the effect of changes in the US\$ exchange rate using labour market data disaggregated both by industry and state. They found that local industries differ significantly in their earnings, hours worked and employment responses to exchange rates. The effects of changes in the exchange rate also differed significantly between different regions of the US as in the study by Branson and Love (1987). Wages were significantly affected by the dollar exchange rate in eight of the twenty manufacturing industries studied. Employment was found to be negatively related to changes in the exchange rate in twelve of the industries. On average, dollar appreciations were associated with employment declines for both high and low profit margin industrial groupings.

The greater the export orientation of the industry the greater the negative effect on employment. Some of these effects were offset by the positive effect on the prices of imported inputs. Ngandu (2008) in his research titled Exchange Rates and Employment where he studied the South African economy also specifically pay attention to exchange rate and employment using the Computable General Equilibrium Technique. He claimed that whereas a partial equilibrium analysis that only focuses on the manufacturing sector might conclude that appreciation has a negative impact on employment taking into consideration the economy-wide impacts there can be an overall positive impact on employment from an appreciation. The four worst-affected sectors in terms of employment according to Ngandu include transport equipment, leather products, chemical products and footwear. The sectors that respond positively to the exchange rate include business services other producers other mining and medical and other services. While according to Adewuyi (2005) in his study titled Impact of Macroeconomic Policy Reforms on Wage and Employment: Evidence from Nigeria's Manufacturing Sector between 1970 and 2005 (pre-SAP reform, 1970-85):

SAP reform (1986-93) and post-SAP (1994-05) established that during the pre-SAP reform period, protectionism is unfavourable to the exportable sector in terms of labour wage and employment but favourable to the importable sector. The effects of trade policy on wage and employment differ by sector during this period.

The results for the SAP reform period suggest that trade policy reform did not impact positively on wage and employment of the manufacturing sector. However, the impact of trade policy reforms are more pronounced in the post-SAP reform period especially in the importable sectors of the manufacturing sector. Generally, according to Adewuyi, the trade policy variables have no significant effect on the manufacturing wage and employment during the reform period. From the foregoing, most of the empirical studies carried out have focused more on the developed and non-African economies, particularly the US economies. Few studies exist yet on the effect of exchange rate volatility on manufacturing employment on country like Nigeria. This study intends to fill this gap.

## MATERIALS AND METHODS

**Three transmission channels of exchange rate on employment:** Campa and Goldberg (1999) developed a theoretical framework where exchange rate influences manufacturing employment through three different channels. According to them, the three channels through which optimal labour demand is exposed to exchange rate movements are presented as:

$$\frac{\partial L^o}{\partial e} \frac{L^o}{e} = \frac{p}{\beta} \left( (1 + \eta^{-1}) kM + (1 + \eta^{*-1}) \chi - (\partial Q / \partial Z^*)^{-1} \alpha \right)^5 \quad (1)$$

The three transmission channels are through industry import penetration (M), export orientation ( $\chi$ ) and imported input use ( $\alpha$ ). From Eq. 1, e, p,  $\beta$ ,  $\eta$ , k,  $\eta^*$ , Q, Z\* represent exchange rate, the price of domestic goods labor intensiveness domestic product demand elasticity proportionality factor foreign product demand elasticity aggregate sales in the home market and imported productive inputs, respectively.

The framework explicitly shows that the role of exchange rates in labour demand is strongest in industries that impart pricing power to firms. This occurs when k is high and when demand elasticities are low. Thus, all else equal labour demand is most sensitive to exchange rates if foreign firms have pricing power in local markets. Product demand elasticities in both domestic and foreign markets also are important. The higher the price elasticity of demand facing producers and the lower the implied price-over-cost markups in the industry, the more responsive will be labour demand to exchange rates.

**Data and model specification:** The study adopts yearly observations for the period 1970-2008. This period is not extended beyond 2008 because of the shortcomings in generating the data sets used. Data for the study are mainly secondary and are sourced from the Central Bank of Nigeria (CBN), Statistical Bulletin, United Nations Statistics Division-National, Federal Office of Statistics, National Bureau of Statistics (NBS) Statistical Fact Sheets, National Account of Nigeria, National Manpower Board (NMB) Data File, National Rolling Plan and Nigerian National Petroleum Corporation (NNPC) Annual Statistical Bulletin. All variables are in logarithmic terms.

Flowing from the theoretical framework adopted from the research of Campa and Goldberg (1999), this study in its own scope limits itself to two channels of export orientation and import penetration since, there is a high correlation according to Campa and Goldberg between the import penetration and imported inputs use. Therefore, the specification of the model for estimation in this study is that Employment (EMP) is a function of Export Orientation Ratio (EXOR), Import Penetration Ratio (IMPR), Real Gross Domestic Product (RGDP), Oil Price (OILP) and Past Employment ( $EMP_{t-1}$ ). Thus, the relationship stated above can be represented as:

$$EMP = F(EXOR, IMPR, RGDP, OILP, EMP_{t-1}) \quad (2)$$

Equation 2 is transformed into an empirical model specification as:

$$EMP_t = \beta_0 + \beta_1 EXOR_t + \beta_2 IMPR_t + \beta_3 RGDP_t + \beta_4 OILP_t + \beta_5 EMP_{t-1} + \varepsilon_t \quad (3)$$

The constant term is represented by  $\beta_0$  while  $\beta_1, \beta_2$  are the coefficients to be estimated and  $\varepsilon_t$  is the stochastic error term. A priori expectation is that  $\beta_2, \beta_4, \beta_5 < 0$  meaning a negative relationship with employment and  $\beta_1, \beta_3 > 0$  meaning a positive relationship with employment. The EXOR is defined as (exports/GDP)\*real exchange rate and IMPR is defined as (imports/(GDP-exports+imports))\*real exchange rate; the RGDP is included as one of the explanatory variables to capture the distinctive effect of total output given the understanding that it is a major determinant in measuring the performance of an economy; OILP represents energy price which is expected to have a negative relationship with employment, meaning when there is an increase in energy price, cost of production increases and finally resulted to decrease in employment and EMP (-1) given the fact that whatever happens to present employment has its connection to the past situation of employment. The ARCH (Autoregressive Conditional Heteroscedasticity) and GARCH (Generalized

Autoregressive Conditional Heteroscedasticity) models are employed in this study in measuring exchange rate volatility and in identifying the link and impact associated with manufacturing employment.

As a preface to modelling the real exchange rate volatility using the GARCH approach, this study investigates whether the real exchange rate actually follow the autoregressive process. Therefore, the evidence of the existence of auto-correlation is established by employing the Lagrange Multiplier (LM) and the ARCH test. The results suggest that real exchange rate actually follows the autoregressive process in Nigeria and can be modelled as such. Since, higher order ARCH indicates persistence in the conditional variance the model is estimated as a GARCH (1, 1) process. The GARCH Model is therefore chosen because even with a small number of terms, it appears to perform as well or better than an ARCH Model with many terms. Therefore, we specify the conditional mean equation of the GARCH (1, 1) process as:

$$Y_t = c + X_t' \theta + \varepsilon_t \quad (4)$$

and conditional variance equation as:

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (5)$$

in which the mean equation given in Eq. 4 written as dependent variable (EMP) as a function of independent variables (EXOR, IMPR, RGDP, OILP,  $EMP_{t-1}$ ) and the error term. This equation is the major focus of our analysis in this study. The conditional variance equation specified in Eq. 5 is a function of three terms: a constant term:  $\omega$ ; news about volatility from the previous period, measured as the lag of the squared residual from the mean equation:  $\varepsilon_{t-1}$  (the ARCH term) and last period's forecast variance;  $\sigma_{t-1}$  (the GARCH term).

## RESULTS AND DISCUSSION

This study shows the empirical results of the study beginning with the time series properties of the variables used for estimation. This is meant to ascertain the appropriateness of the specification and determine the underlying properties of the data generating process.

**Unit root results:** Since, this study deals with time series macroeconomic variables which in most cases exhibit non-stationarity. Therefore in order to avoid spurious regression that might result from running regressions with non-stationary variables, this study will examine the time series characteristics of all the variables. The importance of this derives from the fact that estimation in the

presence of non-stationarity in variables usually leads to biased and inconsistent estimates of the standard errors of the coefficients. This situation is commonly referred to as being spurious. This could lead to misleading inference if appropriate technique is not applied to overcome the problem.

The Augmented Dickey Fuller, ADF and Phillip Perron, PP tests shown in Table 2 are employed in this study. All the variables are nonstationary at levels but when they are first differenced there is evidence that all variables are stationary at 1%. It follows that the variables in the model follow an I (1) process.

**Cointegration results:** Having established the unit root properties of the variables in this study, the combination of two or more nonstationary variables could be stationary if these series share a common long-run equilibrium relationship.

In this case, these variables are said to be cointegrated in other words each series deviates from its long-run mean value in response to a shock but all series will tend to move toward the common long-run equilibrium as the effect of the shock dies out. Thus, given the presence of nonstationarity in all the variables, this study further investigates if these variables are cointegrated employing the Johansen cointegration test (Table 3). The standard statistics used in the interpretation of the test are the trace statistic and the maximum Eigen value at given level of significance. The results establish that there are three cointegrated equations. Hence, provide strong evidence of long-run equilibrium relationships among the variables in the study.

**Estimation and interpretation of results:** The effect of real exchange rate volatility modelled with the aid of the GARCH Technique among other determinants of employment in the manufacturing sector in Nigeria is the main concern in this study. The result for both the conditional mean equation and conditional variance equation is stated respectively:

$$\begin{aligned} \text{LOG}(\text{EMP}) = & 2.34 + 0.12\text{LOG}(\text{EXOR}) - 0.08\text{LOG}(\text{IMPR}) - \\ & t = (1.1188) \quad (2.2970) \quad (-1.4171) \\ & 0.06\text{LOG}(\text{OILP}) + 0.08\text{LOG}(\text{RGDP}) + \\ & (-3.1249) \quad (4.5038) \\ & 0.08\text{LOG}(\text{EMP}(-1)) \\ & (5.2611) \\ R^2 = & 0.877, d = 2.2523 \end{aligned} \tag{6}$$

$$\begin{aligned} \sigma_t^2 = & 0.000176 + 0.786 \varepsilon_{t-1}^2 + 0.438 \sigma_{t-1}^2 \\ Tt = & (0.1837) (1.3797) (2.5163) \\ R^2 = & 0.8877, d = 2.2523 \end{aligned} \tag{7}$$

The first observation about the results is that the estimated mean equations have very high statistical significance, except for the influence of real exchange rate volatility through the import penetration ratio (import penetration channel) which stands not to be significant at a 15% level. Likewise, the variance equation exhibits good level of significance (2%) for  $\sigma_{t-1}^2$  the GARCH term) which signifies that error variance is a function of past error variance in the model but low level of significant for  $\varepsilon_{t-1}^2$  (the ARCH term) which signifies the impact of past errors or shocks in the equation. This observation is an

Table 2: Results of unit root tests

Variables	ADF				PP				Decisions
	Without trend		With trend		Without trend		With trend		
	Level	First diff.	Level	First diff.	Level	First diff.	Level	First diff.	
EXOR	-1.206	-6.753***	-3.021	-6.653***	-1.144	-7.363***	-3.021	-7.268***	I(1)
IMPR	-1.035	-6.481***	-2.864	-6.382***	-0.770	-8.147***	-2.896	-8.220***	I(1)
EMP	-1.215	-7.367***	-2.591	-7.302***	-1.028	-7.337***	-2.773	-7.282***	I(1)
RGDP	-2.277	-5.680***	-1.982	-5.980***	-5.360***	-5.697***	-1.757	-7.134***	I(1)
OILP	-0.140	-7.024***	-3.277*	-6.933***	0.208	-7.707***	-3.265*	-7.648***	I(1)

\*, \*\* and \*\*\*implies significance at 10, 5 and 1% level, respectively. Critical values for ADF and PP test are the following: In the model without trend; Level form: -3.616 (1), -2.941 (5) and -2.609 (10), First difference: -3.621(1), -2.943 (5) and -2.610 (19), In the model with trend: Level form: -4.219 (1), -3.533 (5) and -3.198 (10). First difference: -4.226 (1), -3.537 (5) and -3.200 (10)

Table 3: Johansen cointegration test

Hypothesized	No. of CE(s)	Trace statistic	Critical value (trace) at 5%	Prob.**(trace)	Max-eigen statistic	Critical value (eigen) at 5	Prob.**(eigen)
None*		255.1853	88.80380	0.0000	136.0825	38.33101	0.0000
At most 1*		119.1028	63.87610	0.0000	63.12652	32.11832	0.0000
At most 2*		55.97625	42.91525	0.0016	40.38336	25.82321	0.0003
At most 3		15.59289	25.87211	0.5256	9.739158	19.38704	0.6467
At most 4		5.853728	12.51798	0.4791	5.853728	12.51798	0.4791

The variables included in the regressions are: employment, export orientation ratio, import penetration ratio, oil price and real GDP, Lag interval (in first difference) is 1-1. The linear trend assumption is Intercept+trend in CE, trace and maximum Eigen value tests indicate 3 cointegrating equations at the 0.05 level; \*Denotes rejection of the hypothesis at the 0.05 level; \*\*Mackinnon-Haug-Michelis p-values



indication that exchange rate movement in Nigeria really follows the autoregressive process and that volatility in real exchange rate actually exists.

The e-views result of the GARCH Model is shown in Table 4. The result thus reveal that real exchange rate volatility is significant at 3% level in explaining the movement in employment in Nigeria’s manufacturing sector through export orientation channels while insignificant at even 15% level through the import penetration channels. However, the result shows that both channels examined in this study to check for the impact of exchange rate volatility on manufacturing employment carries a negative sign to the a-priori sign. This follows that as it is expected for a devaluation of exchange rate to improve the level of manufacturing employment in Nigeria through the export orientation channels, the reverse is the case.

Likewise as expected for devaluation to reduce manufacturing employment in Nigeria through import penetration channel, it is established from the result that devaluation eventually improves manufacturing employment through import and vice versa. The intuition behind this is as currency depreciation makes export goods to be cheaper it attracts foreign economies to demand more of such goods. Thus as there is the need for increase in production, more employees is also needed to match such level of production which finally leads to increase in employment. On the other hand as currency depreciation makes imported inputs to be more expensive, importation of such inputs reduces whereby contract production of companies that uses such inputs. As a result, this situation discourages recruitment and can further lead to retrenchment as the case may be. Analyzing the results further, the Export Orientation Ratio (EXOR) representing export orientation channel through which real exchange rate volatility impacts on employment in Nigeria’s manufacturing sector exhibits an unexpected positive relationship but significant, meaning has exchange rate depreciates, manufacturing employment also contract. This result is consistent with the findings of some scholar on the effect of exchange rate devaluation on trade and employment. Adewuyi (2005) in his study titled Impact of Macroeconomic Policy Reforms on Wage and Employment: Evidence from Nigeria’s Manufacturing Sector between 1970 and 2005 (pre-SAP reform (1970-85): SAP reform (1986-93) and post-SAP (1994-05)), established that during the pre-SAP reform period, protectionism is unfavourable to the exportable sector in terms of labour wage and employment but favourable to the importable sector. The effects of trade policy on wage and employment differ by sector during this period. The results for the SAP reform period suggest that trade

Table 4: Estimated GARCH regression (1970-2008)

Variables	Values
<b>C</b>	
Coefficient	2.341231
SE	2.092618
z-statistic	1.118805
Prob.	0.263200
<b>LOG (EXOR)</b>	
Coefficient	0.126215
SE	0.054948
z-statistic	2.297008
Prob.	0.021600
<b>LOG (IMPR)</b>	
Coefficient	-0.080263
SE	0.056638
z-statistic	-1.417141
Prob.	0.156400
<b>LOG (OILP)</b>	
Coefficient	-0.057376
SE	0.018361
z-statistic	-3.124888
Prob.	0.001800
<b>LOG (RGDP)</b>	
Coefficient	0.080327
SE	0.017835
z-statistic	4.503810
Prob.	0.000000
<b>LOG (EMP (-1))</b>	
Coefficient	0.800245
SE	0.152107
z-statistic	5.261069
Prob.	0.000000
<b>Variance equation</b>	
<b>C</b>	
Coefficient	0.000176
SE	0.000960
z-statistic	0.183745
Prob.	0.854200
<b>RESID (-1)^2</b>	
Coefficient	0.786141
SE	0.569793
z-statistic	1.379695
Prob.	0.167700
<b>GARCH (-1)</b>	
Coefficient	0.438352
SE	0.174208
z-statistic	2.516252
Prob.	0.011900
R <sup>2</sup>	0.902891
Mean dependent var.	14.963960
Adjusted R <sup>2</sup>	0.887718
SD dependent var.	0.298237
SE of regression	0.099935
Akaike info criterion	-1.756858
Sum squared resid	0.319583
Schwarz criterion	-1.369009
Log likelihood	42.380300
Hannan-Quinn criter	-1.618864
Durbin-Watson stat	2.252330

Dependent variable: LOG (EMP); Method: ML-ARCH; Date: 09/09/11  
 Time: 08:52; Sample (adjusted): 1971 2008; Included observations: 38 after adjustments; Convergence achieved after 106 iterations; Presample variance: backcast (parameter = 0.7); GARCH = C(7) + C(8)\*RESID(-1)^2 + C(9)\*GARCH(-1)

policy reform did not impact positively on wage and employment of the manufacturing sector). This result can be attributed to the deficiency in the Nigeria economy

where >85% of the country's export earning in 2008 comes from a sector (oil) that contributed only 1.38% to total employment in 2008.

Therefore, given the limitations of petroleum industry in employment generation in Nigeria, a result like this is not expected to be strange as such. From the above, it is established from this study that real exchange rate impact on manufacturing sector's employment in Nigeria through its impact on export. Likewise, the Import Penetration Ratio (IMPR) the second channel considered for this study also, established an unexpected negative relationship but in this case not significant. This means from the findings of this study, real exchange rate volatility does not have a notable effect on the level of employment in the manufacturing sector in Nigeria through its impact on import. Other variables included in this study prove their inclusion important as their significant level stand at 1%. Real Gross Domestic Product (RGDP) is found to be positively related to manufacturing employment in Nigeria as expected. By implication, it means an increase in aggregate output causes an increase in the level of manufacturing employment. The intuition behind this is that as output increases more labour is recruited to keep pace with the increase in output. Oil Price (OILP) also established its negative relationship with employment. This is expected because an increase in oil price increases the cost of production which in turns reduces production and finally translated to employment reduction.

One period lagged Employment (EMP(-1)) also exhibits the expected positive relationship with employment as increase in one period lagged employment is expected to have its positive effect on present manufacturing employment. In addition,  $R^2$  value shows that 89% of the variations in the rate of manufacturing employment are accounted for by the respective explanatory variables employed in the study. The Durbin-Watson statistic stood at a satisfactory value of 2.25 and greater than the  $R^2$  value as expected ( $DW > R^2$ ).

A value of DW near 2 indicates absence of autocorrelation in the disturbances. This explains that the result from this regression is reliable as it does not show an evidence of spurious results. The basic GARCH (1, 1) results are given in the variance equation section of Table 4 which indicates that it took the algorithm over 106 iterations to maximize the likelihood function and computed standard errors. The three coefficients in the variance equation are the intercept, C; the first lag of the squared residuals, ARCH (1) and the first lag of the conditional variance, GARCH (1). Standard errors, Z-statistics (the ratio of coefficients and standard errors) and probability values complete the table.

## CONCLUSION

This study investigates the effects of real exchange rate movements on employment in the manufacturing sector in Nigeria between 1970 and 2008 employing Campa and Goldberg (1999)'s model and utilizing Generalized Autoregressive Conditional Heteroscedasticity (GARCH) methodology for analysis. This study examined two channels through which real exchange rate can impact on manufacturing employment; the export orientation channel and the import penetration channel. In theory, real domestic currency depreciation has three effects for an industry: First, it stimulates net exports and thus the demand for goods and services of an industry, thereby increasing the level of employment and wages.

Second, it raises the cost of imported intermediate goods or inputs: in the face of increasing marginal cost of production an industry thus lowers the demand for labour and wages. Finally, due to uncertainty about the marginal profitability as naira loses value against other currencies in real terms investors tend to lower their demand for domestic currency because a foreign currency can bring them higher capital gains than the domestic currency. Combining these three effects, real currency depreciation therefore leads to a contractionary or expansionary effect on an industry.

Major findings of the study can be summarized as follows. The role of real exchange rate volatility on manufacturing employment in Nigeria is controversial. According to theory, it is expected that exchange rate be negatively related with manufacturing employment on the export side and be positively related with manufacturing employment on the import side. On the export side, its means currency depreciation increases manufacturing employment and currency appreciation reduces it. However, this study established a positive significant relationship which implies currency depreciation results to reduction in manufacturing employment and currency appreciation results to increase in manufacturing employment during the period covered by this study. This result therefore calls for proper diversification of the country's economy to accommodate and improve the role of other sectors; particularly manufacturing that has a greater potential to contribute to employment generation than the dominant oil sector.

On the import side, it is expected that currency depreciation will reduce manufacturing employment and currency appreciation increases it (positive relationship). However, this study reveals that real exchange rate volatility has a negative insignificant effect on manufacturing employment in Nigeria through import. The insignificant relationship in this case means that real

exchange rate volatility does not have a notable effect on the level of employment in the manufacturing sector in Nigeria through import. This result therefore calls for policy makers' attention in the area of technological advancement in Nigeria's manufacturing sector's so as to boost its production scale. Gross output and oil price flow well in the model as their significant respective positive and negative relationship with manufacturing employment is adequately established.

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