
ESTIMATING SHORT RUN AND LONG RUN MACROECONOMIC MODEL OF NIGERIAN ECONOMY: A BOUND TEST APPROACH

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Abstract: Macroeconomic model have recently attracted the attention of the researchers and policy makers across the globe especially in the area of policy analysis. Although different model was developed at different time to answer the question yet not solve, however, not all the model can capture economic structure at the same time. Based on the structural imbalance in the Nigerian economy, we therefore capture short run and long run macroeconomic model in Nigeria for the period of 1970 to 2014 using employed autoregressive distributed lag (ARDL). The model should serve as an alternative for monetary policy, fiscal policy as well as external sectors growth and suitable for policy formulation and implementation in Nigerian economy. The results from the estimates reveal that long run model perform better than short run model in Nigeria under the period of study. It was further identified that fiscal expansion and tax revenue will be more effective towards achieving sustainable development but this will be recognize only when there is no structural changes in the especially when using taxation as a fiscal instrument. Evidence from finding shows that exchange rates has serious implication to the Nigerian economy in the model, hence its recommended to be set aside especially in designing monetary policy.

Key words: Macroeconomic Model, ARDL, Open E

Introduction: Macroeconomic models was developed as a tools that can aids in formulation and implementation of policy to a targeted sectors, the model can be clearly selected in line with the economic theory and structure of a given economy. Basically, in the literature, there are different types of models, but two most important ones can be identify to be macroeconomic models mostly for policy analysis and forecasting, these are macroeconomic models and dynamic stochastic general equilibrium model (DSGE). However, constructing such models depend on how policy makers need to address certain issues, purpose of the model as well as the complexity arises from the economy so as formulate and implement certain economic policies. Over the years, the study of macroeconomic models can be seen from the angle of testing macroeconomic theories, simulating the effects of an alternative policies situation, and forecasting the structural changes in the economy. The history of macroeconomic models can be traced back to the work of Jan Tinbergen (1939), Keynes (1940). Since then, substantial research from the policy makers and academician was devoted toward understanding the macro models that capture major economic policies and external sector fluctuations across the globe. Among the earliest models developed include, Klein and Goldberger (1955), Duesenberry, et al. (1965), Sachs (1991), Gagnon (1991), and Helliwell, et al. (1990), Previous macroeconomic models of Nigeria Naseer (1983), Soludo (1995), Kahede (1998), Oloafin (1997) Uwujere (1997), Osinubi (2005), Udah (2005) Charles et al. (2011), Adebayo (2012) Despite the development and implementation of several policies in the last three decade, however, the

performance of macroeconomics indicators remains unstable in Nigeria without much improvement as there is evidence of growing poverty, unemployment and record of low economic growth in the Nigerian economy. Following the structural changes that takes place in Nigerian economy especially with fall oil price shock, exchange rates depreciation, inflation dynamics, the objectives of the research is to re – construct macroeconomic model in Nigeria, its main objectives its estimate short and long run dynamic macro models using autoregressive distributed lag model (ARDL) such model could use in addressing the issues and major challenges in alternative monetary policy, fiscal policy as well as external sectors growth .

2.0 Literature Review: Soludo (2002) gives details background to the macroeconomic modelling, macro modelling serve as a tools for policy making and analysis, this has a long been in existence since the works of Tinbergen in 1936 in the Dutch economy as well US economy in 1939. However, considerable effort has been put in place to construct a lot of numbers of model a single country specific, regionals, cross country differences and world model economy. However, the number of the model widely applied can be categorically classified as: The IS-LM-AS Macroeconometric Models, World Bank Model, Micro-Based, Multi-Sectoral Models. Substantial research was conduct to the application of macroeconomic model across the globe, these models were applied using different estimation at different time leading to different results and policy making in those countries these includes: Were at al. (2013); A. Al-Muatwaa (1991); Asari et al (2011) and Soludo (1994). Rotatori et al. (2007) utilized time series

analysis to study macroeconomic model and the role of theory in modelling framework in Brazil in 1986, criticize the VAR approach to framing behaviour of and interpretation of economic model. The research suggest an alternative approach based on the 'LSE methodology' in modelling monetary system, the finding from the methodology allows a much more interpretable analysis based on two theoretical hypotheses, namely the Administered Exchange Rate Policy and a model for nominal wage inflation. The impact on industrial activity that arises from the nominal wage inflation, probably because of the accommodating monetary policy implemented in the period.

3. Methodology:The focus of the research is to estimate short and long run macroeconomic model in Nigeria for the period of 1970 to 2014 using autoregressive distributed lag model (ARDL). Eighteen Variables were basically been used.

3.1 Model Specification:

Output Block:Output at the aggregates level is considered to be equal to national income or total goods produces in the economy over a periods of time usually a year. Several theories was developed to explains the relationship between output and economic growth ranging from the classical, Keynesian and post Keynesian schools of thought. Therefore the growth rates equation is given as:

$$Y = f(T, I, g, reer, FD, \pi) \dots \dots \dots 3.1$$

Inflation Block:Inflation is rapid changes in the general price level in a given country. It's computed normally from consumer price index (CPI) which is a basket of goods and service arrived at, after survey of household units. This however, is adjusted normally after four years or from time by the monetary policy committee (MPC).Keynes was of the believed that when economy is at full employment, it will lead to an increase aggregate demand due increases in demand of investment which will leads to price to increase. Since consumer demand depends on real income, which is not reduced by rising prices because the sale of output at higher prices creates an equivalent rise in money incomes. If the M were constant an increase in the level of prices would raise transaction demand and thus pushup interest rate to eliminate the extra investment. Since some cash was extracted from the speculation to transaction then security prices would fall. This in turn removes part of excess demand. The classical economist establishes the relationship between quantity theory of money and price, meaning prices is a proportional to the changes in money supply and the direction is positive. However, with the degree of open economy and the nature of Nigerian economy there should a quite direction between inflation, exchange rates and oil price especially domestic monetary

policy, therefore the inflations is specify as a functions of the following:

$$P_t = f(M^S, I, Y, reer, oil, pt-1) \dots \dots \dots 3.2$$

Investment block:Investment can be seen as one of the key variables and component of aggregate demand. Changes in investment was assume to effect both demand and supply through expansion of the available stock and it well effected by other factors as well since it's been sensitive to changes by many factors. There has been theoretical models that provides explanation to the modelling of investment equation, this includes among others; simple accelerator, flexible accelerator model, Tobin's Q Model and neoclassical model given by Hall-Jorgenson. For this reason it's been included in the model.

$$Piv = f(mpr, pcr, y, oil) \dots \dots \dots 3$$

Monetary Sector block:

Money Demand:Classical economist was the basis to the explanation money demand function, with the development of financial sector and further empirical research the model of demand function was redefined. The traditional money demand was determined by two factors but this is summaries as a scale variable and opportunity cost variables. Mundell (1963) extended his analysis by introducing exchange rates among the variable to capture the influence of the fluctuation of exchange rates depreciation on domestic currency. Specifically the model is defined as:

$$M = (I, \pi^e, y) \dots \dots \dots 3.4$$

Taylor rules:The prototype operating rule contained in contemporary literature of monetary policy where given by the Taylor's rule. According to this view interest rate responds more than proportionately to changes in inflation to ensure its optimal use. Taylor (1993) has approximated the rule to only 2per cent in the modern monetary policy adjustments. According to this theory the sign of the inflation and output is to be 1.5 and 0.5 to ensure the overall objectives of monetary policy is achieved. This coefficient indicates the adjustment needed to attain full employment equilibrium, by implications nominal interest rates is adjusted when there is a slight change in the inflation or deviation of actual output from the targeted, his justified the need to include it in the models:

$$i_t = (i_{t-1}, \pi^e, y) \dots \dots \dots 3.5$$

External sector: This sector consist of three blocks, these are:

Exchange Rates Block:
$$e_t = f(M^S, Y, I, oilp) \dots \dots \dots 3.6$$

In standard open economy model, exchange rates can regarded as price of foreign good that used in the international payment. The pass thorough of exchange rates is considered to be important especially in designing of monetary policy, a rise in the crude oil prices is associated with the positive

effects on oil earnings in the Nigerian economy and accumulation of foreign reserve, this in turn cause an appreciation of exchange rate. Higher import prices, rises in price level and cause depreciation of the exchange rate. Evidence from findings indicates import price, oil price and price index have negative effect on the exchange rates in the model while The inclusion of the interest rate allows the money market, including the impact of monetary policy, to influence the pass-through relationship (Aliyu 2007) this is due to the rises in productivity and higher money there causing appreciation of exchange rates.

Real Export Block: $X_t = f(KA, Y, KA, REER)$3.7

The specification is imperative in the small open economy on Nigerian economy, given the importance and influences of financial market or monetary approach to the external sector, the has been a relationship between exchange rates, income and capital account where a positive relationship exist with the capital account, depreciation of exchange rates, and income

Real Imports Block: The need to specify import equation is also important so as to direct a policy towards stimulating export and discouraging importations. It should be note appreciation of exchange rates has positive effect on import, while a negative relationship exist with the capital account in terms of more payment attracted to the international payment in term of bond or changes in the interest rates. Therefore the export equation is given as:

$M_t = f(STIR, Y, KA, REER)$3.8

4.5.4 ARDL Modelling Approach to Cointegration Analysis:

The Autoregressive Distributed Lag (ARDL) modelling approach to cointegration analysis is utilized in the presence research. This is due to its ability to capture both stationary and non-stationary regressors and its simplicity in small sample analysis. In addition, it allows for identification of both long-run and short-run coefficients of explanatory variables Tang (2007). However, given both the Engle-Granger and the GLS-based cointegration tests, ARDL F - test possesses greater power than the two tests Cook (2006). Accordingly, the unrestricted error correction model (ECM) which follows the order of ARDL specification that capture both short run and long run is given as:

$$M_{it} = \beta_0 + \sum k_{it-1} + \dots + \sum \beta_2 k_{t-n} + \sum \Omega_1 L_{t-n} + \dots + \sum \Omega_t \text{LogFDIP}_{t-1} + u_t$$

Where:

M_{it} is the endogenous variables included in the model.

$\sum k_{it-1}$ is the n - numbers of exogenous variables to be included in the short run

$\sum \Omega_1 L_{t-n}$ is the long run multiplier within the context of ARDL model.

n is the number of lags to be included in the models.

4. Estimation and Analysis:

4.1 Unit Root Test: The variables under gone series of unit root test before further estimation if ARDL method, some of the variable are in $I(0)$ while others are in order $I(1)$. This was utilized using ADF and KPSS method of testing cointegration, the result of the test is not present at the analysis but is available when ever it's needed. The lag length criteria were selected based on SBC since it penalized more of adding regressors than the AIC.

Analysis using ARDL Output Block:

Long run Analysis: From the results coefficients taxation, of interest rate and government is but are correctly sign and statistically significance at 5%, but that of tax is not significant the positive confirm the revenue - spend hypothesis proposed by Friedman in 1978 that revenue collected from tax can be spend to enhance economic growth. Supporting the Peacock and Wise hypothesis consistence with the Petterson (2003) in Sweden government expenditure has positive effect in the economy. The coefficient of exchange also is correctly sign and it statistically different from zero; the findings do reflect that variation of exchange rate by 1 unit cause real output to fall by 50% this contradict with the findings from Kolapo and Ojo (2010) in Nigeria but consistence with Thirlwall (2000). The diagnostics checks of long run are satisfactory; the F- statistics is significance 92.6 and its corresponding probability values at the 1% level while the goodness of fit shows that 94 % variation of economic growth is explained by the explanatory variables.

$$\text{LNRGDP} = 1.954 + 0.052 \text{LNT} + 1.069 + 0.704 \text{LNSTIR} - 0.498 \text{LNG} + 0.014 \text{LNREER}$$

$$\text{Long Run Model: } \text{LNRGDP} = 1.954 + 0.052 \text{LNRGDP} + 0.052 - 1.069 \text{LNT} + 0.704 \text{LNSTIR} + 0.498 \text{LNG} + 0.014 \text{LNREER} + 0.015 \text{FD}$$

Short Run Estimates Based on SBC: $\text{LNRGDP} = 0.25 + 0.64 \text{LNRGDP}(-1) + 0.06 \text{LNT}(-1) + 0.29 \text{LNSTIR}(-1) - 0.31 \text{LNG} + 0.27 \text{LNREER} - 0.11 \text{FD} - 0.75 \text{ECM}$ The finding from short run is very important, the results reveal ECM is negative and significance at 5% level, hence cointegration in the model.

$$\text{Inflation block: } \text{INFL} = 1.607 - 0.39 \text{LNMPR} + 0.08 \text{LNRGDP} + 0.09 \text{LREER} - 0.50 \text{LNOILP}$$

Long Run Analysis: The analysis of inflation will start with estimation of long run determinants of inflation, the independent variable that is money supply, interest rates, oil price and real effective exchange rate is correctly but not significance except for the case of interest is which is significance at 5% percent level significance level, all thing being equal an increase in money, exchange rates will exert positive inflationary pressure in the economy, the

finding is in conformity with the Gybe and Boafa(2009), in Ghana, Ahmad (1970) also noted that excessive monetary expansion arising from government borrowing from the banking system to finance budget deficits generated strong inflationary pressures in the country and Ashwin (2014) in India. In addition interest rates however indicates a significance level at 5% , meaning a reduction of interest rates will attract new investors in the economy which will in turn effect production and increase income and hence inflationary pressure. Sign of exchange rates also implies that, an appreciation in naira increases the money availability in the economy which then raises current inflation. And also fails in the oil price in the world market in the previous year could lead to reduction in money available to the economy and thus lowers inflation in the current year. The finding is consistence with work of Andersson et al.(2009) in the European countries and Olatunji(2010) in south Africa. It was also examine the sign of economic growth is positive in conformity with economic theory but it's not significance. The diagnostics checks of long run are somehow satisfactory; the F- statistics is not significance at the 1% level but the goodness of fit shows that 90% variation of inflations is explained by the explanatory variables.

ShortRun Analysis: $INFL = 0.03 - 0.38LNFL (-1) - 0.08LNMPR (-1) - 0.37LNRGDP(-1) - 0.02LREER(-1) + 0.36LNOILP(-1) - 0.76 ECM$ In short run results indicate lagged value of dependent variables and explanatory variables. However the error correction terms is negative and significance at 5 % level using bound test because computed F- value from Wald test is 3.72 which is greater than upper critical bound test 3.28 given the degree of freedom, this implies there is long run relationship between inflation and money supply, real effective exchange rates, interest rates, and output in Nigeria under the period of the reviews. By implications 76 variations of the deviations is expected to converge towards equilibrium level to ensure full employment is achieved in the current period.

Monetary sector:

Money Demand BlockLong Run Analysis:The finding shows all variable are correctly sign and significance at 5% level. The positive signimplies changes in real income will cause an increase in demand for money, the coefficient is greater than unity 1.185 but the estimates do contradict with the transactionary and precautionary theory and supportive to the quantity theory of money and money can be considered as a luxury. The finding is in consistence with Barro (1996), Doguwa (2014) in Nigeria, Das and Mandal (2000) in india, and Anourou in Nigeria (2002).

$$LNRM2 = 0.19 - 2.05 LNSTIR - 0.06 LNIF + 1.18GDP$$

The diagnostics checks reveal that the model is significance looking at F- value, the overall long run is significance at 1% significance level and adjusted R² explained 49 percent explanatory power of the independent variables, both LM test and JB test are significance and the null hypothesis of cannot be rejected and model is normally distributed.

Short Run Analysis: $LNRM2 = 0.19 - LNRM2 (-1) 2.05 LNSTIR - 0.06 LNIF + 1.18GDP$

The short run demand for the is influenced by its own lag and lag value if the lagged value of the exogenous variables, lag value of money supply is negative showing that an increase in the past cash balances values will leads to decrease in money demand by 21%. The parsimonious error correction terms is negative significance, however the critical value from bound test from upper value is greater than wald test stand that Wald statistics is greater than lower bound test, hence inconclusive when long run relationship is expected.

$$LNRM2 = 0.23 - 0.21 LNRM2 (-1) + 0.17LNSTIR (-1) - 0.084 LNIF (-1) + 0.11LNGDP -0.47ECM$$

The finding shows goodness of fit is approximately 23 percent and adjusted 20%. In addition the model satisfied diagnostics checks of autocorrelation and heteroscedasticity. To determine the stability of money demand function, both CUSSUM and CUSSUM square was applied, the results reveal that null hypothesis cannot be rejected at 5% showing that broader money supply is stable under the period of the reviews.

External sector:

Exchange Rate Block:The findings shows a positive and significancerelationship between exchange rates and exogenous variables in long run expect oil price which is not significance at 10 % level respectively. All variable are correctly sign, a rise in oil price positively effects foreign reserve which make exchange rates to appreciates, while rise in productivity lead to higher income causing exchange rate to appreciates. The result indicates that one percent changes income will cause exchange rates to appreciate by 51 percent and this is significance at 1 % level. While a changes in the interest rates will more than one unit appreciation of exchange rates in Nigeria, this has a lot of important implication concerning the monetary policy. The overall model is fit as it shown by the R² 68 percent, while joint significance of the variables is significantly different from zero.

$$LNREER = -10.15 + 0.185LNRM2 + 0.52 LNRGDP + 1.67 LNMPR + 0.11LNOIP$$

Export Block :The model of export block reveal that capital account balance, income, and exchange rates has positive impact on exports in Nigeria and is statistically significance at 10 percent level, while a negative and insignificance with the interest rates, may be due to the fact that change in interest effect

investment and productivity in the given in Nigeria will eventually effect export earnig. The adjusted R^2 is 93 percent while F - value snd its corresponding probability value (0.00) which is significance, other diagnostic checks confirm the overall model is well fit as there is no evidence of autocorrelation and heroskedasticity.

$$\text{LNEX} = 6.52 + 8.18 \text{ KA} + 2.74 \text{LNREGDP} - 0.27 \text{LNSTIR} + 1.7 \text{LNREER}$$

Short Run Analysis: $\text{LNEX} = 0.22 + 2.1 \text{LNEX} (-1) - 4.18 \text{ KA} (-1) + 0.22 \text{LNREGDP} (-1) - 0.406 \text{LNSTIR} - 0.86 \text{LNREER} - 0.36 \text{ECM}$

In the short run income is not correctly sign while exchange rates and interest rates are negative which conform to the a priori expectation. But the ECM is negative and significance at 5 % level respectively indicating that the deviation of equilibrium is corrected toward equilibrium level at 37 %. The model is stable and there is no misspecification in the model.

5. Recommendation: Following the main findings the research therefore, recommended that:

(i) The long run effect was more apparent and serious than short run effect.

(ii) That interest rate system do not encourage investment in Nigeria, while credit to private sector has important role to plays in investment function while changes in oil price has important role to play but its role is discouraging through price effects.

(iii) Inflation in Nigeria can see as monetary phenomena this is consistence with the Gybe and Boafa(2009), in Ghana, Ahmad (1970).

(iv) Income is considered as luxury in long run while can serve as transactionary and precautionary purpose in short, while inflation and interest rates have role to plays in determinant of money demand and that money demand is stable has important implication when implementing monetary policy.

(v) That the coefficients of interest rate are reveals that that Taylor's rule can be applies when embarking monetary policy.

(vi) Exchange rates appreciation has serious implication the Nigerian country trade position, cannot be used as tools for correcting balance of payment position hence concludes to be reserves

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