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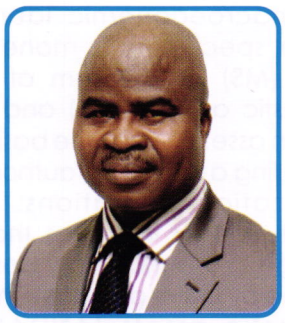
NIGERIA'S EXPERIENCE WITH MONETARY STERILISATION (2000 – 2016)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1. Introduction

For good and obvious reasons, monetary operations routinely involve monetary sterilization. The most obvious reason is to ensure that the balance sheet of the monetary authority is optimized to keep inflation under control. The reality of most central banks today is that they have to always keep an eye on other objectives like output stabilisation and exchange rate stability. In both cases, keeping the monetary aggregates, foreign and domestic assets, in the right balance is not only desirable but necessary.

Changes in either foreign or domestic assets alter the balance sheet the monetary authority and could undermine the attainment of the objectives of monetary policy. Because changes in assets are often generated by economic agents acting pseudo-independently, the central bank has to continuously watch movements in the economy's balance sheet – the monetary survey- and take remedial actions from the back end. Sterilisation is one of such remedial actions; it ensures that the supply of money does not grow uncontrollably. In this sense, the extent of sterilisation could be a measure of the policy stance of the central bank, particularly during periods of rapid inflow of external capital, that invariably translate to domestic liquidity through monetization.

This study attempts to estimate the extent of sterilization undertaken by the Central Bank of Nigeria (CBN) during the period from 2000 to 2016. The approach used in this study involved construction of a monetary sterilisation index by measuring the rate of change in domestic asset (net) with respect to the change in foreign asset (net). The index expands the menu of available indicators which may be considered by monetary policy makers in in evaluating policy response to changing economic conditions.

2. Review of Moneta

3. Sterilization Literature

Tamas Gabor (2012) examined China's monetary policy in terms of its effectiveness and cost vis-à-vis sterilization of excess liquidity caused by perennial exchange rate intervention. He applied a two-stage least squares (2SLS) regression method and found the sterilization process of the yuan to be relatively successful at the monetary base level and partially effective at the M2 supply level over a period of 15 years. His study further used a cost-benefit analysis to ascertain that the monetary sterilization process, traditionally perceived as loss making in the literature has been a profitable activity carried out by the Chinese central bank.

Hashmi M.S et al (2011) focused on estimation of a monetary policy reaction function and degree of sterilization using a sample of four countries: Pakistan, Korea, Philippines and Japan. They used the Johansen multivariate co-integration technique and employed quarterly data from 1981Q1 to 2007Q2. Their findings revealed that over the study period, the central banks of the countries studied espoused a strong monetary sterilization policy although with varying degrees of magnitude and intensity. This was irrespective of the economy being agriculture dependent or not. They also concluded that in the long run, all capital inflows were sterilized.

According to Okpanachi U. M (2012), large and persistent capital inflows could be both invaluable as well as detrimental to developing economies. The negative outlook was predicated on the tendency of capital flows to display significant volatility and reversals which occasion boom and bust cycles in recipient countries. This he opined could cause potential loss of monetary policy independence, inflationary pressure and rapid exchange rate appreciation, and as such required a sterilization policy response to mitigate the downside risks. His study employed an analytical framework to estimate the effectiveness and intensity of the Central Bank of Nigeria's (CBN) monetary sterilization used in response to surges in capital inflows in recent years. His study found evidence of significantly high but less-than-full, sterilization intensity. He further reported evidence of declining sterilization intensity over time ascribed in part to the rising cost of conducting sterilization operations as well as considerations in financial system stability. These rising costs attributed to sterilisation activities, should inflows of the magnitudes observed in the past persist could significantly undermine the sustainability of the current approach.

Cavoli and Ramkishen S. Rajan (2006) in their paper examined five Asian countries in the 1990s and the reasons behind the surges in capital inflow prior to the financial crisis of 1997/98. They examined the economies of Indonesia, Korea, Malaysia, the Philippines and Thailand, the crisis-hit countries, during the period (1990m1–1997m5). They employed a simple model organizational framework and used related empirical tests to investigate the varying correlations between capital inflows, intensity and magnitude of sterilization as well as uncovered interest rate differentials over the period. Their findings revealed that sluggish response of interest rates to domestic monetary disequilibrium, complete monetary sterilization and perfect capital mobility or some combination of all three were responsible for the persistent uncovered interest differentials and consequent capital inflows witnessed in the period. Cavoli and Rajan (2005) constructed monetary sterilization indexes for Thailand, Indonesia, Malaysia and Philippines during 1990 – 1997 when these countries experienced large inflows. The indices ranged from 0.77 to 0.98. The study also reported over-sterilization in Korea at 1.1 over the same sample period.

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Lee (1997) provided a discursive analysis of the conduct of sterilization in some select economies (Chile, Colombia, Indonesia, Korea, Spain, and Thailand) over a ten year period and assessed their pros and cons in their sterilization processes. Recent times have revealed that many developing economies lack appropriate tools to sterilize consistently large capital inflows such that when markets were liberalized, such countries found that traditional tools were no longer effective and they needed suitable infrastructure necessary for implementing more advanced market-based controls. He concisely summarized the usage of traditional monetary instruments and discussed the practical limits to classic sterilization measures. He also identified other possible supplementary measures, including foreign exchange swaps. In concluding, he found that although traditional sterilization activities could be effective in short to medium term, the application of supplementary measures like indirect capital controls could also be both desirable and effective.

4. Analytical Framework

The macroeconomic identity which specifies the monetary base (MS) as the sum of net domestic assets (NDA) and net foreign assets (NFA) is the basis for modelling a monetary authority's sterilization operations. The identity further indicates that a change in the monetary base is caused by either a change in net domestic assets (ΔNDA), a change in net foreign assets (ΔNFA), or an associated change in both. This can be depicted as follows:

$$\Delta MSt = \Delta NDAt + \Delta NFAt \quad \textbf{(1a)}$$

$$Mst - MSt\text{-}1 = NDAt - NDAt\text{-}1 + NFAt - NFAt\text{-}1 \quad \textbf{(1b)}$$

$$Mst = \Delta NDAt + \Delta NFAt + MSt\text{-}1 \quad \textbf{(2)}$$

Ensuing from the supposition that any increase in foreign assets is completely sterilized by the CBN, the following equivalent conditions would hold:

$$\Delta MSt = 0 = \Delta NDAt + \Delta NFAt \quad \textbf{(3a)}$$

$$\Delta NDAt = -\Delta NFAt \quad \textbf{(3b)}$$

The derivative of NDA with respect to NFA inferred from equation (3b) is (-1), denoted by σ. As such, equation (3b) can be rewritten as:

$$\Delta NDAt = \sigma NFAt \quad \textbf{(4)}$$

Thus, σ can be interpreted as the degree to which domestic liquidity is insulated from the direct impact of changes in foreign assets. Consequently, to measure the extent of CBN sterilization operations, this study adopts the methodology applied by Cavoli and Rajan (2005), Glick (2008) and Cardarelli et al. (2009) and seeks

to evaluate the following linear relationship between net domestic assets and net foreign assets:

$$\Delta NDAt = a + \sigma \Delta NFAt + \varepsilon t \quad \textbf{(5)}$$

The measure of sterilization (σ) is the slope of equation (5) and when multiplied by (-1), the result is recognized as the sterilization index of the monetary authority (Cardarelli et al., 2009). A sterilization index value of unity (1) infers complete sterilization of any increases in net foreign flows while an index value of zero (0) implies no sterilization at all. It is conventional to expect a sterilization index value to lie between zero and one ($0<\sigma<1$) as a central bank is unlikely to take no action in the wake of disruptive large and persistent inflows which usually prompt monetary policy responses to retain financial stability.

Given that equation (5) captures only contemporaneous adjustments in net domestic assets and does not account for the possibility of the monetary authority making staggered sterilization operations or making corrective adjustments in subsequent periods (sterilization smoothening), a one-period lagged (NFA) is included in equation (5) as follows:

$$\Delta NDAt = a + \sigma 1 \Delta NFAt + \sigma 2 \Delta NFAt\text{-}1 + ut \quad (6)$$

A significant $\sigma 2$ is evidence of sterilization smoothing by the monetary authorities. When $\sigma 2 > 0$, it is implied that a perceived over-sterilization from a previous period is being corrected while when $\sigma 2 < 0$, this is interpreted as gradual sterilization of inflows over two periods.

The study used monthly data on inflows from January 2000 to March 2016, sourced from the Central Bank of Nigeria Statistical database.

5. Data Analysis

5.1. Unit Root Analysis

Our examination of the relevant times series, domestic asset (net) and foreign asset (net) showed that both series are integrated of the order one. The results of stationarity test conducted on the series using the Dickey-Fuller test are summarised in Table 1.

5.2. Model Estimation and Results

In order to obtain the parameter (∂) in equation 5, we estimated the equation at first difference, the level at which the series (NDA and NFA) become stationary. We first assess sterilisation across the entire sample period, 2000M1 – 2016M3. The linear regression yields a coefficient (∂) of -0.697. The E-views output of the regression is reported as an Appendix. This result meets a priori expectations in terms of the standard behaviour of the monetary authorities - the tendency to offset expansion in one of the two aggregates (NFA and NDA) by depressing the other so as to keep the balance sheet from exploding especially during periods of extraordinary flows.

Multiplied by (-1), the coefficient of NFA (∂), -0.697) becomes the sterilisation index which may be high, low or over. In this case, the average sterilisation activity of the CBN between 200 and 2016 is (-0.697 *-1) equals 0.7 approximately. This may be judged to be fairly high. We note however that this level of sterilisation intensity did not happen at all time during the period. In fact knowing average sterilisation intensity of a long period offers very little policy-relevance. It is the short term changes in sterilisation intensity that is much more useful for tracking monetary policy dynamics. In this sense, sterilisation indices obtained from rolling regressions provide some clues about the stance of monetary policy or its evolution over time (okpanachi, 2012).

Sterilization coefficients for all the rolling regressions were statistically significant, implying that the CBN sustained some level of sterilization throughout the sample period (2000-2016), even as intensities differed. The sterilization indices reported in the Table 2 above were computed simply by multiplying by (-1) the slope coefficients of the linear relation between changes in NDA and NFA. The indices provide information with which to gauge adjustments to the tempo of sterilisation activity by the CBN during the period.

The CBN maintained a relatively high tempo of monetary sterilization activity from 2000, slowed significantly from 2006; ramps it up again from 2012. Rolling sterilization indices also provide useful indications bout the stance of monetary policy (Cardirelli, 2009). The lower sterilization intensities between 2008 and 2010 may therefore be interpreted as monetary easing. However, such a reading must be done cautiously especially because the broad money

Variable	Augmented Dickey-Fuller test statistic				
	LEVELS	P-VALUE	FIRST DIFF	P-VALUE	ORDER
NDA	2.118	0.999	-14.128	0.000	I(1)
NFA	-1.548	0.506	-15.253	0.000	I(1)

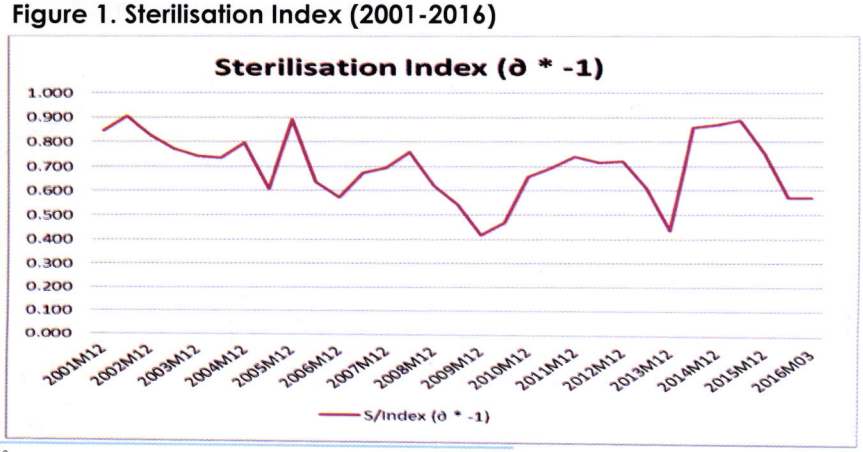
[1]Through repetitive estimation of the same model using data adjusted each time by six months, we obtained the rolling regression estimates that yield various values for the coefficient of NFA (∂) in equation 5, which corresponds to the sterilisation intensity during the period.

Table 2: 24-month Rolling Regression Results and Sterilisation Indices

Regression End Period	Coefficient (∂)	S/Index (∂ * -1)
2001M12	-0.846	0.846
2002M06	-0.903	0.903
2002M12	-0.825	0.825
2003M06	-0.77	0.770
2003M12	-0.741	0.741
2004M06	-0.732	0.732
2004M12	-0.793	0.793
2005M06	-0.605	0.605
2005M12	-0.89	0.890
2006M06	-0.635	0.635
2006M12	-0.57	0.570
2007M06	-0.673	0.673
2007M12	-0.693	0.693
2008M06	-0.757	0.757
2008M12	-0.619	0.619
2009M06	-0.541	0.541
2009M12	-0.417	0.417
2010M06	-0.466	0.466
2010M12	-0.657	0.657
2011M06	-0.693	0.693
2011M12	-0.738	0.738
2012M06	-0.714	0.714
2012M12	-0.719	0.719
2013M06	-0.608	0.608
2013M12	-0.434	0.434
2014M06	-0.857	0.857
2014M12	-0.868	0.868
2015M06	-0.887	0.887
2015M12	-0.751	0.751
2016M03	-0.568	0.568

Source: 24-month rolling estimates of ∂ in Equation 5 over the period 2000 to 2016 and corresponding monetary sterilization indices ((∂ * -1)

Figure 1. Sterilisation Index (2001-2016)



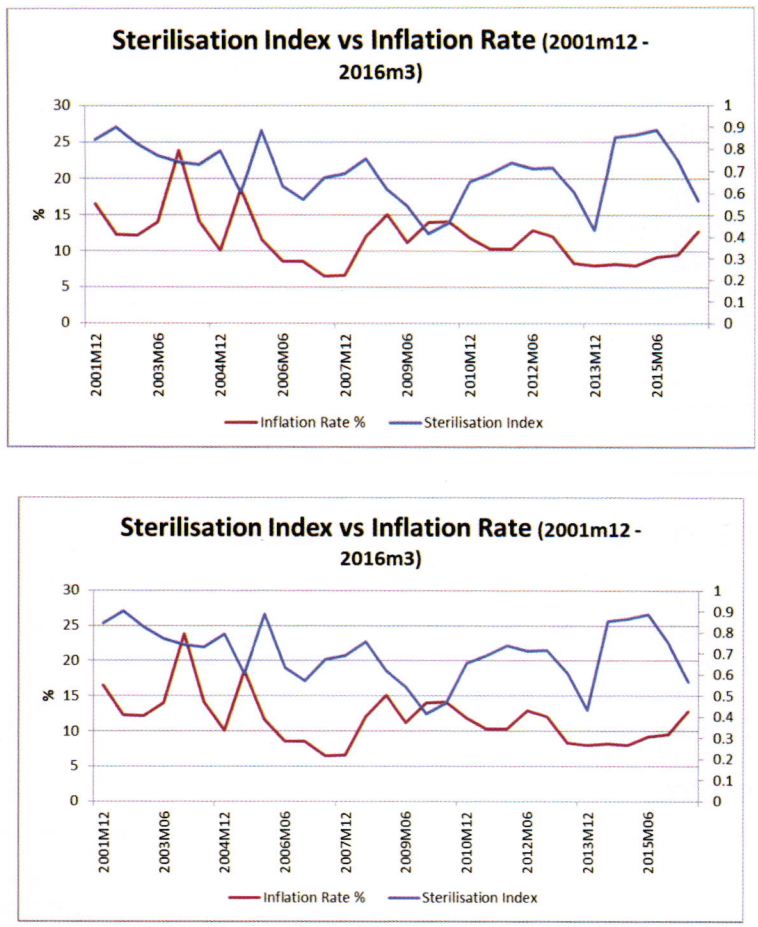
multiplier has in recent years exhibited some degree of instability.

6. The Sterilisation Index and key Monetary Policy Variables

Monetary stériliozation is conducted by the cetral bank with a view to influencing economic conditions in any direction it deems fit. For most central banks, the primary goal is to control liquidty in order to alleviate pressures on prices. In effect, the intensity of strilisation should bear some relationship variables like inflation and exhange rate

Figure 2 shows the sterilisation index and the naira exchange rate between 2001 and 2016, while Figure 3 shows the index and inflation. From both figures, we observe what appears to an inverse trends between the trend and both inflation and exchange rate of the naira. This is not unexpected as strilisation is expected to keep liquidty at an optimal level which should keep inflation and demand pressure in the foreign exchange market in check.[2]

[2] *A formal test of the validity of this using Nigerian data, though quite deserving, is beyond the scope of this work.*



Sterilisation Index vs Inflation Rate (2001m12 - 2016m3)
%
2001M12
2003M06
2004M12
2006M06
2007M12
2009M06
2010M12
2012M06
2013M12
2015M06
Inflation Rate %
Sterilisation Index

Figure 3. Sterilisation index and Inflation rate (2001-2016)

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Appendix

Dependent Variable: D(NDA)
Method: Least Squares
Date: 05/12/16 Time: 20:28
Sample (adjusted): 2000M02 2016M03
Included observations: 194 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NFA)	-0.697746	0.072850	-9.577828	0.0000
C	94632.62	23766.63	3.981743	0.0001

R-squared	0.323312	Mean dependent var	77221.48
Adjusted R-squared	0.319787	S.D. dependent var	400195.3
S.E. of regression	330061.1	Akaike info criterion	28.26220
Sum squared resid	2.09E+13	Schwarz criterion	28.29589
Log likelihood	-2739.433	Hannan-Quinn criter.	28.27584
F-statistic	91.73479	Durbin-Watson stat	2.048946
Prob(F-statistic)	0.000000		