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Exogenous Macroeconomic Variables and Nigerian Output: An Extension of the Taylor Rule and IS-MP-PC Model

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Abstract
This paper examines the current economy reality in Nigeria, where almost all the macroeconomic variable failed to normalize with fear and panic that we no longer understand the workings of the economy. Furthermore, this study extends the theoretical foundation of IS-MP-PC model and Taylor rule by incorporating net-export gains. Using quarterly data from 1971-2012, the study implements the ADF and PP unit root test to test the stationary properties of the series, the Johansen co-integration test to examine the existence of the long-run relationship and the error correction model for the short-run relationships. Overall findings reported that real output in Nigeria is negatively influenced by the adjusted exchange rate, real government deficit spending, expected inflation rate and world industrial output, and positively affected by net export and world interest rate. Appropriate policy options towards boosting the national outputs would help normalize the economy including the macroeconomic variables.
JEL Classifications: E31, E37, E59
Keywords: IS-MP-PC model, Taylor rule, exchange rate, deficit spending, world interest rate, net export

1.0 Introduction

The growing in macroeconomic problems and complexities have always been the major challenges facing the Nigeria economy, ever since the country began their endeavor to improve her standard of living. These macroeconomic challenges are: recession, depression, unemployment gap, stag inflation, balance of payment deficit, outflow of cash exchange rate fluctuation, output gap, and investment backwardness coupled with debt bondage. However, the desire of most individuals is to live and work within an economic framework which gives them the prospect of steady employment, relatively stable prices and a rising standard of living as being constrained. Some economists recognized that to achieve stabilization the economy must trade and pay its way with other economy.

Without doubt, it becomes imperative to set macroeconomic objective that aims at full employment, price stability and rapid economy growth, coupled with long run equilibrium in the balance of payments. With regard to the objectives, the most obvious difficulty is that the objectives, trade off against each other. At the present time, the policy instruments the government used to achieve the objective of lower inflation have imposed a cost of higher unemployment. Curbing the money supply has reduced the value of spending, and raised interest rates, resulting in the closure of many firms, with the loss of jobs. Curbing government spending as part of monetary policy has also reduced employment in the public sector. A higher exchange rate from dollar/Naira during 2011, 2012, and 2013 made Nigeria export expensive and import cheaper, reducing domestic output, increasing unemployment and decreasing investment. The monetary authority suggested a lower inflation achieved normalized the economy at high cost of unemployment. Other economists attempt to use the IS-LM model to decide between two major types of policy responses (fiscal and monetary policy) but there is still a gap between model and current economic reality as this policy as failed to predict financial crises and other related problems. The failure reflected from the causal mechanism in IS-LM model which suggests money supply as an exogenous variable, while, IS-MP reconsider monetary policy reaction as a touchstone for normalizing macroeconomic behavior.

Conversely, since there is no consensus as to the advisability of monetary accommodation of a supply-side shocks. The policy decision depends to some extent, judging the relative costs to the state of extra unemployment against extra inflation in Nigeria. David Romer (2000) suggests that the IS-MP model can give a better understanding of the consequence of monetary policy reaction to the economy in the short run output. Others argued that the Philip curve (PC) is also required since it provide a framework for accessing the tradeoff between unemployment, expected inflation and price shocks. Hsing (2005) claimed that the Taylor rule cannot be neglected in this regard as it shows the relationship between actual fed fund rate, the targeted inflation and output in the short run. This study attempts to validate all this proposition by adapting the extended the Taylor rule and IS-MP-PC model to investigate the exogenous macroeconomic variables and output in Nigeria.

This paper also recognized that, some erudite scholars have made several attempts to investigate the determinant macroeconomic variables in Nigeria, Chimobi and Uche (2010); Nenbee and Madume (2001);

Emeka (2009); Folawemo and Osinubi (2006); Osinubi and Amaghionyediwe (2009); Salibu and Nwosu (2006);Ayadi (2000) among others. Unfortunately, most of these previous studies were in inconclusive as further statistical work were require not only to validate their findings, but to logically reunite the recent economic theory with current economic reality. This study deviates from the previous one in Nigeria by adapting of the extended version of the IS-MP-PC model developed by Hall and Taylor (1997), Romer (2000), and Taylor (2001) by incorporating net export in analyzing the current exogenous shocks on the overall size of the Nigerian economy. In a clear-cut, the paper has several distinguished features: it is the first attempt to use IS-MP-PC model to investigate exogenous macroeconomic variable and output in Nigeria. The paper also clarifies the hypothetical policy difference of IS-LM and IS-MP. More significantly, the findings of the study would not only reveal the crucial role of exogenous macroeconomic variable in Nigeria economy, but will provide adequate measures for dealing with the trend in macroeconomic variables. Further, it will serve as a conductor for a pre-emptive appropriate policies guide in the economy.

The rest of this paper is presented in four sections: Section two focuses on the theoretical underpinnings as well as a review of previous studies while section three provides a robust description of the research methodology. In all, section four shows the analysis and empirical result of the study while discussion and possible policy recommendation are the focus of section five.

2.0 Literature review

The knowledge that exists today about the way the economy function is the result of prolonged research effort often involving intense controversy and an ever increasing data bank of experience (Blanchard, 1997).

Synge (1993) Nigeria-"*The Way Forward"* provides a review of the structure of the Nigerian economy. The limitation of this work is that its focus on the era of structural adjustment programs, in fact the analysis was limited to 1988-1991 period.

Chimobi and Uche (2010) investigate the relationship between money, inflation, and output in Nigeria using a cointegration and granger causality test analysis. The result suggests that monetary stability can contribute towards inflation and ensure price stability. Nenbee and Madume (2011) investigate the impact of monetary policy on Nigeria macroeconomic stability between 1970-2009 using cointegration and error correction model. The result revealed that monetary tools showed a mixed result in terms of the impact on inflation in Nigeria.

Salibu and Nwosu (2006) examine the effect of monetary policy on sectorial output in Nigeria over the period 1986-2008. The study utilized an Auto Regressive Distributed Lag (ARDL) the results indicated that monetary policy serve as a measure of ensuring stability.

Okonjo-Iweala (2007) reviewed Nigeria recent experience with economic reform and policy measures which were implemented. The paper reviewed economic reform programs, progress and challenges of policy implementation However the paper failed to address some key determinants of exogenous shock to the Nigeria economy.

Kutan and Brada (1998) studied the koruna crises in May 1997 and subsequent stag inflation with a decline in output and rising unemployment. They argued that the key problem of macroeconomics was relatively high inflation.

Friedman (2003) examines macroeconomic analysis issue such as the role of credit markets and how interest rates are determined by the central bank without using the LM curve. The paper claimed that LM model has little effect on policy impact in its findings. Pobre (2003) examines the macroeconomic and its policy implication. The study notice that tight monetary policy significantly affected investment and consumption expenditures, which, in turn where major economic slowdown in 1997. Lee (2001) evaluates the IMF's role in the Asian financial crisis and concluded the IMF underestimated the extent of the economic slowdown. This led to tightening of monetary and fiscal policy which have an adverse effect of the recession.

Olomola (2006) examines the impact of oil price shocks on aggregate economic activity (output, inflation, the real exchange rate and money supply) in Nigeria using quarterly data from 1970 to 2003. The findings revealed that, contrary to previous empirical findings, oil price shocks do not affect output and inflation in Nigeria significantly. However, oil price shocks were found to significantly influence the real exchange rate.

Emeka (2009) opines that the pursuit of price stability invariably implies the indirect pursuit of other objectives such as economic growth, which can only take place under condition of price stability and allocative efficiency of the financial markets, since inflation is generally considered as purely a monetary phenomenon, with significant cost to the economy. Folawemo and Osinubi (2006) examine the efficacy of monetary policy in controlling inflation and exchange rate instability using quarterly data spinning over 1980-2004.The study notes that monetary policy is a key determinant of inflation in Nigeria. Chuku (2009) soughts a controlled experiment using a structural vector auto regression (SVAR) model to trace the effects of monetary policy shocks on output and prices in Nigeria. He conducted the experiment using three alternative policy instruments; board moneyM2, Minimum Rediscount Rate (MRR) and the real effective exchange rate (RER). They found out that M2 is the

most influential instrument for monetary policy implementation.

Ayadi (2000) examines the effects of oil production shocks on a net oil exporting in Nigeria. The impact responses show that a positive oil production shock was followed by a rise in output, reduce inflation and a depreciation of the domestic currency. With the same methodology and a set of variables, except that oil price replaces its level of production. Kireyev (2000) examined 18 Arab countries using the mean-group estimator in a PVAR approach to analyse the effects of both internal and external shocks on macroeconomic movements. Kireyev found that oil shock was responsible for macroeconomic instability in this Arab country. Lescaroux and Migno (2008) in three panels of OPEC members, other major oil exporting countries and some oil importing countries investigated the links between oil prices and various macroeconomic and financial variables including GDP, CPI, unemployment rate and bond price. Using causality tests, evaluation of cross-correlations between the cyclical components of the series and cointegration analysis, they found various relationships between oil prices and macroeconomic variables in both the short and long run. In the long run, specifically, the causality generally running from oil prices to the other variables.

Darby (1982) estimated the impact of the 1973-74 oil price shock on real income in eight OECD countries. He was unsatisfied with the ability of the available data to distinguish among three factors that may have contributed to the recession: the oil price shocks; a largely independent course of monetary policy fighting inflation in the wake of the 1973 collapse of the Bretton Woods system; and a partly statistical partly real effect of the imposition. Jonas and Mishkin (2003) appraised inflation targeting for three transition countries including the Czech Republic. They found that the pursuit of inflation targeting has helped reduce inflation and their economies and suggested that the central bank should not actively manipulate with the exchange rate, should communicate more with the government and the public, and should avoid the over-shooting of the inflation target.

Wakeford (2006) considered the impact of oil price shocks on the South African macro economy. The study traced the history of oil shocks and their impact on South Africa. The findings reveal that while commodity exports-especially gold-provided an initial buffer, the economy was not immune to sustained price shocks. Bartleet and Gounder (2007) scanned oil price shocks and economic growth in Venezuela uses the Vector Autoregressive (VAR) methodology based on quarterly data. Three oil price measures were considered, following the various theoretical implications that oil price shocks have on economic growth. The authors analysed the short-run impact of oil price shocks in a multivariate framework which traced the direct economic impact of oil price shocks on economic growth as well as indirect linkages.

Bruneau and De Bandt (2003) indicated that a significant correlation of monetary shocks between Germany and France was found, whereas fiscal shocks were not correlated and that monetary policy has a more significant impact than fiscal policy. Their empirical results are consistent with the IS-LM model. Yu Hsing (2005) assessed macroeconomics shock in the Germany economy using the extending the IS-MP-IA model developed by Romer (2000) and applying GARCH (Engle, 1982, 2001) methodology. Hsing finds that equilibrium GDP in Germany is positively affected by stock market performance and real exchange rate appreciation and negatively influenced by the expected inflation and government deficit spending.

3.0 Method

The estimated model specifications employed in this study follow the works of Clark and Hsing (2005) where they apply the ***IS-MP-PC*** model and the Taylor rule in Korea. In their model, real gross domestic product (RGDP) are regressed on exogenous macroeconomic variables. The functional forms of their model equations represent a simple linear function, specified thus:

$$RGDP = f(AEXR, DFT, EIR, WIO, WIR) \quad \textbf{(3.1)}$$

Structurally, it is specified linearly as follows:

$$RGDP_t = \beta_0 + \beta_1 AEXR_t + \beta_2 DFT_t + \beta_3 EIR_t + \beta_4 WIO_t + \beta_5 WIR_t + \mu_t \quad \textbf{(3.2)}$$

Where; $RGDP_t =$ Real gross domestic product at time t; $AEXR_t =$ Adjusted exchange rate measured by nominal exchange rate in terms of the host currency per US dollar and is adjusted for relative price levels in the US and host country at time t; $DFT_t =$ Real government deficit spending at time t; $EIR_t =$ Expected inflation rate measured as a lag-period of inflation rate at time t; $WIO_t =$ World industrial output at time t; $WIR_t =$ World interest rate at time t; $\beta_0 =$ constant; $\beta_{1-5} =$ coefficients and $\mu_t =$ white noise residuals.

This model is found to be a useful tool for investigating determinants of economic growth in Nigeria since she actively implemented monetary, fiscal, and exchange rate policies to stimulate her economy during and after the Structural Adjustment Programme (SAP). Thus, it will be used to evaluate the effectiveness of

monetary and fiscal policies in Nigeria. In addition, the control variable (CV) included in this study was net export (NX) which measures the gains from liberalizing the Nigerian economy. Also, log values of the variables are used so as to report empirical results in growth rates, while the error correction term to test for the short-run effects of exogenous shocks on output growth is included, which is expressed in equation (3.3) as thus:

$$gRGDP_t = \beta_0 + \beta_1 AEXR_t + \beta_2 gDFT_t + \beta_3 EIR_t + \beta_4 gWIO_t + \beta_5 WIR_t + \beta_6 gNX_t + \alpha_7 EC_{t-1} + \mu_t \quad \textbf{(3.3)}$$

Where; $gRGDP_t =$ growth rate of real gross domestic product at time t; $AEXR_t =$ adjusted exchange rate measured by nominal exchange rate in terms of the host currency per US dollar and is adjusted for relative price levels in the US and host country at time t; $gDFT_t =$ growth rate of real government deficit spending at time t; $EIR_t =$ expected inflation rate measured as a lag-period of inflation rate at time t; $gWIO_t =$ growth rate of world industrial output at time t; $WIR_t =$ world interest rate at time t; gNX_t growth rate of net export (i.e. export minus import) at time t; $EC_{t-1} =$ one period lagged error correction term captured from long-run regression; $\beta_0 =$ constant; $\beta_{1-6} =$ coefficients and $\mu_t =$ white noise residuals.

Additionally, the model has several distinguishing features such as being the first attempt to use the IS-MP-PC model incorporating gains from trade liberalization so as to investigate macroeconomic impacts of exogenous shocks on the Nigerian economy; the Taylor rule is expanded to include the inflation gap, output gap, exchange rate gap, world interest rate and trade gains gap; the expanded IS-MP-PC model that accounts for international trade in the IS function, the exchange rate and the world interest rate in the MP function, and the inflation-unemployment trade off in the PC function will enable us to better understand macroeconomic relationships and monetary policy in an economy (Clark and Hsing, 2005) likewise in the case of Nigeria.

The error-correction model (ECM) derived from the long-run cointegrating vectors helps to determine the direction of causation among our variables in the two models. Nevertheless, the first step before testing cointegration and error correction model is to test the time series variables for their stationarity. Following the argument made by Engle and Granger (1987) that a linear combination of two non-stationarity series can be stationary and if it thus exists, the time series of such variables are considered to be cointegrated. Thus, indicates that the series have the same order of integration. Therefore, this study combines two conventional unit root tests such as ADF by Dickey and Fuller (1979, 1981) and PP by Phillips and Perron (1988) to confirm the validity of stationarity level (either difference stationary or trend stationary) in the data sets. Thus, the test equations are expressed as:

$$\Delta Z_t = \eta_0 + \eta_1 Z_{t-1} + \sum_{i=1}^{n} \pi_i \Delta Z_{t-i} + \nu_t \quad \textbf{(3.4)}$$

$$\Delta Z_t = \eta_0 + \eta_1 Z_{t-1} + \eta_1 t + \sum_{i=1}^{n} \pi_i \Delta Z_{t-i} + \nu_t \quad \textbf{(3.5)}$$

$$H_0: \quad \eta_1 = 0 \qquad H_1: \quad \eta_1 < 0$$

The time series variable is represented by Z_t and ν_t as time and residual respectively. Equation (3.4) and (3.5) are the test model with intercept only, and linear trend respectively. After the unit root test, Johansen cointegration test was used to determine the Trace and Maximum-Eigen value for our cointegration test. The specified multiple regression model (3.3) is estimated through the use of ordinary least square estimator and other time series diagnostic tests are employed such as residual diagnostic tests like Histogram normality test, Breusch Godfrey serial correlation LM test, and Breusch-Pagan-Godfrey (BPG) Heteroskedasticity tests to examine the level at which the estimated coefficient variance is inflated due to multicollinearity.

The time series data on real gross domestic product in US$ (RGDP), real government deficit spending in US$ (DFT), total trade in US$ (TTR),world industrial output in US$ (WIO), exchange rate [US$1=₦] (AEXR), expected inflation rate (EIR) and world interest rate (WIR) were sourced from the World Development Indicator (WDI) April, 2013. This time frame for this study covers the period of Pre Structural Adjustment Programme (Pre-SAP), Structural Adjustment Programme (SAP) and Post Structural Adjustment Programme (Post-SAP) era in the Nigerian economy within 1970Q1 to 2012Q4 fiscal year.

4.0 Results

The average growth value of real gross domestic product (RGDP) in ***Table 4.1***stood at 25.0%, which reveals that

the national output of the Nigerian economy grow at an average level of 25.0%.In addition, growth rate of adjusted exchange rate (AEXR), real government deficit spending (gDFT),expected inflation rate (EIR), net export (gNX), world industrial output (gWIO) and world interest rate (WIR) stood at 4.4%, -15.5%, 19.5%, 12.8%, 29.5% and 5.3% respectively indicating their annual growth rate within a quarterly period of 1971 to 2012. The probability value of the Jarque-Bera statistics for all variables shows their distribution level at mean zero and constant variance.Other statistical values presented in the table are minimum, maximum and standard deviation.

Table 4.1: Descriptive Statistics

	gRGDP	gAEXR	gDFT	EIR	gNX	gWIO	WIR
Mean	24.945	4.413	-15.466	19.531	12.747	29.496	5.246
Median	24.783	4.556	-21.498	13.613	21.708	29.799	6.028
Maximum	25.920	5.304	22.080	80.716	25.253	32.954	7.758
Minimum	24.477	3.050	-23.017	-0.022	-22.616	-30.119	2.220
Std. Dev.	0.3987	0.591	14.794	16.997	17.779	4.663	1.691
Jarque-Bera	39.311	13.105	146.861	105.19	50.242	178940.1	16.731
Probability	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Sum	4190.73	741.32	-2598.32	3281.12	2141.45	4955.3	881.34
Obs.	168	168	168	168	168	168	168

Source: Authors' computation, 2014.

The ***Table 4.2***below shows the correlation coefficients of the variables employed for analysis. All the independent variables have weak relationships with the dependent variable, where adjusted exchange rate (AEXR), growth rates of net export (gNX) and world interest rate (WIR) reported positive correlation values while real government deficit spending (gDFT), expected inflation rate (EIR) and world industrial output (gWIO) shown negative correlation values. The independent variables also demonstrate different level of association among themselves.

Table 4.2: Partial Correlation Values

	gRGDP	gAEXR	gDFT	EIR	gNX	gWIO	WIR
gRGDP	1.000						
gAEXR	0.318	1.000					
gDFT	-0.193	-0.237	1.000				
EIR	-0.197	-0.084	0.200	1.000			
Gnx	0.255	0.395	0.009	0.125	1.000		
gWIO	-0.094	0.010	0.017	0.016	-0.015	1.000	
WIR	0.483	0.566	-0.230	0.196	0.468	0.0145	1.000

Source: Authors' computation, 2014.

4.1 Unit Root and Co-integration Test Results

The results of the stationarity tests at levels and first differenced for all the incorporated variables based on Augmented Dickey Fuller (ADF) and Phillips Perron (PP) test were presented in ***Table 4.3***. The results indicated that only growth rates of real government deficit spending (gDFT) and net export (gNX) are stationary at levels i.e. I(0), while all other series are non-stationary at their level i.e. I(1) when combining all the two methods together. Thus, most of the series excepttwo variables are integrated of order one.

Table 4.3: Unit Root Test Results

Variables	Augmented Dickey Fuller Test (ADF)		Phillip-Perron(PP)		Remarks
	Levels	*First Difference*	*Levels*	*First Difference*	
Grgdp	0.036 (6) [-3.143]	-5.699 (5) [-4.016]*	-0.233 (3) [-3.143]	-5.034 (4) [-4.014]*	*I(1)*
AEXR	-2.499 (6) [-3.143]	-4.901 (5) [-4.016]*	-2.323 (6) [-3.143]	-4.627 (4) [-4.014]*	*I(1)*
gDFT	-4.596 (0) [-4.014]*	-13.459 (0) [-4.014]*	-4.749 (2) [-4.014]*	-13.932 (8) [-4.014]*	*I(0)*
EIR	-3.086 (11) [-3.144]	-5.333 (13) [-4.019]*	-3.086 (4) [-3.143]	-4.867 (4) [-4.014]*	*I(1)*
gNX	-5.851 (1) [-4.014]*	-8.225 (5) [-4.016]*	-5.224 (4) [-4.014]*	-12.145 (4) [-4.014]*	*I(0)*
gWIO	-0.746 (8) [-3.144]	-9.442 (4) [-4.016]*	-12.219 (7) [-4.014]*	-28.577 (4) [-4.014]*	I(1)
WIR	-1.179 (1';lkjg3) [-3.144]	-4.843 (4) [-4.016]*	0.287 (11) [-3.143]	-5.133 (4) [-4.014]*	*I(1)*

Note: ** significant at 1%; ** significant at 5%; *** significant at 10% Mackinnon critical values and are shown in parenthesis. The lagged numbers shown in brackets are selected using the minimum Schwarz and Akaike Information criteria.*

Source: Authors' computation, 2014.

Furthermore, the Johansen (1988) co-integration test was employed to test whether the linear combinations of the variables could result in a long-run relationship among the variables. The co-integration result is presented in ***Table 4.4***.From the output of ***Table 4.4***, it shows that the null hypothesis of co-integrating

vector is accepted at "atmost 3" and "atmost 4" co-integrating vector at 5% significance level denoting four and three co-integrating vectors respectively under the Trace and Maximum Eigen test.

Table 4.4: Co-integration Test Results
Hp: rank = p (no deterministic trend in the data)
Hr: rank r < p (co-integration relations)

Series:gRGDPAEXR gDFT EIR gNX gWIO WIR

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics		Max-Eigen Statistics	
		Likelihood Ratio	5% Sig. lev.	Likelihood Ratio	0.05 Crit. Val.
None *	0.316	189.804*	125.615	61.864*	46.231
At most 1 *	0.239	127.940*	95.754	44.402*	40.078
At most 2 *	0.189	83.539*	69.819	34.212*	33.877
At most 3 *	0.134	49.326*	47.856	23.350	27.584
At most 4	0.106	25.976	29.797	18.212	21.132
At most 5	0.042	7.765	15.495	6.971	14.265
At most 6	0.005	0.793	3.842	0.793	3.842

* denotes rejection of the hypothesis at 5% significance level. Likelihood ratio test of both Trace and Max-Eigen indicates 2 co-integrating equation(s)
Source: Authors' computation, 2014.

4.2 Long-Run Estimates

Table 4.5: Result for Long-run Estimates

Model: gRGDP C AEXR gDFT EIR gNX gWIO WIR

Variables	Inflation Gap	Output Gap	Exchange Rate Gap	World Interest	Trade Gain Gap	Overall
C	24.954	25.183	24.756	24.348	24.872	24.672
AEXR			0.0020*			-0.0016*
gDFT	-0.0043**					-0.0011
EIR	-0.0038**					-0.0081*
gNX					0.0057*	0.0020
gWIO		-0.0081				-0.0077
WIR				0.1137*		0.1475*
F-Stat	5.593	1.494	11.123	50.390	11.530	14.867
Prob.	0.005*	0.223	0.001*	0.000*	0.001*	0.000*

** significant at 1%; ** significant at 5%; *** significant at 10%*
Source: Authors' computation, 2014.

The long-run estimates from the model suggested a depreciation of the Naira, a lower real government deficit spending, a lower expected inflation rate, greater net export, a lower world industrial output and greater world interest rate will raise real national output in Nigeria. Only adjusted exchange rate reported different direction (i.e. sign) in relation to the overall test.

Specifically, a 1% point increase in the adjusted exchange rate would reduce real GDP by 0.002%. If real government deficit spending and expected interest rate rise by 1%, real GDP is expected to reduce by 0.11% and 0.81% respectively. An increase in the net export of 1% raises real GDP by 0.20%. A 1% increase in the world industrial output would reduce real GDP by 0.77%. Whilst, the world interest rate rises 1%, real GDP would increase by 14.8%. Exchange rate, expected interest rate and world interest rate are significant at 1% level, though; real government deficit spending and net export are significant at 5% and 1% level respectively in both inflation gap trade gain gap tests.

4.3 Over Parameterized, Parsimonious Regression Estimates and Higher-Order Test

The over-parameterized regression was presented in ***Table 4.6*** where the Schwarz Information Criteria (SIC) was used to guide the parsimonious reduction of the model.

Table 4.6: Over Parameterized Regression Estimates

Model 1: D(gRGDP)				
Variable	**Coeff.**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.0044	0.0009	5.1669	0.0000
D(AEXR)	-0.0006	0.0002	-3.1079	0.0023
D(gDFT)	-9.4E-05	8.1E-05	-1.1513	0.2515
D(EIR)	-2.2E-05	0.0003	-0.0643	0.9488
D(gNX)	4.5E-05	6.7E-05	0.6616	0.5093
D(gWIO)	-1.4E-05	0.0001	-0.1127	0.9105
D(WIR)	-0.0950	0.0237	-4.0164	0.0001
D(gRGDP(-1))	1.3746	0.0560	24.530	0.0000
D(AEXR(-1))	0.0008	0.0003	2.9820	0.0034
D(gDFT(-1))	-1.5E-06	8.0E-05	-0.0191	0.9848
D(EIR(-1))	-0.0002	0.0005	-0.2914	0.7712
D(gNX(-1))	-2.8E-06	6.5E-05	-0.0430	0.9657
D(gWIO(-1))	-3.7E-05	0.0001	-0.2542	0.7997
D(WIR(-1))	0.1379	0.0357	3.8607	0.0002
D(gRGDP(-2))	-0.7607	0.0566	-13.447	0.0000
D(AEXR(-2))	-0.0005	0.0002	-2.5037	0.0134
D(gDFT(-2))	0.0002	8.1E-05	1.9593	0.0520
D(EIR(-2))	9.6E-05	0.0004	0.2775	0.7818
D(gNX(-2))	-4.9E-05	6.9E-05	-0.7111	0.4782
D(gWIO(-2))	-4.3E-05	0.0001	-0.3378	0.7360
D(WIR(-2))	-0.0890	0.0239	-3.7335	0.0003
ECM(-1)	-0.0099	0.0054	1.8173	0.0711

Adj. R^2 = 0.848, *F-stat* = 44.41 (0.000), *DW* = 1.284

Source: Authors' computation, 2014.

The short-run estimates from the model were reported in ***Table 4.7***. The estimated coefficient for ECM (-1) of 0.0099 is significant at the 10% level. The Durbin-Watson statistic value of 1.559 indicates approximately that the absence of autocorrelation cannot be rejected. All the coefficients are significant at both 1% and 5% level. The adjusted co-efficient of determination revealed all the independent variables were able to explain 85.5% of the total variation in national income in Nigeria. Thus, this result denotes the non-spurious of the model when compared to the Durbin-Watson value. Our empirical findings suggest a lower adjusted exchange rate, world interest rate, lag-two of real GDP, lag-two of adjusted exchange rate, lag-two of real government deficit spending and lag-two of world interest rate will raise real output in the Nigerian economy. Also, a greater lag-one of real GDP, lag-one of adjusted exchange rate, lag-one of world interest rate and lag-two of world interest rate will raise real output in the Nigerian economy.

Consequently, a 1% point increase in the adjusted exchange rate, world interest rate, lag-two of real GDP, lag-two of adjusted exchange rate, lag-two of real government deficit spending and lag-two of world interest rate would reduce real GDP by 0.0005%, 9.6%, 75.7%, 0.0004%, 8.85% respectively. An increase in the lag-one of real GDP, lag-one of adjusted exchange rate, lag-one of world interest rate and lag-two of world interest rate of 1% raises real GDP by 136.4%, 0.0008%, 13.8% and 0.02% respectively.

Table 4.7: Parsimonious Error Correction Regression Estimates

Model 1: D(gRGDP)				
Variable	**Coeff.**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.0045	0.0008	5.4889	0.0000
D(AEXR)	-0.0005	0.0002	-3.0941	0.0023
D(WIR)	-0.0960	0.0211	-4.5487	0.0000
D(gRGDP(-1))	1.3637	0.0524	26.007	0.0000
D(AEXR(-1))	0.0008	0.0003	2.9450	0.0037
D(WIR(-1))	0.1377	0.0322	4.2844	0.0000
D(gRGDP(-2))	-0.7570	0.0530	-14.271	0.0000
D(AEXR(-2))	-0.0004	0.0002	-2.5001	0.0135
D(gDFT(-2))	0.0002	7.5E-05	1.9941	0.0479
D(WIR(-2))	-0.0885	0.0219	-4.0331	0.0001
ECM(-1)	-0.0099	0.0054	1.8173	0.0711

Adj. R^2 = 0.855, *F-stat* = 97.53 (0.000), *DW* = 1.559

Source: Authors' computation, 2014.

The ***Table 4.8*** below reports the model's probability values for the Jarque-Bera statistic value to be

statistically significant at 5%, which reveals that the estimated residual series are not normally distributed with zero mean and constant variance. The Breusch-Godfrey serial correlation test results also reported that we do reject the null hypothesis *"no serial correlation"* at 5% significance level, whereas for the Breusch-Pagan-Godfrey heteroskedasticity test, the result indicated that we do not reject the null hypothesis "*no heteroskedasticity*" at 5% significance level.

Table 4.8: Higher-Order Test

	Residual Normality Test	
Jarque-Bera	159.679**Prob(J.B)**	0.0000
	Breusch-Godfrey Serial Correlation LM Test	
F-statistic	29.06035 **Prob. F(2,152)**	0.0000
Obs*R-squared	45.64003 **Prob. Chi-Square(2)**	0.0000
	Heteroskedasticity Test: Breusch-Pagan-Godfrey	
F-statistic	0.403511 **Prob. F(10,154)**	0.9434
Obs*R-squared	4.212942 **Prob. Chi-Square(10)**	0.9372

Source: Authors' computation, 2014.

5.0 Discussion and Policy Options

The paper applied extended IS-MP-PC model and Taylor rule by incorporating net-export gains to investigate possible impact of exogenous macroeconomic variables on output in Nigeria. Major findings reported that real output in Nigeria is negatively influenced by the adjusted exchange rate, real government deficit spending, expected inflation rate, world industrial output and world interest rate but positively influenced by net export. There are several policy implications. The central bank needs to continue to maintain price stability and contain inflation because of the negative impact of rising expected inflation on output. The negative relationship between the deficit/GDP ratio and equilibrium suggests that fiscal discipline is needed. Recent increase in dollar/naira exchange rate gratified net export. Conversely, the overall impact of real appreciation of naira on the Nigeria output is negative, suggesting that the appreciation is a concern for the Nigeria output. The extended IS-MP-PC model and Taylor rule demonstrate a better understanding of the exogenous macroeconomic variables and output in Nigeria. In all, appropriate policy options towards boosting the national outputs would help normalize the economy and enhance macroeconomic reality.

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