External Economic Shocks and Monetary Policy Tools in Nigeria

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Abstract: **The study investigated the effect of external economic shocks on monetary policy tools in Nigeria for a period of 1990 to 2020. External economic shocks were measured though their passthrough variables of exchange rate (EXR), foreign direct investment (FDI), external debt (ED), and trade openness (TO); while monetary policy tools were considered in terms of broad money supply (M_2), monetary policy rate (MPR) and cash reserve ratio (CRR). The Zivot and Andrews test and the Bayer and Hanck combined cointegration tests were employed to to check for stationarity (with structural breaks) and cointegration among the variables. We then applied the autoregressive distributed lag (ARDL) test to determine the effect of the relationship between the independent variables and the dependent variable. The results of the structural indicated that there are structural breaks accounting for the existence of shocks, while the cointegration test showed that the variables are cointegrated. The ARDL test disclosed that external economic shocks (through EXR, FDI, ED, and TO) have significant effect on monetary policy variables. This study therefore recommends that the monetary authorities should safeguard the monetary operations in Nigeria from external economic mishaps that have spillover to the country by making allowance for the external economic shocks in setting these tools and putting in place mechanisms that can make these tools resilient and resistant to the shocks.**

***Keyword*: External economic shocks, monetary policy tools, Bayer-Hanck co-integration,**

Jel Codes: E4, E5, C01 and F3

I. INTRODUCTION

In the recent times, the global economy is increasingly becoming integrated, with rapid increase in trade and higher openness degrees. And the more integrated the world economies are getting, the more they share the good and the bad which comes unprepared (i.e., as external shocks) to an economy from another or others. These external shocks alter and determines new patterns and trends in the behaviour of economic variables in an economy. The developing economies are tend to bear the brunt of such external shocks. According Özler and Rodrik (1992) "the manner in which the political system responds to external economic shocks in developing countries is a key determinant of the private investment response." Due to international liberalization process, the Nigerian economy is assumed to be affected by external shocks at various levels including its policies like monetary policy.

Achieving monetary stability is one of the targets of economic policies. According to CBN (2019), the objectives of monetary policy, over the years, have remained the attainment of internal and external balance of payments. To achieve these, two major monetary policy phases – before and after 1986 – have been pursued. Whereas the *before 1986* (first) phase emphasized on direct monetary controls, the *after 1986* (second) phase relies on market mechanisms and is highly influenced by the movements in the external sector variables especially as the world becomes more and more a global village. Thus, monetary policy during the second phase has continued to be greatly shaped by developments in the global economic and financial environment. These external developments come most times as shocks that destabilize existing domestic equilibria, including those of monetary policy. Since the global economic/business environment had remained uncertain, thus creating more shocks, there is need to assess the effect of these on the performance of monetary policy tools in Nigeria. This will help in policy adjustments necessary to improve the performance of monetary policy instruments in the face of an ever-volatile external sector.

This paper, therefore, seeks to investigate the effects of external economic shocks on the performance of monetary policy tools in Nigeria by investigating the effect of exchange rate movements on monetary policy tools in Nigeria, examining the effect of foreign direct investment on monetary policy tools in Nigeria, analysing the effect of external debt on monetary policy tools in Nigeria, and assessing the effect of trade openness on monetary policy tools in Nigeria.

The paper is structured in the following order: following the introduction is section two which contains the review of literature; section three is the methodology of the study; section four presents the results and discussions; and section five contains the conclusion and recommendations.

II. LITERATURE REVIEW

Literature review was basically done under conceptual, theoretical and empirical reviews as below.

2.1 Conceptual Review

There are always natural and human related factors (usually as the result of events thought to be beyond the scope of normal economic transactions) that cause changes in economic variables. These changes are most times unpredictable, spontaneous, and produce long-lasting waves in the behaviour of economic variables and relationships. These come as

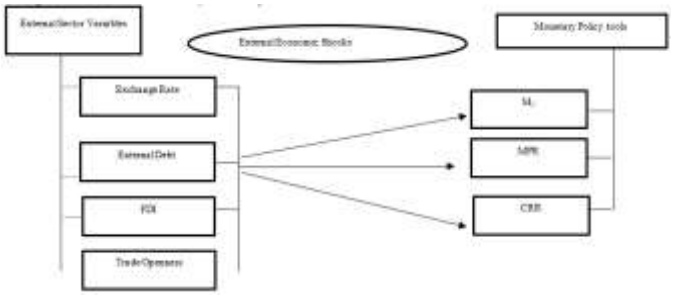
economic shock which exert change to fundamental macroeconomic variables or relationships leading to substantial effect on macroeconomic outcomes and the performance of economic policies such as monetary policy. It is these economic shocks that, according to real business cycle theory (RBC), are said to be the root cause of recessions and economic cycles.

An external economic shock is thus an unpredictable event that originates outside of an economy but is expected to have significant impact on it in a visible way. Examples include a sudden and sharp falls or rise in international prices of essential commodities like oil and other forms of energy, drastic decline in global aggregate demand and the outbreak of pandemics like the coronavirus. These exert pressures that distort the erstwhile established equilibria in an economy; thus, requiring much efforts to return to such equilibria (if deemed good) or establish new ones. External shocks occur when unpredictable change in an exogenous factor affects endogenous economic variables. Hence, economies that rely on foreign resources and foreign markets are more susceptible to external shocks than others. As Chami (1998) noted, unfavorable external shocks caused by a steep decline in the price of an export commodity can have serious implications for macroeconomic performance if the policy response is inadequate. He stated further that, a country's economic performance depends in part on how quickly and efficiently it reacts to external shocks, and that it is not so much the external shocks themselves as the domestic responses to them that determine a country's success or failure.

Economic policies are no exceptions from the influence of these external shocks. Such policies like monetary policies are deeply affected from the economic uncertainties that these external shocks bring. The external sector transmits its shocks to monetary policy through its tools which are the monetary instruments (or variables) with which the government (through its monetary regulatory bodies like the central bank) tries to achieve macroeconomic objectives like low inflation, high consumption, full growth and liquidity through the management of money supply and interest rates.

2.1.2 Conceptual framework

The schema below gives an abstraction of the relationship between external economic shocks and monetary policy tools. In this relationship, unpredictable changes in external economic variables (exchange rate, external debt, foreign direct investment, and trade openness) are transmitted to monetary policy tools thus causing their change and effectiveness.



Source: Authors' design.

Schema 1: Conceptual Model of External Economic Shocks and Monetary Policy Tools

In the face of any external economic shock, the country tends to use, as one of its weapons, monetary policy variables at its disposal to respond to these external shocks and steer the economy back toward a sustainable path and restoring macroeconomic balance. Through this, the monetary policy tools are themselves influenced and determined by these shocks.

2.2 Theoretical Review

Theoretical wise, there is a growing body of literature (like Backus, Kehoe, & Kydland; 1992 and Zimmermann; 1994, 1995) that are using business cycle theory to account international co-movement and external shock. It is almost a given that an economy witnesses a number of business cycles in its life, which involve phases of high or even low level of economic activities, and periods of economic expansion, recession, trough and recovery. The duration of such stages may vary from case to case and economy to economy. According to the business cycle theory theory, monetary shocks or expectation changes have no role to play in a business cycle. The real business cycle theory makes the fundamental assumption that an economy witnesses all these phases of business cycle due to technology shocks. Technological shocks include innovations, bad weather, stricter safety regulations, etc. The business cycle literature theory assumes that economic fluctuations are determined by external supply shocks, especially productivity and technological shocks.

To account for external shocks in the business cycle, given our real-world situation characterized by free trade, led to the International Real Business Cycle (IRBC) models by Bakus, Kehoe and Kydland (1992, 1994) and Zimmermann (1997) (Rzigui, 2005). These hold the belief that external shocks may affect business cycle fluctuations arguing that foreign technological shocks may affect domestic real activity. Extended from these is that others kinds of external shocks, including economic, can be transmitted to other country through international business transactions. Thus, these models provide an important role to external shocks transmissions in business cycle analysis on the theoretical as well as empirical levels. And it is on this theoretical proposition that this study was abased.

2.3 Empirical Review

For the many empirical literatures that exist on monetary policy, a greater portion rather focused on the effect of monetary policy on the outcomes of other economic variable, thus neglecting what influences monetary policy. In this list are works like Ridhwana, de Groota, Nijkamp, and Rietveld (2010); Anowor and Okorie (2016); Nwoko, Ihemeje, and Anumadu (2016); Ufoeze (2018); Jordà, Singh, and Taylor (2020). These works have deliberately or unintentionally viewed monetary from the angle of exogenous variable without

much care to what first cause the changes in monetary policy variables themselves.

Of the few that considered monetary policy as an endogenous variable are Filardo, Ma, and Mihaljek, (2011); Gokarn and Singh (2011); Mihaljek (2011); Moreno (2011); Pesce (2011); Takáts and Villar (2011); Ogbonna (2016); Olamide and Maredza (2019) who investigated policy variables that determine monetary policy and economic growth of some selected countries within the economic bloc of Southern Africa Development Community (SADC). Employing the dynamic regression panel model with panel data for a period of 1980–2015 collected from Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe, they found that GDP growth rate, inflation rate, exchange rate, money supply and oil and commodity prices do have profound impact on monetary policy within SADC. The study further revealed that commodity price shock is the major exogenous determinant of monetary policy dynamics and the effect is transmitted via exchange rate channel to macroeconomics of the region.

Ogbonna (2016) examined the effect of inflation and exchange rate on efficacy of monetary policy in Nigeria. They analysed the post SAP persistence of inflation in Nigeria for the period, 1960-2008 with exchange rate, money supply and trade balance as preferred influential variables. The results of the estimates from a vector auto regression model (VAR) suggest that in both time horizons, exchange rate has been identified as a singular most promising macroeconomic fundamental for both internal and external sectors adjustments.

Takáts and Villar (2011) assessed the impact of international banks' activities on the domestic financial system and monetary policy in emerging markets; how the new liquidity rules are likely to affect the operations of internationally active banks in emerging markets; and, in this light, how far banks in emerging markets might need to fund themselves by issuing long-term debt securities. They found that the differences between foreign and domestically owned banks in emerging markets have diminished over the past 15 years. International banks have significantly increased the lending provided from deposits collected locally in emerging markets. Their entry also seems to have improved competitiveness in local EME banking sectors. The new liquidity standards are can significantly strengthen EME banking system stability. In some cases, however, the new standards could result in lower cross-border and domestic bank lending in EMEs.

Filardo, Ma, and Mihaljek (2011) in their paper examined, among others, how long-run equilibrium exchange rates influence monetary policy strategies; and how monetary policy frameworks and actual decisions could incorporate exchange rate movements. They found that policy rates and exchange rate flexibility are critical tools in addressing the challenges facing EME central banks today, but there is no consensus yet on how best to incorporate exchange rate movements into monetary policy frameworks.

Georgiadis (2015) equally showed the effect the external sector shocks when he assessed global spillovers from identified US monetary policy shocks in a global VAR model. He discovered that US monetary policy generates sizable output spillovers to the rest of the world, which are larger than the domestic effects in the US for many economies. And that the magnitude of theses spillovers depends on the receiving country's trade and financial integration, de jure financial openness, exchange rate regime, financial market development, labor market rigidities, industry structure, and participation in global value chains. Also, the extent of spillover a country gets depends on whether it is an advanced or non-advanced economies. Furthermore, economies which experience larger spillovers from conventional US monetary policy also displayed larger downward revisions of their growth forecasts.

Others like Rzigui (2005); Oyelami and Olomola (2016); Oluleye and Horgan (2019); and Abere and Akinbobola (2020) have traced the effect of external economic shocks on the economy considering other economic variables and have found that these shocks affect the performance of these variables individually and aggregately. However, none of these works has sought to look at the impact of external economic shocks on the money policy tools as this works sought to.

III. METHODOLOGY

3.1 Variables and Data

Whereas the dependent variable, monetary policy tools, is represented by money supply (M_2), monetary policy rate (MPR), and cash reserve ratio (CRR), the external economy shock is proxied by the changes in the external economic variables. For this study, those considered are: exchange rate (EXR), foreign direct investment (FDI), external debt (ED), and trade openness (TO), the trade-to-GDP ratio that measures the degree of openness of a country's economy to international trade. The measurements of these are as determined by the respective standards.

Time series data was collected about these variables from the Central Bank of Nigeria (CBN) and the World Bank records. These were used for the analysis.

3.2 Model Specification

The relationship to be estimated is of the nature:

$$M2_t = \alpha_0 + \alpha_1 EXR_t + \alpha_2 FDI_t + \alpha_3 ED_t + \alpha_4 TO_t + \varepsilon_t \quad (1)$$

$$MPR_t = \beta_0 + \beta_1 EXR_t + \beta_2 FDI_t + \beta_3 ED_t + \beta_4 TO_t + \epsilon_t \quad (2)$$

$$CRR_t = \gamma_0 + \gamma_1 EXR_t + \gamma_2 FDI_t + \gamma_3 ED_t + \gamma_4 TO_t + \in_t \quad (3)$$

To analyzing the long-run and short-run effects of the relationships the study adopts a formulation of dynamic time series autoregressive distributed lag (ARDL) model by Pesaran, Shin and Smith (2001). The ARDL specifications for the three monetary policy tools under investigation in this study are captured by Equations (4), (5) and (6).

$$\Delta lnM2_t = \alpha_0 + \alpha_1 lnM2_{t-1} + \alpha_2 lnEXR_{t-1} + \alpha_3 lnFDI_{t-1} + \alpha_4 lnED_{t-1} + \alpha_5 lnTO_{t-1} + \sum_{i-0}^{p} \alpha_6 \Delta lnM2_{t-I} + \sum_{i-0}^{q} \alpha_7 \Delta lnEXR_{t-I} + \sum_{i-0}^{q} \alpha_8 \Delta lnMPR_{t-I} + \sum_{i-0}^{q} \alpha_9 \Delta lnED_{t-I} + \sum_{i-0}^{q} \alpha_{10} \Delta lnTO_{t-I} + \lambda ECM_{t-1} + \varepsilon_t \quad (4)$$

$$\Delta lnMPR_t = \beta_0 + \beta_1 lnMPR_{t-1} + \beta_2 lnEXR_{t-1} + \beta_3 lnFDI_{t-1} + \beta_4 lnED_{t-1} + \beta_5 lnTO_{t-1} + \sum_{i-0}^{p} \beta_6 \Delta lnMPR_{t-I} + \sum_{i-0}^{q} \beta_7 \Delta lnEXR_{t-I} + \sum_{i-0}^{q} \beta_8 \Delta lnMPR_{t-I} + \sum_{i-0}^{q} \beta_9 \Delta lnED_{t-I} + \sum_{i-0}^{q} \beta_{10} \Delta lnTO_{t-I} + \lambda ECM_{t-1} + \epsilon_t \quad (5)$$

$$\Delta lnCRR_t = \gamma_0 + \gamma_1 lnCRR_{t-1} + \gamma_2 lnEXR_{t-1} + \gamma_3 lnFDI_{t-1} + \gamma_4 lnED_{t-1} + \gamma_5 lnTO_{t-1} + \sum_{i-0}^{p} \gamma_6 \Delta lnCRR_{t-I} + \sum_{i-0}^{q} \gamma_7 ln\Delta EXR_{t-I} + \sum_{i-0}^{q} \gamma_8 ln\Delta MPR_{t-I} + \sum_{i-0}^{q} \gamma_9 \Delta lnED_{t-I} + \sum_{i-0}^{q} \gamma_{10} \Delta lnTO_{t-I} + \lambda ECM_{t-1} + \in_t \quad (6)$$

where $\alpha_1 - \alpha_5$, $\beta_1 - \beta_5$, and $\gamma_1 - \gamma_5$, are the long-run parameters; $\alpha_6 - \alpha_{10}$, $\beta_6 - \beta_{10}$, and $\gamma_6 - \gamma_{10}$, are the short-run parameters; α_0, β_0, and γ_0 are the intercepts; while ε, ϵ, and $\in$ are the white noise stochastic term respectively; λ is the parameter of the error correction mechanism (ECM); *ln* is the natural logarithm of the variables; and Δ is the difference operator. A shock to any of the regressors may not result in an immediate long-run effect on the regresands (M2, MPR, and CRR) which creates disequilibrium in the system and requires that the short-run adjusts to its long-run equilibrium through the error correction mechanism (ECMt−1). The ECMt−1 is a one lag error correction term that accounts for the speed of adjustment to the long-run equilibrium.

3.3 Unit Root Test with Structural Breaks

Prior to the investigation of the long-run and short-run nexus between external economic shocks and monetary policy instruments, the unit properties of the series were examined using the Zivot-Andrew (1992) unit root test with structural breaks.[1] This is due to Engle and Granger (1987) claim that time-series data sets are not stationary; therefore, we need to check the stationarity of the series to avoid the spurious results obtained from the application of OLS method.

Zivot and Andrews (1992) unit root test, which is based on exogenously determined break date into an unconditional unit root, is an improvement on Perron's test. It allows for a break in the intercept and the trend. They estimated it thus:

$$\hat{y}_t^B = \hat{a}^B \hat{y}_{t-1}^B + \sum_{i=1}^{k} \hat{c}_i^B \, \Delta \hat{y}_{t-i}^B + \hat{e}_t \quad (7)$$

Where $\hat{y}_t^B$ and y_t are regression residuals and dependent variable respectively, and where the explanatory variables contain a constant and time trend, and the change in the slope of the trend function.

The null hypothesis their structure break is given as:

$$y_t = \alpha_0 + y_{t-1} + e_t \quad (8)$$

The Zivot and Andrews (1992) test is aimed at finding the breakpoint that support this hypothesis. The null hypothesis for Zivot-Andrews unit root test is: the time series has unit root with structural break in the intercept. This null hypothesis can be rejected when the critical values (of 1%, 5% and 10%) are greater than the test statistics value.

3.4 Cointegration Test - Bayer and Hanck method

The investigation of the cointegration or long-run relationship using the recently developed combined cointegration test by Bayer and Hanck (2013). The Bayer and Hanck (2013) combines four major cointegration tests of Engle and Granger (1987), Johansen (1995), Boswijk (1994) and Bannergee (1998) and provides a result that is robust. Therefore, the test circumvents arbitrary decision over which test should be used if perhaps there is conflict in their results.

In line this, Bayer and Hank (2013) produced the blend (combined) computed significance level (p-value) of individual cointegration test using the Fisher's formulas as follows:

$$EG - J = -2\left[ln(\rho_{EG}) + ln(\rho_J)\right] \quad (9)$$

$$EG - J - B - BDM = -2\left[ln(\rho_{EG}) + ln(\rho_J) + ln(\rho_B) + ln(\rho_{BDM})\right] \quad (10)$$

[1] These may be the change in the time series due to some unique economic happenings that may have occurred as a result of changes economic policies, technology, institutions, or legislation; or large economic shocks. These can have permanent effect on the stationarity of a time series.

Where ρ_{EG}, ρ_J, ρ_B, and ρ_{BDM} are the ρ-values of various individual cointegration tests – Engle-Granger (EG, 1987); Johansen (J, 1988); Boswijik (B, 1994) and, Banerjee et al. (BDM, 1998) – respectively. The decision criterion is that, if the estimated Fisher statistics exceed the critical values provided by Bayer and Hank (2013), the null hypothesis of no cointegration is rejected. And the alternate hypothesis of cointegration will be accepted.

IV. RESULTS AND DISCUSSION

The major expectation of the paper is that FDI, ED, and TO will have a positive effect on all the three tools of monetary policy (M_2, CRR and MPR), while EXR will have an inverse effect on the three tools.

4.1 Test for Unit Root and Structural Breaks

The Zivot-Andrews unit root test, which allows for structural breaks, was conducted based on equation (1). The results, as presented in Table 1, revealed that all the variables are stationary after the first difference; that is integrated of difference one [I(1)] at 5% and 10% significance levels (with MPR, Ex. Rate, FDI, and trade openness even stationary at 1%). This meant the rejection of the null hypothesis that a unit root exists in the series. The implication is that these variables have the mean reverting ability such that any perturbation to the series will fade out with passage of time.

Table 1: Zivot-Andrews Unit Root Test with Structural Break

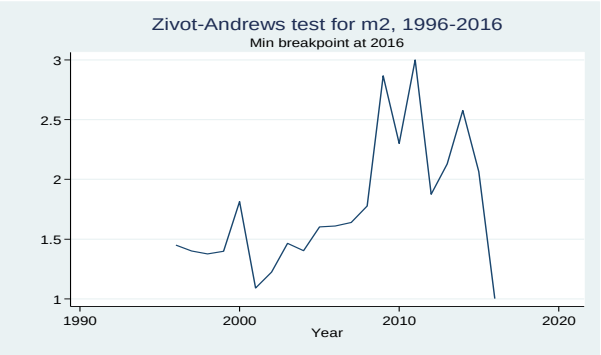
	M_2	MPR	CRR	Ex. Rate	Ex. Debt	FDI	Trade Openness
Lags included*	1	0	0	0	1	0	
Min. t-statistic	5.002	-6.575	-5.278	-5.709	-4.907	-6.885	-5.471
at year	2016	2011	2012	2016	2005	2005	2007
1% Critical Value	-5.34	-5.34	-5.34	-5.34	-5.34	-5.34	-5.34
5% Critical Value	-4.80	-4.80	-4.80	-4.80	-4.80	-4.80	-4.80
10% Critical Value	-4.58	-4.58	-4.58	-4.58	-4.58	-4.58	-4.58

*Lag selection via TTest:

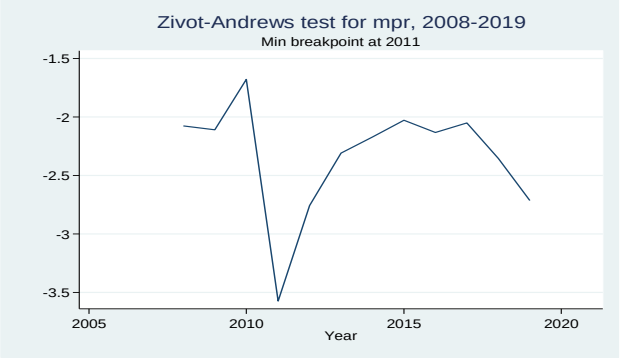
Source: Authors' computation.

Each of the series had a structural break that may have altered their direction of flow causing them to be non-stationary. The results and figures 1 to 7 shows that, between 1990 and 2021, broad money supply (M_2), monetary policy rate (MPR), cash reserve ratio (CRR), exchange rate (Ex. Rate) external debt (Ex. Debt), foreign direct investment (FDI), and trade openness had structural breaks in 2016, 2011, 2012, 2016, 2005, 2005 and 2007 respectively. Most of these periods can be linked to the United States housing bubble in 2005–2012 and the 2016 can be identified with the Chinese crash and the stock market crashes other major economies of the world. These global phenomena created shocks to the economy and were transmitted to economics variables and relationships in other individual nation states.

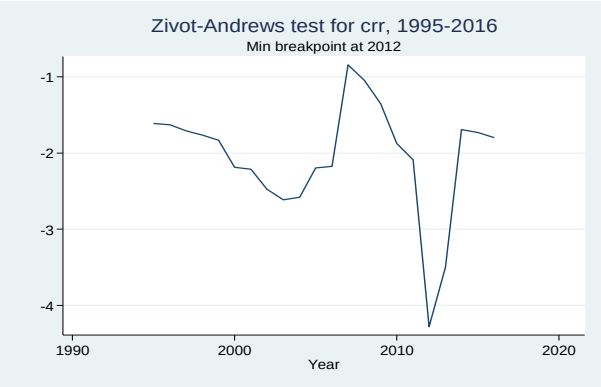
As it is argued, that when structural breaks are present in the time series, they share features similar to unit root processes; especially when analyzing the statistical properties of unit root tests in the presence of breaks. That is evident in the series exhibiting unit root at level. However,



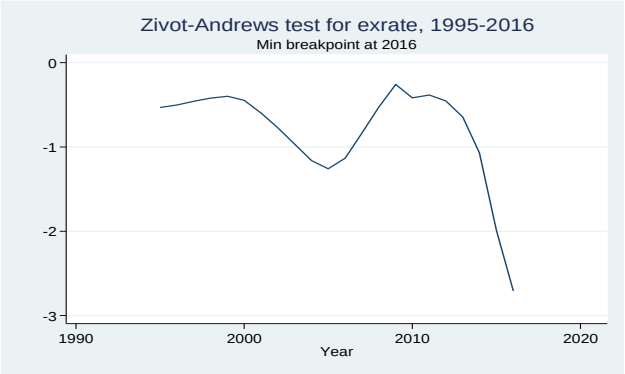
Plot 1: Zivot-Andrew test of structural break for Broad Money Supply (M_2)



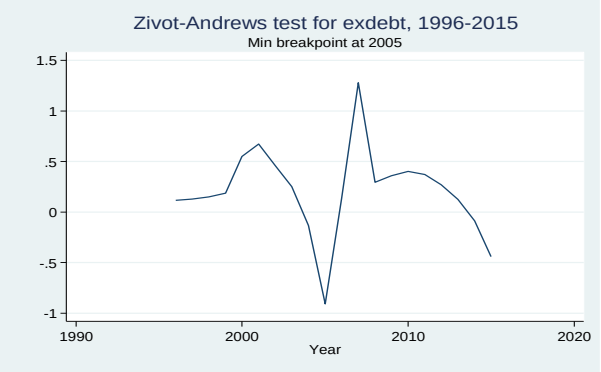
Plot 2: Zivot-Andrew test of structural break for Monetary Policy Rate (MPR)



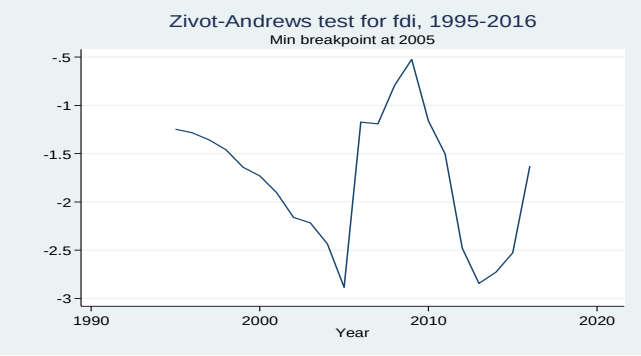
Plot 3: Zivot-Andrew test for of structural break Cash Reserve Ratio (CRR)



Plot 4: Zivot-Andrew test of structural break for Exchange Rate (Ex. R



Plot 5: Zivot-Andrew test of structural break for External Debt (Ex. Debt)



Plot 6: Zivot-Andrew test of structural break for Foreign Direct Investment (FDI)

Plot 7: Zivot-Andrew test of structural break for Trade Openness (TO)

Figure 1: Plots of estimated timing of structural break by Zivot-Andrews procedure

Source: Authors' computations.

4.2 Cointegration Tests

Given the uniform order of the ZAndrews results [I(1)], we proceeded with the Bayer and Hanck (2013) co-integration test to ascertain the long-run relationship among the series. The results are presented in the following Tables 2, 3, and 4.

Revealed from the results in Table 2 is that the Fisher statistics for EG–JOH and EG–JOH–BO–BDM tests are greater than the Bayer and Hanck critical values at 1%, 5%, and 10% for all the models. The null hypothesis (no cointegration among the variables) was rejected and the alternate of the existence cointegration among the variables, irrespective of which variable is endogenized, was accepted. That means that broad money supply (M_2) is cointegrated (i.e., do have a long-run relationship) with the variables of external economy. This implies that, since these variables do have a long-run relationship, any shock in the external economy variables can, *ceteris paribus*, determine the movement in M_2.

Table 2: The Results of Bayer and Hanck Cointegration Analysis between M_2 and External Economic variables

Estimated Models	EG-JOH	EG-JOH-BO-BDM	Lag Order	Cointegration
$lnM_2 = f(lnEXR_t, lnFDI_t, lnED_t, lnTO_t)$	55.628***	67.287***	1	Exist
$lnEXR_t = f(lnM_2, lnFDI_t, lnED_t, lnTO_t)$	56.108***	166.632***	1	Exist
$lnFDI_t = f(lnM_2, lnEXR_t, lnED_t, lnTO_t)$	55.720***	166.244***	1	Exist
$lnED_t = f(lnM_2, lnEXR_t, lnFDI_t, lnTO_t)$	55.619***	117.621***	1	Exist
$lnTO_t = f(lnM_2, lnEXR_t, lnED_t, lnFDI_t)$	55.620***	117.134***	1	Exist
Significance level	**Critical values**			
1%	15.845	30.774		
5%	10.576	20.143		
10%	8.301	15.938		

Notes: The optimal lag length for combined cointegration test is [0]. Akaike Information Criteria (AIC) is used to select the number of lags in the cointegration test.

***Shows statistical significance at the 5% level.

Source: Authors' computations.

It is revealed from the results in Table 3 that Fisher-statistics for both EG-JOH and EG-JOH-BO-BDM tests exceed the critical values at all the levels of significance when MPR, EXR, and TO was used as dependent variables for respective models. The null hypothesis of no cointegration among the variables was rejects for these models. But when FDI, and ED were considered as dependent variables, the test failed to reject the null hypothesis of no cointegration. However, in overall, we could conclude that there is a long-run relationship between monetary policy rate (MPR) and the external economic variables. Due to the existence of a long-run relationship among these variables, this also goes to imply that any shock in the external economy variables can determine the movement in MPR, if other factors are held constant.

Table 3: The Results of Bayer and Hanck Cointegration Analysis between MPR and External Economic variables

Estimated Models	EG-JOH	EG-JOH-BO-BDM	Lag Order	Cointegration
$\ln MPR = f(\ln EXR_t, \ln FDI_t, \ln ED_t, \ln TO_t)$	55.843***	129.525***	1	Exist
$\ln EXR_t = f(\ln MPR, \ln FDI_t, \ln ED_t, \ln TO_t)$	56.771***	167.195***	1	Exist
$\ln FDI_t = f(\ln MPR, \ln EXR_t, \ln ED_t, \ln TO_t)$	5.390	10.698	1	Do not Exist
$\ln ED_t = f(\ln MPR, \ln EXR_t, \ln FDI_t, \ln TO_t)$	5.760	16.978	1	Do not Exist
$\ln TO_t = f(\ln MPR, \ln EXR_t, \ln ED_t, \ln FDI_t)$	55.444***	125.908***	1	Exist
Significance level	**Critical values**			
1%	15.201	29.852		
5%	10.366	19.143		
10%	9.117	14.701		

Notes: The optimal lag length for combined cointegration test is [0]. Akaike Information Criteria (AIC) is used to select the number of lags in the cointegration test.

***Shows statistical significance at the 5% level.

Source: Authors' computations.

In a similar fashion, when considering our third relationship, Bayer-Hanck test (see Table 4) showed the Fisher-statistics for both EG-JOH and EG-JOH-BO-BDM tests to surpass the Bayer-Hanck critical values at all the levels of significance when all the variables were considered as dependent variables in the respective models. The null hypothesis of no cointegration among the variables was thus rejects models. We then concluded that there is a long-run relationship between cash reserve ratio (CRR) and the external economic variables. Following the establishment of the existence of a long-run relationship among these variables, it was inferred that any shock in the external economy variables can cause changes in CRR, holding other factors constant.

Table 4: The Results of Bayer and Hanck Cointegration Analysis between CRR and External Economic variables

Estimated Models	EG-JOH	EG-JOH-BO-BDM	Lag Order	Cointegration
$\ln CRR = f(\ln EXR_t, \ln FDI_t, \ln ED_t, \ln TO_t)$	56.974***	101.743***	1	Exist
$\ln EXR_t = f(\ln CRR, \ln FDI_t, \ln ED_t, \ln TO_t)$	55.328***	168.271***	1	Exist
$\ln FDI_t = f(\ln CRR, \ln EXR_t, \ln ED_t, \ln TO_t)$	56.233***	166.484***	1	Exist
$\ln ED_t = f(\ln CRR, \ln EXR_t, \ln FDI_t, \ln TO_t)$	55.152***	115.022***	1	Exist
$\ln TO_t = f(\ln CRR, \ln EXR_t, \ln ED_t, \ln FDI_t)$	55.601***	116.550***	1	Exist
Significance level	**Critical values**			
1%	15.775	30.024		
5%	11.106	20.143		
10%	8.890	15.938		

Notes: The optimal lag length for combined cointegration test is [0]. Akaike Information Criteria (AIC) is used to select the number of lags in the cointegration test.

***Shows statistical significance at the 5% level.

Source: Authors' computations.

The ARDL Results

Long run empirical results

Tables 5a, 6a, and 7a contains the respective long run empirical results for the three monetary policy tools – broad money supply (M_2), monetary policy rate (MPR) and cash reserve ratio (CRR), while Tables 5b, 6b, and 7b showcases the short run results. The long run results indicates that external economic shocks have impact on monetary policy tools in Nigeria. Considered individually, EXR, FDI, ED have positive impact on M_2 while TO has a negative relationship with M_2. From the results, a 1% increase in these will lead to 0.748%, 0.677%, 4.076% and −2.776%, respectively, in money supply, ceteris paribus. About 97% changes in M_2 (as shown by the adjusted R^2) are explained by external economic shocks. The error correction term is significant, to confirm the existence of cointegration among the variables.

In terms of MPR, the results show that, FDI, ED, TO impact positively on MPR with EXR impacting negatively on MPR. The results indicate that, a 1% rise in EXR, FDI, ED, TO will cause a −1.078%, 0.598%, 2.076%, and 4.576% change, respectively, in MPR holding other factors constant. All tests about this relationship are okay, with an adjusted R^2 of about 72%.

The results about CRR did not differ from this trend. It is revealed from the results that EXR, FDI, ED do have positive impact on CRR and TO, on the other hand has a negative impact on CRR. The estimated coefficients show that a 1% increase in these variables will bring about a corresponding 3.9206%, 0.1443%, 0.2456%, 3.775%, and −2.500% change, respectively, in CRR, all things being equal. Also revealed is

that about 89% changes in CRR (see the adjusted R^2 in Table 7a) are explained by external economic shocks through EXR, FDI, ED, TO. The error correction term is significant, to confirm the existence of cointegration among the variables.

These findings are in line with those of Filardo, Ma, and Mihaljek, (2011); Gokarn and Singh (2011); Mihaljek (2011); Moreno (2011); Pesce (2011); Takáts and Villar (2011); Ogbonna (2016); Olamide and Maredza (2019) who in their various studies, made similar findings and concluded that monetary policy variables and influenced by external economic shocks.

Table 5a: Long-run ARDL coefficients M_2 Model

Dependent Variable = $\ln M_2$				
Variables	Coefficient	Standard Error	t-statistic	ρ-values
Constant	1.285	0.932	1.380	0.201
$\ln EXR_t$	0.748**	0.325	2.504	0.037
$\ln FDI_t$	0.677*	0.338	2.348	0.040
$\ln ED_t$	4.076**	0.707	5.769	0.000
$\ln TO_t$	−2.776**	0.475	−5.840	0.000
R-squared	0.9739			
Adj. R-squared	0.9683			
Akaike info. Criterion	-3.1388			
Schwarz Criterion	-2.8559			
F-statistic	172.2751			
Durbin-Watson Test	2.0844			

Note: * and ** significant at 1% and 5% levels of significance respectively

Source: Authors' calculations.

Table 5b: Short-run ARDL coefficients M_2 Model

Dependent Variable = $\Delta\ln M_2$				
Variables	Coefficient	Standard Error	t-statistic	ρ-values
Constant	0.0114	0.010	1.1032	0.282
$\Delta\ln EXR_t$	0.0888	0.071	1.2571	0.223
$\Delta\ln FDI_t$	0.1290**	0.059	2.1696	0.042
$\Delta\ln ED_t$	0.0600**	0.026	2.3226	0.030
$\Delta\ln TO_t$	0.1529**	0.058	2.6375	0.015
ECM_{t-1}	-0.6454*	0.186	-3.4626	0.002
R-squared	0.6284			
Adj. R-squared	0.5222			
Akaike info. Criterion	-3.8024			
Schwarz Criterion	-3.4693			
F-statistic	5.9190			
Durbin-Watson Test	1.7256			
Diagnostic Tests		**F-statistic**	**Prob. value**	
χ^2ARCH		0.544 [1]	0.524	
χ^2SERIAL		3.990 [2]	0.070	
χ^2NORMAL		1.958 [1]	0.253	
χ^2RESET		2.523	0.218	

Note: * and ** significant at 1% and 5% levels of significance respectively

Source: Authors' calculations.

Table 6a: Long-run ARDL coefficients MPR Model

Dependent Variable = lnMPR				
Variables	Coefficient	Standard Error	t-statistic	ρ-values
Constant	6.001	0.843	1.547	0.302
$\ln EXR_t$	−1.078**	0.521	−2.662	0.013
$\ln FDI_t$	0.598*	0.430	2.311	0.047
$\ln ED_t$	2.076**	0.404	4.623	0.001
$\ln TO_t$	4.576**	0.325	5.977	0.000
R-squared	0.7237			
Adj. R-squared	0.6821			
Akaike info. Criterion	-4.6848			
Schwarz Criterion	-2.7412			
F-statistic	102.2705			
Durbin-Watson Test	2.4137			

Note: * and ** significant at 1% and 5% levels of significance respectively

Source: Authors' calculations.

Table 6b: Short-run ARDL coefficients MPR Model

Dependent Variable = ΔlnMPR				
Variables	Coefficient	Standard Error	t-statistic	ρ-values
Constant	2.346	1.658	1.415	0.191
$\Delta\ln EXR_t$	−0.053	4.763	−0.011	0.991
$\Delta\ln FDI_t$	9.419**	2.018	4.668	0.001
$\Delta\ln ED_t$	1.660**	0.054	2.3226	0.030
$\Delta\ln TO_t$	2.544**	0.1009	2.5376	0.021
ECM_{t-1}	−0.182**	0.120	−9.186	.000
R-squared	0.8620			
Adj. R-squared	0.8416			
Akaike info. Criterion	-3.1140			
Schwarz Criterion	-5.4693			
F-statistic	16.1790			
Durbin-Watson Test	1.9907			
Diagnostic Tests		**F-statistic**	**Prob. value**	
χ^2ARCH		0.664 [1]	0.376	
χ^2SERIAL		2.312 [1]	0.175	
χ^2NORMAL		1.939 [1]	0.280	
χ^2RESET		2.473	0.305	

Note: * and ** significant at 1% and 5% levels of significance respectively

Source: Authors' calculations.

Table 7a: Long-run ARDL coefficients CRR Model

Dependent Variable = lnCRR				
Variables	Coefficient	Standard Error	t-statistic	ρ-values
Constant	3.9206*	0.525	7.4633	0.000
$\ln EXR_t$	0.1443*	0.017	8.4556	0.000
$\ln FDI_t$	0.2456*	0.074	3.3151	0.003
$\ln ED_t$	3.775**	0.297	5.112	0.000
$\ln TO_t$	−2.500**	0.320	−5.447	0.000
R-squared	0.9062			
Adj. R-squared	0.8923			
Akaike info. Criterion	-3.0108			

Schwarz Criterion	-2.7952			
F-statistic	67.1411			
Durbin-Watson Test	2.8603			

Note: ** significant at 5% levels of significance respectively

Source: Authors' calculations.

Table 7b: Short-run ARDL coefficients CRR Model

Dependent Variable = ΔlnCRR				
Variables	Coefficient	Standard Error	t-statistic	ρ-values
Constant	0.0114	0.0103	1.1032	0.282
$\Delta lnEXR_t$	0.0888	0.0707	1.2571	0.2225
$\Delta lnFDI_t$	0.1290**	0.0594	2.1696	0.0417
$\Delta lnED_t$	0.0600**	0.0258	2.3226	0.0303
$\Delta lnTO_t$	0.1529**	0.0579	2.6375	0.0154
ECM_{t-1}	-0.6454*	0.1863	-3.4626	0.0023
R-squared	0.7834			
Adj. R-squared	0.7513			
Akaike info. Criterion	-5.5714			
Schwarz Criterion	-3.4693			
F-statistic	5.9190			
Durbin-Watson Test	2.2811			
Diagnostic Tests		**F-statistic**	**Prob. value**	
χ^2ARCH		1.733 [1]	0.469	
χ^2SERIAL		4.100 [2]	0.204	
χ^2NORMAL		2.883 [2]	0.345	
χ^2RESET		1.978	0.117	

Note: * and ** significant at 1% and 5% levels of significance respectively

Source: Authors' calculations.

V. CONCLUSION AND POLICY IMPLICATION

The study was set out with the main aim of assessing the effect of external economic variables on monetary policy tools in Nigeria. External economic variables of exchange rate, foreign direct investment, external debt, and trade openness were used as the passthrough of external economic shock; while monetary policy tools were considered in terms of broad money supply, monetary policy rate, and cash reserve ratio. To achieve these objectives, annual time series data for these variables from 1990 to 2020 were obtained and tested for stationarity and structural break using the Zivot-Andrews test. The Bayer–Hanck combined cointegration test was used to examine cointegration among the variables; then we apply ARDL test to find the effect of external economic shocks on monetary policy tools. Generally, the empirical results of revealed that external economic shocks have significant positive effect on monetary policy tools in Nigeria. Meaning that external economic shocks are capable of and have cause an increase in broad money supply, monetary policy rate, and cash reserve ratio in Nigeria. Though some of these variables have minimal effect, but cumulatively, it means much as it distorts the operation and success of monetary policy in the country. This, another way, shows how externally dependent the Nigerian economy is. The implication being that, external economic distortions will continue to impede the performance of the Nigerian economy, or at least the performance of these monetary policy variables studied.

Given the increasing complexity in the global economy full of uncertainties (like the impact of Covid-19) leaving the monetary policy open so much to external influence does not hold good potential for the economy. It therefore, behooves on the monetary authorities to safeguard the monetary operations in the country from external economic mishaps that have spillover to Nigeria. This can be done by making allowance for the external economic shocks in setting these tools and putting in place mechanisms that can make these tools resilient and resistant to the shocks.

For a developing country with weak institutions, a cautious integration of the economy with the rest of the world is still a relevant strategy to get the monetary policy tools insulated from external economic shocks. As may scholars have advocated, it is good that domestic economies need to be improved to fully benefit from openness to the global economic space.

Industrial policies should integrate with the trade policy as one factor to endorse the trade of this sector at home and overseas. To reap the benefits of trade reforms, Pakistan should pay attention to develop political and economic institutions because without strengthening these institutions, the desired sustainable development cannot be achieved.

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