

Full Length Research Paper

Inflation in Nigeria: How much is the function of money?

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Inflation is one of the most researched concepts in economics, yet there is always a noisy room when it is discussed. Most empirical literature suggests that excessive inflation is harmful to economic growth. The emphasis on 'excessive' implies that some level of inflation would have a positive association with growth. Considerable study has gone into determining the points of inflexion where inflation becomes harmful. However, monetary policy makers are confronted with a different kind of problem trying to rein in inflation. And that has to do with determining the exact portion of the changes that occur in aggregate prices that could be attributed exclusively to the growth in money supply. This is a real problem because the demand-side inclination of central banks limits their activism against inflation to control of money growth only. Therefore, it is imperative for monetary authorities to isolate the contribution of money to the dynamics of inflation in order for policy to be properly targeted. This is the main aim of this paper using Nigeria data. The data set spanned 1970 to 2012. However, Chow tests indicated several structural breaks in inflation. The most visible break coincided with the transition to market orientation in the economy, marked by high levels of inflation that peaked in 1995. Thus, for practical policy use, the operating model separates both episodes, and emphasizes the more current period. The gross domestic product (GDP), nominal exchange rate (X), and the maximum lending rate (I) are control variables, while inflation, proxied by the consumer price index (CPI) and broad money supply (M2) are focus variables. All variables enter in logarithm forms, except interest rate. The Trace statistic and Maximum Eigen factor test detected cointegration among the variables, with at least 3 cointegrated equations. The Vector Error correction technique was therefore found suitable and applied. The impulse response function showed a persistent positive relationship between inflation and money supply. However, the variance decomposition of inflation shows that GDP was the strongest contributor to inflationary developments in Nigeria, and that money supply accounts for up to 34.5 per cent of aggregate price changes until the tenth period. The result is reflective of the nature of the Nigerian economy as the GDP nests all the structural factors that impact inflation.

Key words: demand for money, monetary policy; vector error correction.

INTRODUCTION

Many economic agents, notably, fixed income earners squall for the fear of evaporating purchasing power with rising inflation rates. Consequently, policymakers deploy multiple variants of decelerators to tame rising inflation. There are quite a few therapies, at least, in textbooks that

are effective for the purpose of keeping aggregate prices less variable over time. Increase taxes, surplus government budgets, remove market hiccups, improve production infrastructure to reduce production lags, reduce the growth of money supply, the list is just

endless. But there is always a dilemma. Which of these treatments is suitable for the economy at any point in time? If a combination of the prescriptions is required, what is the appropriate dosage for each? In fact to be able to recommend any of the prescriptions policy should recognize the functional form of the dynamics of aggregate prices and this is not a mean job considering the myriad of issues involved – changing structure of the economy, technical issues including estimation techniques, international influence on domestic production etc.

Monetary authorities, central banks for most countries, face a more difficult challenge with respect to fighting inflation. They generally assume that excess growth in money supply is on the roots of wayward price developments so that that all potent tools, 'halt the growth in money supply' is capable of fixing inflation. However, causality between inflation and other macro-variables is a contentious subject. In the opposition to monetarism heterodox economists argue that the money supply is endogenous - determined within the interactions in the economy - but not by the central bank and that the sources of inflation must be found in the distributional structure of the economy

In addition, those economists seeing the central bank's control over the money supply as feeble say that there are two weak links between the growth of the money supply and the inflation rate. First, in the aftermath of a recession, when many resources are underutilized, an increase in the money supply can cause a sustained increase in real production instead of inflation. Second, if the velocity of money, i.e., the ratio between nominal GDP and money supply, changes, an increase in the money supply could have either no effect, an exaggerated effect, or an unpredictable effect on the growth of nominal GDP.

Although jumping on the campaign to show that money matters in driving inflation is not the main purpose of this paper, it will be naïve not to pay attention to all the opposing arguments. In terms of the endogeneity of money supply, if the workings of the economy determine money supply, the consideration should concern the initial source of money supply. The mere buying and selling with an existing stock of money supply should not increase money supply, except in the process a higher demand for money induces the creation of high powered money by monetary authorities. Thus, the source of inflation, with the new equilibrium in money supply, will reside in the misjudgment by monetary authorities in getting the new stock of money supply to settle in the economy without causing dislocations in the productive sectors. Again, that during recession increased money supply could help grow real activity is not an argument against inflation being a function of growth in money supply rather it reinforces the fact that what matters for the economy is being able to control the behavior of

money so that its growth keeps within the band that does not impact aggregate prices adversely.

The analysis in this paper is set in Nigeria and by the nature of the economy money supply is mainly exogenous coming from the net foreign assets and so it is safe to assume that the dynamics of inflation depends, at least in part, on the growth of money supply. Therefore, the main purpose of this paper is to ascertain the size of inflation that is accounted for by the growth of money supply. The next section discusses theoretical and empirical literature as well as stylized facts on the link between money and inflation in Nigeria. Section III contains methodological issues. Section IV presents econometric estimations and findings. The last section concludes with recommendations.

THEORETICAL AND EMPIRICAL LITERATURE

Theoretical literature

The Monetarist Theory of Inflation

In the monetary theory of inflation, inflation is said to be driven by the excess of money supply over its demand, where at equilibrium real money supply equals real money demand. The Monetarists affirm that money plays an active role by leading to changes in income and prices. The argument is that changes in income and prices in an economy are mainly driven by the changes in money stocks. And because money supply exerts an upward pressure on prices inflation is seen as always and everywhere a monetary phenomenon. Monetarists however argue that though money is dominant in determining the level of prices and output in the short run, it can only determine price level in the long run. Thus, a sustained increase in the rate of money supply growth would lead to inflation. To contain inflation, monetarists commonly argue that decreasing money supply will increase nominal interest rates which will in turn slow aggregate demand and rein in inflation

The Keynesian theory of inflation

The Keynesians describe the relationship between growth money supply and the level of prices in terms of the ease of access to money. The quantity of money in circulation should have a direct impact on the level of aggregate demand for goods and services in an economy. Scarcity of money constrains demand for goods and services while a glut will energize demand. Thus, demand-pull inflation would arise when aggregate demand rises above aggregate supply. One of the underlying arguments is that changes in income influence the money stock but not

the reverse.

Empirical literature

The relationship between money and inflation has been well researched. Lucas (1980), Dwyer and Hafer (1988), Friedman (1992), and others have found that changes in the nominal quantity of money and the price level are closely related. Ramchandran and Kamaiah (1992) reexamined the relationship between money and price for India using seasonally adjusted quarterly data for 1961:1 to 1987:4 with four alternative measures of monetary stock (M1, M2, M3, and MB) and two price proxies (WPI and CPI with 1970 as a base year). Their result showed that m3 and prices have feedback relationships while the causal relationship with m1 and m2 are inconsistent. Pakko (1994) examined the relationship between money growth and inflation for 13 countries. The findings indicate that countries with the highest rates of inflation are those that have been associated with a strong growth in money stock.

Rolnick and Weber (1994) examined the behavior of money, inflation, and output under fiat and commodity standards for 15 countries. They found that under fiat standards, the growth rates of various monetary aggregates are more highly correlated with inflation and with each other than they are under commodity standards.

McCandless and Weber (1995) found in 110 OECD countries over a 30-year period that growth rates of the money supply and the general price level are highly correlated. They explained that the correlation between money growth and inflation being close to one implies that long-run inflation can be adjusted by adjusting the growth rate of money.

Dwyer (2001) investigated the strength of money supply in predicting inflation using VAR on quarterly data from 1953 to 1997. The study concluded that real income growth, inflation or both are related to money growth and that money growth is more useful for forecasting inflation than other variables besides past inflation.

Cheng and Tan (2002) employed the Johansen's co-integration test and VECM approach to examine the long run equilibrium relationship and the causality between inflation and its determinants (i.e. money supply, output, interest rate, exchange rate and trade balance) in Malaysia. They found that the variables are co-integrated, but there is no evidence of direct causality from money supply to inflation in Malaysia.

Grauwe and Polan (2005) using a sample of 160 countries covering 1969–1999 found a strong positive relation between long-run inflation and the money growth rate. However, they attributed the strong link between inflation and money growth to the presence of high- (or hyper-) inflation countries in the sample. Qayyum (2006) found a strong linkage between excess money supply

growth and inflation in Pakistan for the period 1960–2005. He argues that excess money supply first impacts on the real GDP before it affects inflation.

Bakare (2011) conducted a study on the determinants of money supply growth and its implications on inflation in Nigeria. The study employed quasi-experimental research design approach. The results showed that credit expansion to the private sector determines money supply growth and inflation in Nigeria. He therefore concluded that changes in money supply are concomitant to inflation in Nigeria.

Adenuga et al. (2012) using the ordinary least square technique examined whether inflation is purely a monetary phenomenon in Nigeria for the period of 1970 to 2009. Following the quantity theory of money by Fisher (1997) and the model by Grauwe (2005) and Tang (2008), they specified a model expressing inflation as a function of growth of money supply and gross domestic product. Though the variables in the model had the expected signs as depicted by the quantity theory of money, the result however showed that inflation is not purely a monetary phenomenon in Nigeria as the coefficient of growth of money supply is less than unity. Based on the result, the study recommended that the management of inflation in Nigeria should not be solely in the hands of the monetary authority.

From the various empirical findings there is support that money supply does impact inflation. So, we proceed to isolate the exact effect which money has on inflation in Nigeria.

METHODOLOGY

The importance of situating the exact effect of variations in money supply on aggregate price levels cannot be over emphasized, especially, in policy making realms. However, what is not less controversial is the appropriate methodology to adopt for the effect of money on inflation to be read correctly. In literature most studies have used the OLS based regressions separating variables into dependent and independent. But whereas theoretic expositions belong to the 'outer space' policymaking relates to reality. So that the first challenge is determining why some variables should be assumed constant and whether this assumption does not remove substances that could be useful for the exact form of correlation among variables. Recently, the vector autoregression has helped to downplay the need for holding any variables constant but it is not without its own challenges. What is the best form to apply it? This can only be answered when the temporal properties of variables are ascertained.

Data properties and model

The choice of data to be included in the model is fairly straight forward given the nature of the economy. Broad money supply and inflation are the principal variables but since they do not operate independent of the economy, such other variables that they influence or influence them should be added. The growth of the gross domestic product is easily the overriding objective of

macroeconomic policy. The interest rate channel of monetary policy transmission mechanism has been found to be dominant in Nigeria so that interest rate is a prime candidate for inclusion. However, the argument is made that interest rate to be used should be the difference between interest rate in consecutive periods because the decision to enter the credit market or roll over an existing credit, all other things the same will depend on whether rates are good or bad, that is increasing or decreasing. The effects of international transactions are felt mainly through exchange rate dynamics so that the exchange rate of the naira completes the list of variables. The GDP and CPI are stationary at levels while others are $I(1)$. Thus, all the variables enter the model at $I(1)$. The presence of cointegration does not support the use of unrestricted VAR so the VECM is applied.

The VECM takes the form.

A typical VECM model is specified as follows:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \dots + \Gamma_{k-1} \Delta Z_{t-k-1} + \pi Z_{t-1} + v_t$$

Where $\Gamma_i = -(1 - A1 - \dots - Ai)$ ($i = 1, \dots, k - 1$), a matrix representing short-term adjustments and $\pi = -(I - A1 \dots - Ak)$, being a coefficient matrix showing the long-run relationship between the variables in the vector. Z_t is $p \times 1$ vector of stochastic variables integrated of order 1, k is the lag length and v_t is $p \times 1$ Gaussian white noise residual factor. All the variables in the vector are treated as endogenous.

ESTIMATION RESULTS AND INTERPRETATION

The impulse response analysis is used to ascertain the effect of money supply on domestic prices. From the results one standard innovation on the growth of money supply will not have any effect on prices in the first period. This is expected because the change in money supply is driven by changes in interest rate which comes with a lag. In the second period, the innovation on money supply causes inflation to increase by 0.06 per cent. In the third period, inflation increases by 0.25 per cent. The effect of money supply on inflation remained positive all through to the 10th period. The results appear plausible because we expect money supply to impact prices through the interest rate channel. In the first period, the innovation on money supply reduced the lending rate by 0.47 per cent. The magnitude of impact declined to 0.13 per cent in the 2nd period but remained negative as expected all through the period. There are other interesting findings. The innovation on money supply did not have any effect on the gross domestic product in the first period. In the second GDP was induced to grow by 0.26 per cent. This may be explained by the fact that the increased money supply reduced the cost of capital and grew investment in the process and pushed aggregate demand higher. The result in the 3rd period is rather curious. The innovation on money supply caused a

decline of GDP by 0.01 per cent. Even if the magnitude of this decline is infinitesimal, the fact that the sign is negative requires scrutiny. But on the face value the reason might lie in the fact that some levels of money supply might be counter-productive to the economy. In fact from that second period the trend negative effect after positive effect is sustained all through (Figure 1).

The variance decomposition

This variance decomposition enables us to situate the exact fraction of the changes in the size of any included variable that is attributed to the variables in the model. Here the major consideration is inflation. From Table 1, as expected under normal circumstances, changes in inflation are accounted for by the size of inflation itself. This statement should be understood in the sense that current and expected levels of inflation underlie investment and consumption decisions. Thus, in the first and second periods after the innovation on money supply, the change in inflation was influenced to the extent of an average of 94 per cent. This is in line with expectation given the lag period other factors would take to have a visible impact on aggregate prices. In the third and fourth periods, the size of contribution waned to 85 and 84 per cent, respectively. From the fifth period, the self-contribution of inflation fell steadily until the 80 per cent in the tenth period.

The contribution of money supply, and indeed other variables must be evaluated from the prism of 'other' contributors other than inflation itself. In the first period, other variables did not affect the gross domestic product which accounted for 2.2 per cent. Again this is expected as price developments other than money would relate to sizes of inventory of finished goods and factor inputs and every other hiccup that obstructs the equilibrium between money supply and flow of goods and services. In the second period, the contribution of the GDP declined to 1.98 per cent, while the role of interest rate became noticeable at 0.71 per cent. Money supply also became more dominant than the GDP at 5.5 per cent. In the third and fourth periods, the contribution of gdp steadied at slightly above 3 per cent, while money supply accounted for 5.5 per cent. Money supply did not contribute less than 5 per cent of the variation in inflation from the second period when it became active in the system. From the fourth period, interest rate contributed an average of 1.1 per cent to changes in inflation until the tenth period. This is proof that interest rate is a major factor for investment decisions in Nigeria. The contribution of GDP improved in the third period and grew steadily from 3.1 per cent in that period to 7.7 per cent. The exchange rate was passive in the first two periods. From the third period its contribution averaged about 5 per all through the periods.

Cumulatively, other than the contribution of inflation to

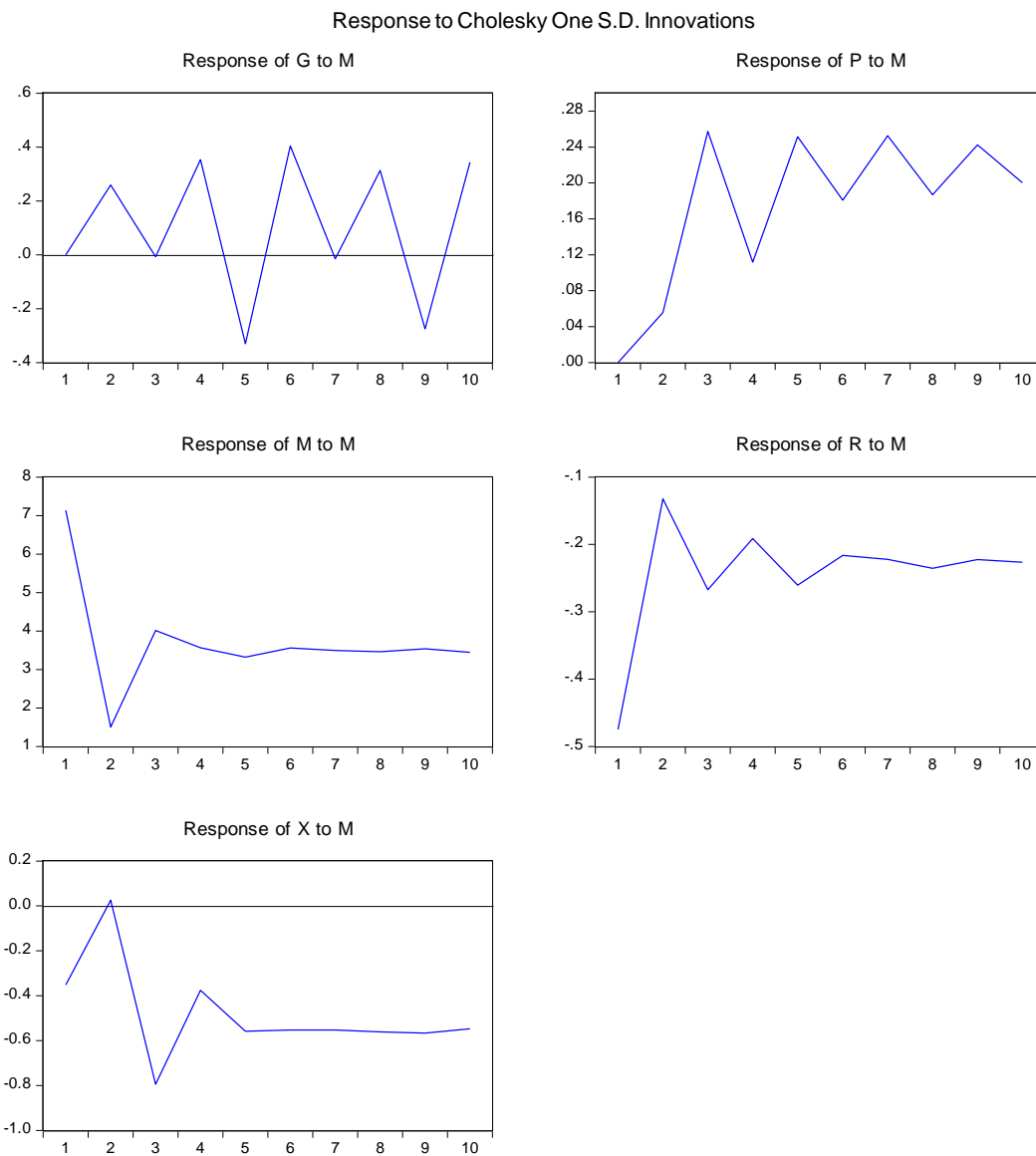


Figure 1. Responses of variables to changes in inflation.

Table 1. Changes in inflation

Period	S.E.	GL	LPI	XL	RL	ML
1	11.05604	2.221566	97.77843	0.000000	0.000000	0.000000
2	11.58847	1.983377	91.86037	2.65E-05	0.705998	5.450229
3	14.05258	3.144385	85.41350	4.984527	0.848359	5.609224
4	14.45098	3.785213	84.15055	5.603847	1.143092	5.317300
5	15.64870	4.357230	83.61330	5.564610	1.179332	5.285526
6	16.01323	5.855452	82.22981	5.513260	1.158119	5.243356
7	16.59501	5.903122	82.15994	5.509400	1.158325	5.269210
8	16.94778	7.039652	81.15318	5.459360	1.147722	5.200085
9	17.20647	7.046713	81.14530	5.459300	1.149130	5.199558
10	17.51857	7.720918	80.56165	5.416539	1.139992	5.160899

Cholesky ordering: GL, LPI, XL, RL, ML.

variations of inflation, money supply plays an important role in explaining inflation. It contributes 34.5 per cent of the other variables, while exchange rate and the interest rate differential accounted for 24.7 and 5.6 per cent respectively. Expectedly, GDP had the most dominant effect at 35.2 per cent. The latter finding reflects the prevalence of structural rigidities in the economy, while the contribution of exchange rate reflects the import dependent nature of the Nigerian economy.

Conclusion

The paper sought to ascertain the contribution of money supply to inflation in Nigeria. The data properties favoured the use of the vector error correction methodology. And using impulse response analysis results showed that money supply is a crucial variable for determining inflation in Nigeria. However, the response of the GDP contains cause for curiosity. Whereas it responded correctly positively in the 1st and 2nd periods, the sign turned negative in the 3rd period. And this trend continued on every other period. This needs closer scrutiny to properly understand the actual impact of monetary expansion on the gross domestic product until the 3rd period.

The variance decomposition revealed an important role for money supply in explaining the variation in inflation in Nigeria. Exchange rate and interest rate differential showed a strong presence as well, but the GDP was dominant.

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Annex 1.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.971799	377.0912	69.81889	0.0001
At most 1 *	0.787210	152.2815	47.85613	0.0000
At most 2 *	0.377736	54.79216	29.79707	0.0000
At most 3 *	0.235940	24.90553	15.49471	0.0014
At most 4 *	0.118576	7.951631	3.841466	0.0048

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.971799	224.8097	33.87687	0.0001
At most 1 *	0.787210	97.48933	27.58434	0.0000
At most 2 *	0.377736	29.88663	21.13162	0.0023
At most 3 *	0.235940	16.95390	14.26460	0.0183
At most 4 *	0.118576	7.951631	3.841466	0.0048

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values. Trace test indicates 5 cointegrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values; Unrestricted Cointegration Rank Test (Maximum Eigenvalue).