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Money Supply, Inflation and Capital Accumulation in Nigeria

Dayo Benedict Olanipekun[1*] Kemi Funlayo Akeju[1,2]
1 Department of Economics, University of Ibadan, Ibadan, Oyo State, Nigeria.
2 Department of Economics, Ekiti State University, Ado Ekiti, Ekiti State, Nigeria.
*e-mail: dayo626@yahoo.com

Abstract
This study examines the relationship between money supply, inflation and capital accumulation in Nigeria between 1970 and 2010. The study investigated the long run relationship of the variables using Johasen cointegration test. As a follow up to this, Error Correction Model was conducted on the variables to capture their short run disequilibrium behavior. Cointegration test reveals that variables employed in the study share long run relationship. The result of the Error Correction Model indicates that money supply (both broad and narrow) has a positive relationship to capital accumulation in Nigeria. It implies that government should direct finances on investment in other to stimulate economic growth in the country. Also the intention of government on inflation targeting should not neglect the contribution of money growth to capital accumulation.
Keywords: Money growth, Inflation, Capital accumulation, Cointegration test, Error Correction Model and Stability test.

1. Introduction

Money supply exerts considerable influence on economic activities in both developing and developed countries. The relationships between money growth, inflation and capital accumulation are core issues in developing counties due to the need to achieve a sustainable economic growth and development. Achieving a very low inflation rate has been the primary goal of monetary policy makers in many developing countries including Nigeria but most of the government policies to generate low inflation end up accelerating it. Developing countries in attempt to develop infrastructure, engage in expansionary monetary policy which has tendency of fuelling inflation.

Several studies have been conducted to examine the implication of money supply and inflation on growth process in developing countries. Among studies that have examined the linkage include Lucas (2000), Morooney (2002), Grauwe and Polan (2005), Odusanya and Atanda (2010), Omoke and Ugwuanyi (2010), Babatunde and Shaibu (2011). Some of these studies suggest the existence of a negative relationship between money supply, inflation and growth driven by capital accumulation while others have found a positive relationship among these macroeconomic variables.

Capital accumulation is indispensable in the determination of output growth in any nation. Specifically output growth depends on the rate of capital accumulation and the rate of capital accumulation in turn depends on the level of savings in an economy. The equality between and capital accumulation (investment) has been established in the Classical theory. This relationship is an identity.

Most developing countries aim at pursuing output growth with the intention of increasing capital accumulation in the short run through increases in money supply coupled with high inflation. Consequently, whether money growth affects output growth depends on whether it affects savings and investment. In developed economies, government avoids policies that can generate high inflation because they are already at a sustainable level of output growth. Conversely, most developing countries engage in expansionary monetary policy in other to push output above its existing level in the short run. The objective of this study is to examine both the short run and long run relationships between money supply, inflation and capital accumulation in Nigeria.

It has been observed that existing literature on money supply and macroeconomic variables have being centered on economic growth with a few studies focusing on capital accumulation which serve as an engine to growth. This study intends to contribute to empirical literature on the relationship between money supply, inflation and capital accumulation in Nigeria. Available statistics reveal that capital accumulation has been averagely low in Nigeria during the period under investigation. Episodes of de-accumulation[5] of capital were experienced in 1980 to 1982 of about 28%. Also in 2005 to 2007 existing capital stock decreased by 7%. This suggests a need to investigate factors that can contribute to capital accumulation in the country.

2. Development in Money Supply, Inflation and Capital Accumulation In Nigeria

Development in the monetary sectors shows that the growth in money supply was substantial as broad and narrow money have exhibited upward trend overtime. Money supply, narrow and broad grew rapidly from 16.3 and 19.4 percent in 1995 to 48.1 and 62.2 percent in 2000 respectively. The growth in monetary aggregates was

[5] De-accumulation was computed by calculating the growth rate and averaging periods experiencing negative growths

due to factors such as rapid monetization of oil inflows, minimum wage adjustments, and financing of government's fiscal deficit through the banking system.

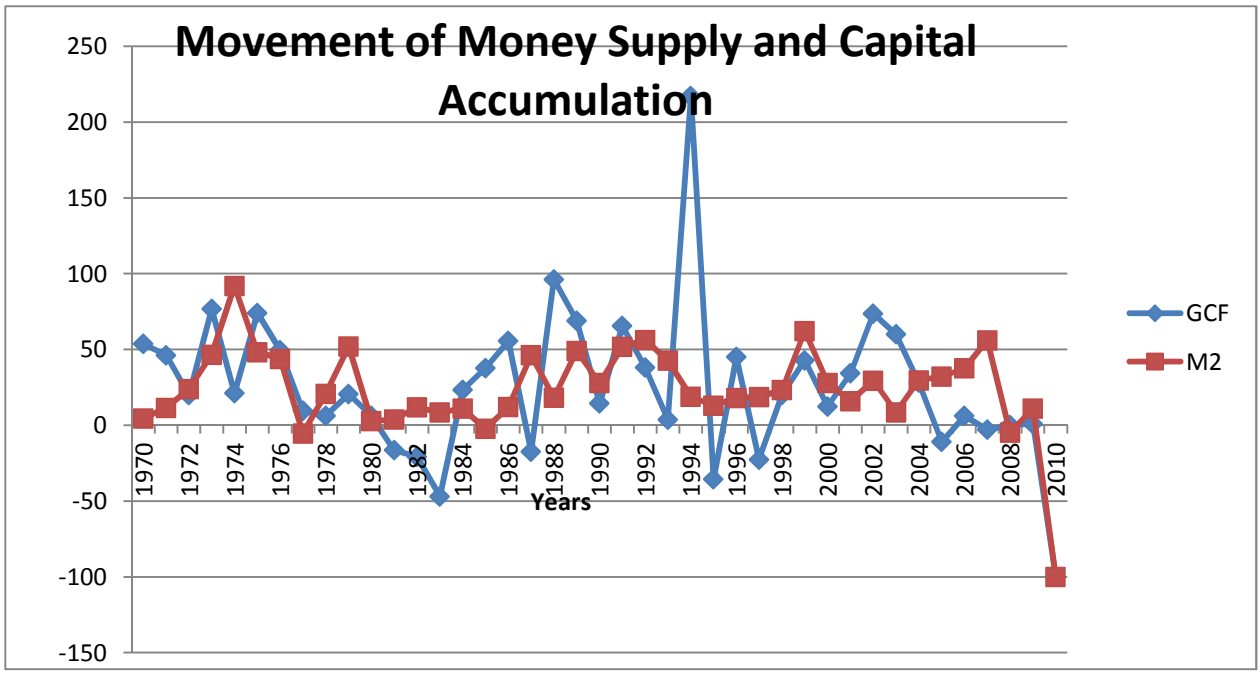
Nigeria has experienced high volatility in inflation rates. Since the early1970's, there have been several major episodes of high inflation, in excess of 30 percent. The growth of money supply is correlated with the high inflation episode because money growth was often in excess of real economic growth. However, preceding the growth in money supply, some factors reflecting the structural characteristics of the economy are observable. Some of these are supply shocks, arising from factors such as famine, currency devaluation and changes in terms of trade. In addition, in the late 1980's, following the Structural Adjustment Program, the effects of wage increases created a cost-push effect on inflation. In the long run, it was the structural characteristics of the economy, coupled with the growth in money supply that translated these into permanent increases.

The first period of inflation in the 30 percent range was in 1976, during this period, there was excessive monetization of oil export revenue, which might have given the inflation a monetary character. In 1985, inflation peaked at 40 percent at a time of relatively little growth in the economy. At that time, the government was under pressure from debtor groups to reach an agreement with the International Monetary Fund, one of the conditions of which was devaluation of the domestic currency

Due to the extensive money growth in the country coupled with government objective to fast track development, another episode of inflation started in the last quarter of 1987 and accelerated through 1988 and 1989 (CBN Economic and Financial Review, 1990). Inflation in the early 1990s was exceptionally high at 45 percent, 57 percent and 72 percent in 1992, 1993 and 1995 respectively, but the late 1990s witnessed a sharp reduction in the rate of inflation.

As part of effort towards increasing capital accumulation, the Nigeria's industrial policy 2003 was embarked on to focus on the competitiveness of industrial sector, finance, technological advancement, incentive to industries, research and development among others. In addition National Integrated Development (NIID) blueprint was adopted by the Federal Government in 2007.

Figure 1



Source: Constructed by the authors, from Central bank of Nigeria statistical bulletin 2010

The movement of money supply and capital accumulation as shown in figure 1 indicates that between 1970 and 1972 there were divergence in the growth rate of broad money supply and capital accumulation in Nigeria. A close observation of the periods of 1974 to 1980 indicates that money supply and capital accumulation show a close relationship in the direction of movement. De-accumulation of capital was visible in the characterization of the line graph analysis during the periods of 1980 to 1984 and 1994 to 1997. Several government policies discouraging domestic investment in these periods were responsible for the occurrence of de-accumulation of capital experienced. In the periods of 1998 through 2002 money supply and capital accumulation exhibit a close relationship which means that increase in money supply supported investment. 2004 to 2010, capital

accumulation remain at a low level and money growth fell critically as a result of financial crisis experienced in 2009 and 2010.

3. Literature Review

Existing theoretical literature on money supply, inflation and capital accumulation have provided divergence views on the relationship between the variables. Initial work by Tobin (1965, 1967) suggested that inflation has a positive effect on the stock of capital. This is called "Tobin effect". According to the Tobin effect a higher inflation will reduce return to holding real money balances and lead individuals to substitute out of money and into the alternative asset, physical capital. This permanent increase in inflation rate would result in a rise in the steady-state level of capital and output and a fall in the real interest rate. In Tobin's model the savings function is ad hoc. A number of authors have looked at the effect of inflation on capital stock models with optimal savings decisions. One attractive feature of these models is the need to be specific about how money enters the economy.
Sidrauski (1967) employed a model in which real money balances are an argument of agents' utility functions, in the model money is super-neutral in the long run, that is the steady state levels of capital, output and the interest rate are independent of the rate of inflation. In addition Fischer (1979) shows that the super-neutrality of inflation in the Sidrauski model does not hold along the transition path of the steady state. Fischer finds that inflation can affect the rate at which the economy approaches the steady state. Gillman and Kejak (2002) examined Tobin-type effects of inflation on the levels of various variables, such as capital usage. A three sector model with human and physical capital was presented in utility function consisting of consumption, leisure and physical capital. Human capital is produced with effective physical capital and effective labor each in a Cobb-Douglas fashion. According to the study the basic link between the magnitude of the growth and the level effect is the degree to which inflation affects the real wage to real interest rate ratio and this depends on the magnitude of the interest elasticity of money demand.
Egwaikhide *et al* (1994) employed cointegration and error correction model technique to analyse the relationship between exchange rate, money supply and inflation in Nigeria. The study showed that the Nigerian inflation seems to explain both monetary and structural factors and that official and parallel market exchange rate exert an upward pressure on the price level in the country. Udah (2009) examined monetary policy and macroeconomic management in Nigeria using 3SLS estimation technique in addition with a policy simulation experiment. Empirical findings from this study suggest that monetary variables and government finances are linked through government's net indebtedness to the banking system. The simulation experiments show that a 20 percent contraction in monetary variables would reduce inflation rate faster than if the reduction in money supply were 10 percent.
Odusanya and Atanda (2010) analyzed the dynamic and simultaneous inter-relationship between inflation and its determinant in Nigeria between 1970 and 2001. The long run and short run mechanism of interaction between inflation and its determinants were examined using Augmented-Engle Granger cointegration test and Error Correction Mechanism (ECM) model. Their results suggest that inflation rate, growth rate of real output and money supply and real share of fiscal deficit are stationary at level, indicating cointegration of the variables. While other variables incorporated in the model such as import, exchange rate, interest rate are stationary at first difference.
Omoke and Ugwuanyi (2010) examined empirically the relationship between money, inflation and output in Nigeria. The authors employed cointegration and Granger causality test for analysis. The findings revealed no existence of cointegrating vector in the series used. Money supply was seen to Granger cause both output and inflation. The result suggests that monetary stability can contribute towards price stability in the Nigerian economy since the variation in price level is mainly caused by money supply and also stated that inflation in Nigeria is to a large extent a monetary phenomenon. Also an empirical support in context of the money-prices-output hypothesis for Nigerian economy was given. Findings from Granger causality suggest that broad money appears to have strong causal effect on the real output as well as on prices.
Bakare (2011) employed ordinary least square, multiple regression technique to examine the relationship between capital formation and economic growth in Nigeria. The study tested the stationarity and cointegration of the two variables. Error Correction Mechanism was used to determine the short run adjustment behavior of the model. Findings from this study suggest that capital formation and economic growth share a long run relationship in Nigeria in the periods under investigation. The study conducted by Babatunde and Shuaibu (2011) provided a monetary growth model for Nigeria by examining the existence of a significant long run relationship between money supply, capital stock , inflation and economic growth between 1975 and 2008. The paper estimated the variables using error correction mechanism in the bounds testing approach to cointegration within an autoregressive distributed lag framework. Empirical findings from this study reveal a positive and significant relationship between money supply and capital stock while a negative relationship was found between inflation

and output growth.

3. Theoretical Framework

The theoretical framework used in this study is the monetary version of growth model proposed by Tobin (1965) and seeks to establish the relationship between money supply, inflation and capital accumulation. This model assumes two assets[6] physical capital and money, household can keep their wealth in either. This model is applicable in Nigeria context considering the structure of the economy and the institutional framework. Among the assumptions of this model is that individual earn income from production and it is also assumed that government makes lump-sum transfer to every household. In addition it is assumed that inflation reduces the value of money, therefore and individual will prefer to hold assets in physical capital during high rates of inflation.

In Tobin's model the decision is between money and physical assets. The production function employed in the model is in a standard Neo-classical type which can be expressed in the intensive form as;

$$y_t = f(k_{t-1}) \tag{1}$$

y_t is the current output. Equation (1) expresses current output as a function of previous capital stock.

Asset accumulation in this model is in two forms; capital and money. Individual income from production and also from government transfer payment. Let τ_t represent the total amount of money receive by individual as transfer payment from government.

$$y_t = N_t y_t, \quad \tau_t = \tau_t N \tag{2}$$

The lost in value of money due to inflation rate can be expressed as follows $\frac{\pi}{1+\pi}\frac{M_{t-1}}{P_{t-1}}$

Accumulation of assets equals to saving rate multiply by household income, therefore assets accumulation in this model can take the form of;

$$\Delta K_t + \Delta\frac{M_t}{P_t} = s\left(y_t + \tau_t N_t - \frac{\pi_t}{1+\pi_t}\frac{M_{t-1}}{P_{t-1}}\right) \tag{3}$$

s represent the fraction of savings in the economy

By substitution and re-arrangement of equation (3)

$$\Delta k_t = \left[s\left(y_t + \tau_t - \frac{\pi_t}{1+\pi_t}\frac{m_t}{1+n_t}\right) - \left(\Delta\frac{M_t}{P_t}\right)\left(\frac{1}{N_t}\right)\right] - \frac{n_t}{1+n_t}k_{t-1} \tag{4}$$

$$\Delta\frac{M_t}{P_t}\frac{1}{N_t} = \frac{\theta_t - \pi_t}{(1+\pi_t)(1+n_t)}M_{t-1}$$

Following this argument equation 4 can be re-expressed as;

[6] Egwaikhide, F.O (2012); Lecture note on Advanced Macroeconomics for Phd Economics Class, 2011/2012 session, University of Ibadan, Nigeria.

$$\Delta k_t = s\left[f(k_{t-1}) + \tau_t - \frac{\pi_t}{1+\pi_t}\frac{m_t}{1+n_t} \right] - \left[\frac{\theta_t - \pi_t}{(1+\pi_t)(1+n_t)} \right] M_{t-1} - \frac{n_t}{1+n_t} k_{t-1} \quad (5)$$

$$\tau_t = \frac{\theta m_{t-1}}{(1+n_t)(1+\pi_t)} \quad (5')$$

Substituting equation 5' in equation 5 and rearrange produces

$$\Delta k_t = sf(k_{t-1}) - (1-s)\left[\frac{\theta_t - \pi_t}{(1+\pi_t)(1+n_t)} \right] M_{t-1} - \frac{n_t}{1+n_t} k_{t-1} \quad (6)$$

The steady state condition is that $\Delta k^* = \Delta m^* = 0$

$$\Delta M^* = \frac{m^* + \theta m^*}{(1+\theta)(1+n)} - m^* = \left[\frac{1+\theta}{(1+\pi)(1+n)} - 1 \right] m^* = 0 \quad (7)$$

The expression in equation 8 shows that the growth of nominal money and population equals zero. Given this, it follows that inflation will be constant, therefore equation 8 becomes;

$$sf(k*) = (1-s)\frac{\theta - \pi}{(1+\pi)(1+n)} m^* + \frac{n}{1+n} k^* \quad (9)$$

Given that $\bar{n} = \frac{n}{1+n}$ equation 9 can be re-written as;

$$sf(k^*) = (1-s)\frac{\theta - \pi^*}{(1+\pi)(1+n)} m^* + \bar{n}\, k^* \quad (10)$$

Multiply and divide equation 10 by k and define $\frac{m^*}{k^*} as\, \eta^*$ gives

$$sf(k^*) = \frac{\theta - \pi}{(1+\theta)} \eta\, k^* + \bar{n}\, k^* \quad (11)$$

$$sf(k*) = \left[(1-s)\eta^* + 1 \right] \bar{n}\, k^* + \pi \quad (12)$$

Equation 12 is the Tobin's framework for capital accumulation, if we assume that savings equals investment

which is an identity in the classical theory. It expresses the effect of inflation through money supply on capital accumulation.

4. Methodology

Since the study deals with time series macroeconomic variables, econometric test of unit root is employed to test for the order of integration and determine the stationarity of the data. To determine the long run relationships of the variables, cointegration tests is conducted while error correction model (ECM) is used to adjust and correct for the possible short run dynamic behavior of the variables.

4.1 Discussion of Results

In other to investigate the stationarity properties of the variables, Augmented Dickey Fuller stationarity test was conducted for all the variables both at level and first difference. Inflation rate is stationary at level while other variables such as gross fixed capital formation, narrow money supply and broad money supply are stationary at first difference. Two cointegration tests were performed to verify the existence of long run relationship among the variables used in the study. Model one include narrow money supply with other variables, model two used broad money supply with variables such as inflation and gross fixed capital formation. The cointegration result provide an evidence of a long run stable relationship among variables employed in this study such as gross fixed capital formation, narrow money supply and inflation. The result of cointegration test employing the broad money supply, gross fixed capital formation and inflation rate is also convincing that there is an existence of long run relationship among the variables.

The result of the short run error correction model for model 1 shows that narrow money supply (M1) and lag 3 of inflation rate are significant at 5% while lag 2 of gross fixed capital formation significant at 10% level. A unit change in inflation rate will lead to 0.03 changes (decrease) in capital accumulation; one unit change in narrow money supply causes 0.80 changes (increase) in capital accumulation in the model. Also, a unit change in two periods lag gross fixed capital formation leads to 0.41 unit change in the current period capital accumulation and one unit change in three periods lag inflation rate causes 0.14 unit changes in capital accumulation in the model. The coefficient of ECM suggests the speed of adjustment of the model. It implies that in the current period 51% of the disequilibrium can be removed from the system.

The result of the short run error correction model for model 2, shows that two periods lag gross fixed capital formation and three periods lag inflation rate are significant in the model. Empirical evidence from the regression results also indicate that a unit change in two period lags gross fixed capital formation leads to 0.39 unit change in the current gross fixed capital formation. One unit change in three periods lag inflation rate causes 0.12 unit changes in the current period capital accumulation. The difference between model 1 and model 2 is that model 1 uses the narrow money supply while model 2 uses the broad money supply in estimation. Theory provides that CUSUM within the 5% critical bound is stable, hence it does not suffer from structural instability.

Conclusion

This paper examines the relationship between money supply, inflation and capital accumulation in Nigeria by investigating the long run relationship among the variables as well as determining their short run dynamics in the periods of 1970 to 2010. The study makes use of Johansen cointegration technique to investigate the long run relationship in the variables namely: gross fixed capital formation, narrow money supply, broad money supply and inflation. Two distinct models were run for narrow and broad money supply to avoid serial correlation in the variables and also to make comparison.

Evidence from the Johansen cointegration provides existence of long run stable relationship among the variables under investigation. The error correction model for model one revealed that narrow money supply has a positive relationship with capital accumulation but inflation shows a negative relationship. Model 2 provides that broad money supply has a positive relationship to capital accumulation in the model. The implication of these results is that government should appropriately channel finances to investment in other to increase the nation's capacity to produce since increasing capital accumulation leads to output growth in the country. However, the result of this paper suggest the necessity to investigate further about the variables that stimulate capital accumulation and how growth can be achieved using other variables. In addition very recent and sophisticated econometric techniques can be employed to carry out study on this topic.

References

Babatunde M.A. and Shuaibu M.I. (2011), Money Supply, Inflation and Economic Growth in Nigeria,

Asian-African Journal of Economics and Econometrics, Vol. 11, No. 1, 2011: 147-163
Bakare A.S. (2011), A Theoretical Analysis of Capital Formation and Growth in Nigeria, *Far East Journal of Psychology and Business* Vol. 3 No 1, April 2011.
Egwaikhide F.O, Chete L.N and Falokun G.O (1994), Exchange Rate, Money Supply and Inflation in Nigeria: An Empirical Investigation , *African Journal of Economic Policy* 1(1)
Gillman M and Kajak M. (2002), Modelling the Effect of Inflation, Growth, Levels and Tobin "*Center for Economic Research and Graduate Education*" http://www.jstor.org. Accessed 29/04/2012
Grauwe P. and Pollan M. (2005), "Is Inflation Always and Everywhere a Monetary Phenomenon?" *The Scandinavian Journal of Economics,* Vol. 45, No. 4, pp 672-710
Moroney, J.R. (2002), Money Growth, Output Growth, and Inflation: Estimation of a Modern Quantity Theory, *Southern Economic Journal*, Vol. 69, No. 2 pp 398-413
Odunsaya I.A and Atanda A.A. (2012), Analysis of Inflation and Its Determinants in Nigeria *Pakistan Journal of Social Science,* Vol. 7, No 2 pp 97-100.
Olubusoye O.E. and Oyaromode R. (2008) Modeling the Inflation Process in Nigeria, *AERC Research Paper* 182, African Economic Research Consortium, Nairobi, Kenya.
Omoke P.C. and Ugwanyi C.U. (2010), Money, Price and Output: A Causality Test for Nigerian, *American Journal of Scientific Research,* Issue 8, pp 78-87
Sidranski M. (1967) Inflation and Economic Growth, *Journal of Political Economy*, Vol. 75. No 6 pp 796-810
Tobin J. (1967) Money and Economic Growth, *Econometricia* XXXIII No. 4 pp 671-84
Udah E.B. (2009), Monetary Policy and Macroeconomic Management; A Simulation Experiment, *Global Journal of Social Sciences*, Vol 8, No 1, 2009

Table 1: Unit Root Test

S/No.	Variables	ADF constant at levels	Critical Value at 5%	ADF with constant at F.D	Critical value at 5%	Order of Integration
1	GCF	5.347217	-2.960411	-3.887769	-2.963972	I(1)
2	M1	2.982302	-2.960411	-3.509589	-2.960411	I(1)
3	M2	3.8512237	-2.960411	-3.752752	-2.963972	I(1)
4	INF	-3.314301	-2.936942	-6.136899	-2.941145	I(0)

Table 2 presents the cointegration result of gross fixed capital formation, inflation and narrow money supply.

Trend assumption: Linear deterministic trend

Series: GCF INF M1

Hypothesized No. of CE	**Eigen Value**	**Trace statistics**	**Critical Value at 5%**	**Prob****
None*	0.537143	43.18959	29.79707	0.0008
At most 1	0.274699	13.14643	15.49471	0.1015
At most 2	0.015794	0.620876	3.841466	0.4307

Trace test indicates 1 cointegrating equation at the 5% level.

Table 3 presents the cointegration result of gross fixed capital formation, inflation and broad money supply.

Hypothesized No. of CE	**Eigen Value**	**Trace statistics**	**Critical Value at 5%**	**Prob****
None*	0.512677	40.85364	29.79707	0.0018
At most 1	0.275225	12.81936	15.49471	0.1216
At most 2	0.006784	0.265479	3.841466	0.6064

Trace test indicates 1 cointegratiing equation at 1%

Model 1

Dependent Variable: Δ(GFCF), Method: Least Squares

Table 4: ECM of Narrow Money Supply, Inflation and Capital Accumulation

Variables	**Coefficient**	**Std. Errors**	**t-Statistics**	**Prob.**
C	-0.049298	0.037984	-1.297859	0.2042
Δ(INFL)	-0.026965	0.055208	-0.488414	0.6288
Δ(LM1)	0.804901	0.055208	2.422562	0.0217**
Δ(GFCF(-2))	0.409956	0.148017	2.769664	0.0095***
Δ(GFCF(-3))	0.201030	0.174066	1.154905	0.2572
Δ(INFL(-3))	0.135678	0.056697	2.393059	0.0232**
ECM(-1)	-0.511932	0.140422	-3.645674	0.0010***

R-Squared 0.472626 Akaike Info Criterion -1.287436
Schwarz Criterion -0.982668 F-Statistic 4.480941
Durbin Waston Stat 1.971969 Prob (F-Statistic) 0.002369

Model 2

Dependent Variable: Δ(GFCF), Method: Least Squares

Table 5: ECM of Narrow Money Supply, Inflation and Capital Accumulation

Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Prob.**
C	-0.106015	0.070396	-1.505988	0.1429
Δ(INFL)	-0.024968	0.065538	-0.380963	0.7060
Δ(LM2)	0.826346	0.546235	1.512804	0.1412
Δ(GFCF(-2))	0.390084	0.163390	2.387451	0.0237**
Δ(GFCF(-3))	0.251541	0.171786	1.464272	0.1539
Δ(INFL(-3))	0.118681	0.061675	1.924307	0.0642*
Δ(LM2(-2))	0.456047	0.444969	1.024896	0.3139
ECM(-1)	-0.472121	0.134154	-3.519253	0.0014***

R-Squared 0.412464 Akaike info criterion-1.1253
Schwarz criterion -0.777048 F- Statistic 2.908387
Durbin Waston Stat 1.868302 Prob (F-Statistics) 0.019712

* ** *** indicates 10%, 5% and 1% significance level respectively

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