

Does Money-growth Still Granger
Cause Inflation and Economic
Growth in Zimbabwe
1991-2005?

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ABSTRACT

The purpose of this study is to analyze, in the light of Zimbabwe's economic crisis, whether there is a stable and predictable relationship between monetary aggregates and macroeconomic variables such as output and prices. The study seeks to assess the relevance of the current designated intermediate target M3 in policy formulation. The relevance of the monetary aggregate is tested using Granger Causality tests and VAR on annual data for the period 1991-2005. This study offers insights on lessons to be learnt from a monetary targeting regime and in so doing fill gaps in the literature focusing on this issue. Evidence points to the fact that monetary aggregates are no longer relevant in Zimbabwe and that targeting of M3 and reserves should be discontinued in favour of an inflation or interest rate target.

1

INTRODUCTION

The purpose of this study is to analyze, in the light of Zimbabwe's economic crisis, whether there is a stable and predictable relationship between monetary aggregates and macroeconomic variables such as output and prices. Through this study the researcher assesses the relevance of current designated target monetary aggregate M3 in policy formulation. In this regard, using Granger causality tests, three testable hypotheses are investigated: (1) does M3 Granger cause inflation?; (2) does M3 Granger cause economic growth?; and (3) does inflation Granger cause economic growth? Granger causality tests are used as the basis and yardstick for this analysis in this regard.

Monetary aggregates are also the subject of intense observation by those attempting to predict Reserve Bank of Zimbabwe (RBZ) actions. The announcement of larger than expected M3 figure, for instance, leads economic agents to increase their estimation of the probability of the central bank increasing its bank rate. Many economists on the other hand study the aggregates to increase their understanding of the relationships between monetary growth and changes in other macroeconomic variables such as income and inflation.

The main money supply aggregate in the conduct of monetary policy in Zimbabwe is broad money supply, M3, which is the intermediate target. Under monetary targeting, the central bank monitors liquidity in the money market with a view of influencing it in a manner consistent with the monetary growth target. Monetary targeting involves the selection of a monetary growth target corridor for example 3.5 to 6.5 % per annum depending on the ultimate targeted real output and inflation in the economy.

Zimbabwe has three monetary aggregates as a strategy that ensures that the three would provide more information for the effective conduct of the monetary policy in order to affect the economy. The hierarchy of liquidity that emerges, from the three, is from the most liquid M1, a narrowly defined monetary aggregate that incorporates; currency in circulation and demand deposits progressing to the broader aggregates-M2 and M3; which include assets that may involve delays and other penalties before they are converted. Moreover, M2 and M3 are classified according to their characteristics as a medium of exchange and a store of value. This investigation focuses on broad money M3, the intermediate target.

This study is important firstly, because Zimbabwe pursues a monetary targeting (M3) monetary policy regime. Therefore the question of a definition of money goes to the heart of the matter of the effectiveness of monetary policy. Consequently, the effective role of monetary aggregates as intermediate targets and leading information variables requires a stable empirical relationship between the intermediate target and macroeconomic variables such as income and inflation. According to Gambs (1980), intermediate targets fall between instruments of the monetary policy and the ultimate target such as the growth of real output and the rate of inflation. These intermediate targets are generally more closely related to economic goals than are the instruments or operating targets such as the bank rate.

Secondly, this study is being conducted at a time when Zimbabwe is facing its worst economic crisis with the last official inflation figure for July 2008 pegged at 231million percent [MPS (2008)] and a phenomenal drop in output of over 40 percent over the previous ten years. Thirdly, this is the first attempt to independently, analyze empirically the definitions of money supply in Zimbabwe(if not in Africa) which is closely linked to maintaining price stability and promoting economic growth- an important and crucial policy issue which is closely linked to the stability of the relationship of money supply to prices. Although

the study is being done at a time when Zimbabwe has Dollarized, this is a stop gap measure which will soon be abandoned to return to a local currency. These issues discussed herein will become relevant in order to avoid falling into the same traps and thinking that led to the collapse of the Zimbabwean dollar. Finally, this study is an attempt to fill the gaps in the literature on this topic in Zimbabwe and Sub-Saharan Africa.

Universally, a breakdown of the stable relationship between the monetary aggregates and the macroeconomic variables, as has happened before in Zimbabwe due to structural changes in the financial markets (new instruments) and technological advances that introduced new payment methods has led to changes in the definition of monetary aggregates..

This paper is organized as follows. The ensuing Section 2 presents a review of monetary targeting in Zimbabwe. This study differs from its predecessors because it seeks to test for the stable and predictable relationship using the Granger causality and vector auto regressions. Section 3 reviews the literature. Section 4 expounds the methodologies such as the Granger causality test. In other words whether, past values of money help predict current values of output or inflation. Section 5 analyses the empirical results of the Granger causality test which are then tested again using variance decomposition and impulse response to obtain a deeper understanding. The three confirm the findings of the Granger causality tests. Section 6 concludes the discussion and questions the efficacy of pursuing a monetary target in the face of a pervasive inflationary expectations and a chronic time inconsistency problem Kydland and Prescott (1977) and Mishkin (2007).

2

MONETARY TARGETING IN ZIMBABWE

The current composition of monetary aggregates, in Zimbabwe, appears to be based on the functional or theoretical approach. The hierarchy of aggregates is from most liquid to the most illiquid and maturity proceeding from demand to long term deposits. This is in contrast to the U.K. where deposits are not distinguished by maturity since the long term deposits are not subject to penalties on redemption.

Since 2006, the reserve bank has started reporting foreign currency deposits included in all its monetary aggregates. While with effect from January 2009, the RBZ has imposed statutory reserves on Foreign Currency Deposits (FCDs). A point worth noting is that the RBZ does not report one monetary aggregate M0 (currency in circulation plus statutory reserves) or the monetary base. This is despite the fact that it has relied heavily on statutory reserves (60% on commercial and merchant banks inter alia) to inhibit the banking system's ability to multiply money supply through loans, RBZ (2006).

Monetary aggregates are defined by the Reserve Bank of Zimbabwe as follows: M1 is made up of currency in circulation and demand deposits; M2 is made up of M1 plus short term deposits; and M3 is made up of M2 plus long term deposits of which a portion comprises foreign currency deposits.

2.1 IMPLEMENTATION OF MONETARY TARGETING

Monetary targeting has its origins in the fact that there is a relationship between money supply and inflation. In the 1980's the monetary policy consisted of direct controls on both lending and deposit rates, quantitative controls on credit, prescribed liquid

asset ratios, and moral suasion. However, with the adoption of the Economic Structural Adjustment Programme in 1990, the RBZ shifted its monetary policy strategy to one that used monetary aggregates as the intermediate target. Under this scheme money supply growth is tightly controlled to ensure it remains within a set band.

To this end, the Reserve Bank of Zimbabwe uses the quantity theory of money to guide monetary targeting because it provides a transparent framework through which to analyse the relationship between the growth of money supply (M) and (P). An increase in money supply is directly reflected in higher inflation.

The central bank has supreme authority to supply money in the economy. This is known as exogenous money supply. However, the Reserve Bank of Zimbabwe lost its ability to do so because of its need to acquire foreign currency. Open market operations were no longer viable due to negative real interest rates prevailing thereby negating its ability to sterilize monetary injections. Money supply therefore became endogenous, thus limiting the central bank's ability to directly control money supply. It could, however, control those variables that influence short-term interest rates, namely the quantity of reserves held by the banking system and the monetary base, and thereby influencing the growth rate of the aggregates. Curiously, the Reserve Bank of Zimbabwe employed reserve money targeting from the mid 90's ostensibly on the realization that there is a stable relationship between reserve money and broad supply $M3$, through the money multiplier process but does not have an aggregate that reports this designated $M0$. Mabika (2001) recognizes this and asserts that the monetary base is a more suitable operational target. The central bank has in (recent years) its bid to control money supply rendered all bank deposits useless and worthless through denying economic agents access to them. Cheque, transfer or cash using local currency is no longer accepted despite the admonitions and proclamations of the Reserve Bank of Zimbabwe).

The Reserve Bank of Zimbabwe constructs its estimates of monetary aggregates from data supplied by banking and non-banking institutions and foreign central banks. These are periodically updated to reflect revisions or redefinitions of the aggregates. Zimbabwe's monetary aggregates have been redefined thrice over the past eighteen years.

The first attempt was in 1991 to take into account the changes brought about by the financial sector deregulation and liberalization, as well as, the technological innovations and new instruments such as Certificates of Deposit (CD). This led to the emergence of M3 aggregates.

The second attempt was in 1997 when deposits with non-bank financial institutions were included for the first time, Mabika (2001).

The third attempt was in 2006 when foreign currency deposits were included in all three monetary aggregates rather than as a footnote to M3 as was the case previously, Monthly Economic Review (2008). Inclusion of FCD in monetary aggregates also reflects their importance as a medium of exchange as the Zimbabwe dollar went into free fall. All these redefinitions were an attempt to include the new instruments which would be a substitute for M1 in the payments mechanism thereby, hopefully, restoring predictability to the relationship between money and nominal income.

Additional constraints (innovations result from the attempts by banks and economic agents to circumvent constraints .) have been imposed, for example limits on cash withdrawals, which affected negatively debit cards, credit cards, cheques payments and electronic transfers. Under such a financial repression of this type, economic agents have an incentive to undertake or intensify the search for new financial instruments; such as fuel coupons; foreign currency, barter, particularly for salaries for services.

3

REVIEW OF LITERATURE

3.1 MONETARY TARGETING

Monetary targeting involves a strategy where the central bank announces a target annual growth rate of a monetary aggregate, such as M1, M2 or M3 such as a 3 or 6% growth rate of M3, making the central bank accountable for meeting the selected target.

Benefits of monetary targeting include: immediate awareness of success or failure of a central bank in achieving its target; Targets send immediate signals to economic agents about the stance of the monetary policy. These signals influence inflationary expectations; and in theory they help constrain the monetary policymaker from abandoning the target. On the other hand, monetary targeting has been criticized for its dependence on assumptions such as; there must be a strong and predictable relationship between inflation or GDP and the targeted monetary aggregate. A weak relationship implies that the monetary policy will not be an efficient signal and this weakness makes it impossible for the monetary policy to be transparent and therefore reduces the central bank's accountability to the public. Another weakness is that of overshooting and undershooting the target. As a result of these weaknesses ; eventually most countries abandoned monetary targeting in favour of Inflation targeting (see table1) Mishkin (2007).

3.2 EMPIRICAL LITERATURE SURVEY

Review of the literature suggests that a common goal of the studies is to determine a stable relationship between monetary aggregates

and macroeconomic variables such as inflation and output regardless of the tools employed.

Friedman and Schwartz (1963) draw the conclusion that changes in money supply preceded changes in nominal income in the United States of America. Following this, Sheppard (1973); Dave and Lewis (1977) and Boehm (1983) conclude that monetary aggregates lead real economic activity. In all these researches, simple regression analysis was being used until Sims (1972; 1980a; 1980b; 1982 identified VAR as a more appropriate general testing procedure that clearly identifies the relationship between the various variables.

The work by Sims (1980a) resolved the three basic criticisms of the traditional macroeconomic model. Firstly, many of the variables were by default assumed to be exogenous to the system. Secondly, the results of the models were amended by users based on judgmental decisions. Finally, economic theory did not justify the selection of variables for inclusion in the reduced form of the model requiring the models to have exclusion restrictions added. In contrast VAR methodology is more robust.

A number of past studies have employed VAR starting with Sims (1972) seminal contributions comprised two hypotheses, the first being in a model with only two variables, money and output; money Granger causes output; the second hypothesis led to his later work Sims (1980) where he examined the question in a vector autoregression VAR employing additional variables, such as , prices and interest rates. He concluded that the statistical significance of the effect of money on output will be lower when other variables are included in a multivariate test. On the other hand, King and Plosser (1984) note that the strong influence of broader money on monetary aggregates is due to reverse causality, with money supply reacting to an increase in output.

The Central bank 's money was demonstrated to have a weaker effect on real activity. Building on previous efforts, Friedman

(1996) after placing money last, in order to generate variance decompositions to investigate money growth's contribution in explaining output and inflation; concludes that the predictive role of monetary aggregates had declined to negligible levels. Hayo (1998) [after testing four hypotheses including two from Sims (1980) and two from King and Plosser (1984); concludes that general hypotheses based upon Granger causality tests were not very robust with regards to different variables, time periods or countries. Nevertheless, he admits that there appears to be Granger causality effect present in many of the economies investigated.

3.3 LITERATURE ON ZIMBABWE

Kovanen (2004) attempts to find a monetary aggregate that could serve as a nominal anchor and seeks the presence of two elements; firstly a well-defined long-term relationship between the monetary aggregate and the price level. Secondly a credible monetary policy which he however concedes that it is the least important than the former. A good survey of the literature on Zimbabwe is provided in the study, confirming a well-identified relationship between monetary variables and the price level, for example Jenkins (1999) and Nyawata (2001).

Kovanen (2004) drew the following conclusions; that currency in circulation would provide a good leading indicator of future price movements. He also notes that reserve money which the Reserve Bank of Zimbabwe uses as an intermediate target is ineffective in the current hyperinflation environment: in addition to this he reveals that narrow money and broad money do not seem to have a well defined long term relationship with the price level. Moreover high inflation appears to distort statistical relationships. Munoz (2006) investigates the divergence between inflation and monetary expansion since late 2003, in particular the sharp drop in inflation in 2004 when inflation decreased in the face of an increase in real money balances. He concludes that

the likely cause of this was as a result of a repressed inflation or mismeasurement.

A goal of the foregoing research is to identify the monetary aggregate that exhibits certain characteristics that would aid in monetary targeting in order to achieve the goals of any economy. Mishkin (2007) argues that monetary targeting has certain benefits among them, transparency of the progress or lack thereof of achieving its target. Monetary aggregates make clear what the central bank's monetary policy stance is and therefore may result in high or low inflation expectations. They also allow for the central bank's accountability and a reduction of the time-inconsistency trap. However, Mishkin (2007) also recognizes that every benefit comes with a cost as the benefits are conditional.

The first is that, there must be a stable and predictable relationship between the goal variable (output or prices) and the targeted monetary aggregate. Following this, a weak or unstable and unpredictable relationship will not work. This situation means it would be a waste of time trying to obtain the desired target. Using the method of panel unit root and panel co integration on the money demand function in Sub-Saharan Africa Hamori (2008) concludes that money supply is a reliable policy variable as an intermediate target due to the relationship between money supply, output and inflation. In the case of Zimbabwe, monetary aggregates no longer provide an adequate signal of monetary stance. Monetary targeting will not dampen inflationary expectations; and it will not serve as a communication device that may increase the transparency of the monetary policy hence making the central bank accountable to the public.

This study diverges from the other studies in that it does not test for which instruments to include in the aggregates, but employs Granger causality tests to determine the relevance of targeting monetary aggregates in Zimbabwe. In short, this paper extends the empirical work to investigate the causal relationship between

money growth and economic growth and inflation in an emerging high inflation economy. It will fill in a gap in the literature available in this area of study. This follows the realization that not much has been done in this area since most works have tended to focus on advanced economies.

METHODOLOGY

This study employs Granger causality test to determine the direction of causality between any two variables as in Granger (1969). A time series $\{X_t\}$ is said to Granger cause another time series $\{Y_t\}$ if the prediction error from regressing Y and X declines by using past values of X in addition to past values of Y.

Definition of variables

The data used in this study is from 1991 to 2005. Data for 2006 to 2008 is unavailable. The data is from Reserve bank of Zimbabwe Annual Reports and Monetary Policy Statements.

The sequence of this section will be; model specification, definition and justification of the variables, theoretical and estimation procedures underpinning the test of stationarity, impulse response function and variance decomposition.

4.1 MODEL SPECIFICATION

The direction of causality between M3 inflation and economic growth is investigated using the Granger causality test, either the vector autoregressive VAR form as in Granger (1969) or the vector error correction form VECM as in Engle and Granger (1987) as appropriate. The following regressions will be estimated for testing causality between GDP and money:

The bivariate Granger causality Model

$$GDP_t = \sum_{i=1}^n \alpha_i M_{t-i} + \sum_{j=1}^n \beta_j GDP_{t-j} + \mu_{1t} \dots (1)$$

$$M_t = \sum_{i=1}^m \lambda_i M_{t-i} + \sum_{j=1}^m \delta_j GDP_{t-j} + \mu_{2t} \dots (2)$$

[Alternatively:

$$D \ln Pt = r_1 + S_{ai} D \ln M_{jt-i} + S_{di} D \ln Pt-i + \text{error term}$$

$$D \ln M_{jt} = r_2 + S_{bi} D \ln Pt-i + S_{gi} D \ln M_{jt-i} + \text{error term}$$

Where:

M_j is the broad money (M3) aggregate

Y_t is the measure of GDP

P_t is the Consumer price index representing inflation]

Where it is assumed that the disturbances μ_{1t} and μ_{2t} are uncorrelated. The first equation GDP postulates that current GDP is related to past values of GDP itself as well as of M. The second, states a similar behavior to the first equation.

The above gives rise to four situations as postulated by Gujarati (1995):

1. Unidirectional causality from M to GDP is indicated (since two hypotheses are being tested) if (1) can be rejected and (2) cannot, then this constitutes evidence of causality from M to GDP.
2. Alternatively, unidirectional causality from GDP exists if (1) cannot be rejected and (2) can be rejected; this constitutes evidence of causality from GDP to M.
3. Feedback, or bilateral causality, is suggested when both (1) and (2) are either both accepted or both rejected.
4. Finally, independence is suggested when the sets of M and GDP probabilities' are not statistically significant in both regressions.

The above implies that since the future cannot predict the past, it follows that if variable X Granger causes variable Y, then changes in X should precede changes in Y.

What will be interpreted are the probabilities which when they are statistically insignificant, then the null hypothesis is rejected. If the probability is statistically significant- the null hypothesis is accepted. Following the Granger causality theorem at least one of ρ_1 and ρ_2 is nonzero. A negative and significant coefficient ρ_1 and ρ_2 would imply or indicate the presence of a long-run causal relationship between money growth and inflation. For instance, if only ρ_1 is significant, this would suggest a unidirectional causality from money to prices implying that money drives prices, but not the other way around. If both ρ_1 and ρ_2 are significant, it would suggest bi-directional causality between money growth and inflation.

Furthermore, according to Hoosain (2005); any causality between devaluation and inflation can also be tested within the above framework. This study however, does not test this aspect. The interpretation in this study is guided by the above framework.

4.2 TEST FOR STATIONARITY: UNIT ROOT TEST

This study employs the Augmented Dickey-Fuller Unit Root Test to test for stationarity of the variables. The software employed is Eviews6. Testing for stationarity is justified because the availability of stationarity or lack thereof may strongly influence the series behaviour and properties: Use of non-stationary variables in a given model leads to "spurious regression phenomenon as discussed by Granger and Newbold (1974), and Phillips (1986). The t-ratio and R2 will become useless; non-stationary variables can prove that the standard assumption for asymptotic analysis will not be valid. This has been proven by Sock and Watson (1989) that the usual test statistics (t,F, DW, and R2) will not possess standard distributions where some of the variables in the model

have unit roots and are thus non-stationary. Thus the t-ratios will not follow a t-distribution and F-statistics will not follow any F-distribution. Granger (1986) demonstrates that any non-stationary time series $\{Y\}$ can achieve stationarity if differenced appropriately.

Decision rule:

If $t^* > \text{ADF critical value} \implies$ accept null hypothesis, i.e., unit root exists.

If $t^* < \text{ADF critical value} \implies$ reject null hypothesis, unit root does not exist.

5

EMPIRICAL RESULTS

5.1 UNIT ROOT TEST RESULTS

Table 5.1: Unit root test

Variable	ADF statistic-Level	ADF statistic -2 nd difference
M3	-3.970229*** I(0)	
P	-0.180221	-3.852530*** I(2)
Y	-4.302361*** I(0)	

Note: *** Significant at 1%; 5% and 10%

Critical values for testing stationarity in levels are

1% — 2.740613

5% — 1.968430

10% — 1.604392

Critical values for testing stationarity in 2nd difference are

1% — 2.771926

5% — 1.974028

10% — 1.602922

These results indicate that inflation was non-stationary in levels. After differencing the variable twice, they became stationary at all levels of significance, that is 1%, 5% and 10%. However, M3 and GDP were stationary at levels with a lagged difference of 0.

5.2 GRANGER CAUSALITY TEST RESULTS

By using Granger causality test, the causality question can be sharply addressed as to whether past values of money help predict current values of output. Granger causality refers to the capacity of X to forecast Y. Table 5.2 illustrates these results.

Table 5.2

Pairwise Granger Causality Tests

Date: 04/18/09 Time: 23:58

Sample: 1991 2005

Lags: 2

Null Hypothesis	Obs	F-Statistic	Prob
DP does not Granger Cause DM3V	13	22.9990	0.0005
DM3V does not Granger Cause DP		23.2409	0.0005
DY does not Granger Cause DM3V	12	0.57384	0.5878
DM3V does not Granger Cause DY		0.36474	0.7068
DY does not Granger Cause DP	12	2.97372	0.1162
DP does not Granger Cause DY		0.58882	0.5803

*Interpretation***The Granger Causality Between Money-growth and Inflation**

The results indicate that the probability that DP does not Granger cause DM3V is 00.005%, which is a small percentage that is too small to accept the null hypothesis. This means that causality runs from M3 growth to inflation. This is so because as prices rise so must the quantity of money and vice versa. On the other hand M3 growth does not Granger cause inflation is again a small percentage of 00.005%. Once again the null hypothesis must be rejected. There is thus bi-directional causality. This is in keeping with theory of the equation of exchange that all things being equal an increase in the quantity of money will be reflected in higher prices or inflation. Furthermore, this finding is consistent with the contention of Hoosain (2005) that in a high inflation environment budget deficits become entwined with both money supply growth and inflation in a vicious cycle. As government attempts to appropriate resources from economic agents by printing money and spending it faster than the rate of inflation in order to compensate for dwindling fiscal revenues.

The Granger Causality Between Money-growth and Economic Growth

The results reveal that the probability that economic growth does not Granger cause M3 growth is 58.779% a large probability requiring acceptance of the null hypothesis. It means that high output does not Granger cause an increase in money supply. The results also reveal that the probability that M3 growth does not Granger cause economic growth is 70.683%, a large probability indicating that it would be most unwise to reject the null hypothesis. This leads to the suggestion that M3 growth is no longer relevant as a target monetary aggregate and as an instrument of the monetary policy as it is unable to predict economic growth.

The Granger Causality Between Economic Growth and Inflation

A serious, but inconclusive debate is taking place in academia concerning the cut-off point at which inflation turns from being a positive influence on economic growth to being a hindrance. However, there is growing consensus that high inflation or even hyper-inflation is counter-productive for economic growth, but at low rates may be beneficial. The controversy is around the meaning of low rates, for instance Bruno and Easterly (1998) suggest that annual inflation rates above 40% may lead to growth crisis. On the other hand Sarel (1996) argues that it is around 8% and more that growth is negatively affected. Whilst on the other hand Ghosh and Phillips (1998) argue that it is located around 2.5% per annum and conclude that inflation is a strong determinant of growth.

The results illustrate that the probability that economic growth does not Granger cause inflation is 11.620%, a marginally significant probability requiring acceptance of the null hypothesis. Being marginal, it may suggest that inflation may under certain circumstances Granger cause economic growth as discussed above. As it stands economic growth does not Granger cause an increase in inflation. On the other hand, these results also reveal that the probability that inflation does not Granger cause economic growth

is 58.029%; a large probability indicating, once again, it would be most unwise to reject the null hypothesis. The acceptance of the null hypothesis in both instances leads to the suggestion that the relationship between economic growth and inflation is weak.

5.3 VARIANCE DECOMPOSITION

Variance decomposition is a standard tool of VAR which reveals the variance of the forecast error for each variable into components attributable to each of the endogenous variables thereby capturing both the direct and indirect effects. This is based on what Sims (1982) states that where a variable is truly exogenous with regard to the other variables in the system then its own innovations would explain all of the variables' forecast error variance.

Moreover, the different ordering of the variables affects the results of the variance decomposition and impulse response functions. To this end, the practice of placing the presumably exogenous variable first followed by relatively endogenous variables in Table 5.3. as recommended by Sims(1980) and Zhou(1996) has been adopted in this paper. Friedman (1996) did a study in which he placed money first.

Table 5.3

Variance Decomposition of DP:				
Period	S.E.	DP	DY	DM3V
1	31.88560	100.0000	0.000000	0.000000
2	112.1179	93.73730	0.619886	5.642819
3	167.1980	95.68639	1.183470	3.130141
4	195.1911	84.24412	10.70639	5.049499
5	207.1485	77.38631	15.80260	6.811089
6	305.4087	79.04521	15.16997	5.784824
7	439.6879	89.75192	7.455371	2.792712
8	593.1842	87.32629	6.961481	5.712225
9	765.0816	87.68847	6.095456	6.216078
10	853.1817	74.40908	20.13326	5.457653

Table 5.3 (cont)

Variance Decomposition of DY:				
Period	S.E.	DP	DY	DM3V
1	5.904634	28.70567	71.29433	0.000000
2	6.461418	31.07956	60.62650	8.293945
3	7.042969	37.06524	51.67594	11.25882
4	7.327639	35.06271	51.29437	13.64292
5	10.72878	62.78241	26.18098	11.03661
6	13.71345	55.52421	27.24272	17.23307
7	15.33302	45.15108	22.10887	32.74005
8	16.96822	38.24005	21.39465	40.36530
9	32.48997	75.88066	11.03605	13.08329
10	40.80010	60.79176	21.79752	17.41072

Variance Decomposition of DM3V:				
Period	S.E.	DP	DY	DM3V
1	542.8448	62.63851	21.72528	15.63621
2	1026.705	62.63016	12.36471	25.00513
3	1323.081	68.99356	8.222339	22.78410
4	1485.955	55.02710	21.47741	23.49549
5	2640.099	75.74657	9.028750	15.22468
6	3616.020	61.47038	16.88041	21.64921
7	4122.859	50.44941	13.55494	35.99565
8	4590.151	41.70673	16.45050	41.84277
9	9282.293	77.68153	8.963649	13.35482
10	11725.85	61.35611	19.99763	18.64625

Cholesky Ordering: DP DY DM3V

Interpretation of the variance decomposition results

The measure of whether a variable is exogenous or not is indicated by having 100% of shocks attributed to the variable at the tenth period. The results on display in Table 5.3 indicate that none of the variables is truly exogenous.

Inflation P

The first table of Table 5.3 displays the variance decomposition of inflation (P) to the other variables. The first column represents the period, in this instance 1-10. The second column indicates the Standard Errors of forecast for the indicated period. The error progressively increases over time reflecting the level of uncertainty involved in forecasting the various variables over multiple periods. The third column is that for inflation and illustrates the percentage of inflation that can be attributed to shock in its own variable regardless of other variables. The fourth column represents output or real GDP and illustrates the error variance of inflation that can be attributed to output. Finally, the fifth column is for money supply $M3 * V$. It shows the effect of money on inflation.

In the first period, it is clear that the forecast error variance of inflation accounted for by inflation is 100%; 0% by output and money supply respectively. In the tenth period the picture is much different; 74.40908% of inflation is accounted for by inflation; 20.13326% by output; 5.457653% by money supply.

The next higher percentage after inflation is output indicating that there is a link between inflation and output. Higher output results in a drop in prices whilst a drop in output may result in higher prices. Alternatively inflation in the short-run leads to an increase in output which in the long-run the relationship turns from positive to negative. The statistical significance of the effect of money on inflation is low in keeping with Sims (1980) hypothesis that the statistical significance of money on output will be lower when including other variables in a multivariate test.

Economic growth Y

The second table displays the variance decomposition of output (Y) to the other variables. In the first period the forecast error of output that is accounted for by its own innovation is 71.29433%, by inflation is 28.70567% and 0% by money supply. The tenth period reveals the following state of affairs; output accounts for 21.79752% of forecast error variance of output; 17.41072% due to money supply and 60.79176 due to inflation. This is consistent with our findings above and in keeping with theory of money. Money in this scenario has a stronger influence although it is still lower than output. A reason for this is provided by King and Plosser (1984) who contend that the strong influence of money is due to reverse causality, with money supply reacting to an increase in output. In the case of Zimbabwe output was actually decreasing.

Money supply M3

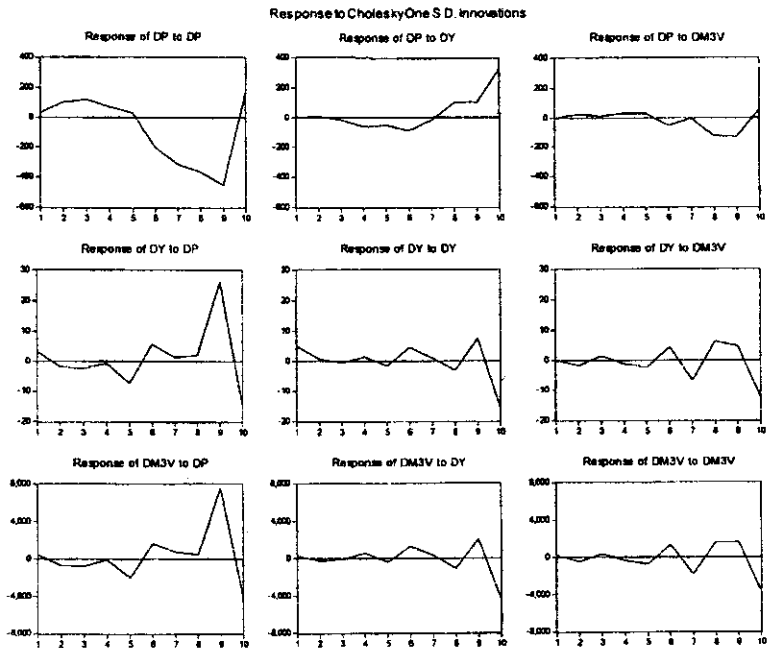
The third table is that of money supply and its decomposition. Only 15.63621% is accounted for by its own innovation (money); 62.63851% by inflation and 21.72528% by output. By the tenth period the changes were marginal; 61.35611% of forecast error variance in money supply is accounted for by inflation; 19.99763% by output; 18.64625% by money itself. The finding that 61% of money growth is accounted for by inflation is in keeping with the findings of Sargent and Wallace (1973) that inflation causes money growth and confirms our findings under Granger causality that there is bi-directional causality between inflation and money growth.

In conclusion, the effect of money on inflation and output is weak implying agreement with Granger causality that the direction of causality is from M3 to output and inflation. It appears further that M3 does not offer sufficiently-early warning signals that justify using only money as an economic indicator, Astley and Haldane (1997).

5.4 IMPULSE RESPONSE FUNCTION

The impulse response function measures how each endogenous variable responds to a shock and tracks the response to an innovation in the endogenous variable over a time period. This enables the dynamic interaction among variables in the system to be characterized. VAR models are visualized by impulse response diagrams bearing in mind that when interpreting focus it can give a response that is positive or negative.

Figure 5.1: Impulse response function



Interpretations of impulse response functions

The main focus of interpretation is the first two rows and constitutes the result or empirical findings of this investigation. A secondary goal is to prove whether the results of the Granger causality test and variance decomposition remain valid.

Inflation (P)

The first row illustrates the response of inflation to inflation; to output and to money supply. In the first instance, the response of inflation to its own shock starts off positive from the first period until the fifth when it turns negative until period nine when it turns again to positive growth by the tenth period. This conforms with theory of money that initial injections of money lead to no increase in inflation. In fact, it may have a positive effect on output. However, once economic agents catch-on, they acquire inflationary expectations. With regard to a response of inflation to output indicates that it is negligible for about two and a half periods before declining into negative territory until the seven and a half period when it turns into positive territory again. Finally the response of inflation to shocks from money supply indicate that from the first period the response was positive until the five and half period when the response turned negative.

Output (Y)

The second row illustrates the impulse response of output to inflation; to output; and to money supply. The response of output to its own shock indicates that it is cyclical. In the first period it is declining, reaches a peak in the fourth, dips below zero briefly in the fifth briefly before resuming its positive upward trend cresting the peak in the sixth period dipping below zero in the seventh and repeating the pattern until the tenth period. With regard to the response of output to inflation it is positive in the first period

turning negative in the second and continuing until the fifth when it turns upward in a positive growth breaching the zero barrier in the seventh period like that until the ninth period when it peaks and starts its decline to negative territory. This is in keeping with the theory of money. Finally, the response of output to money supply is negative in the first period and every alternate period peaks and goes negative and so and so forth. These findings confirm those of Granger causality test, that there is a marginal causation from inflation to output and a stronger causality from output to inflation.

5.5 EVIDENCE ACROSS COUNTRIES

Available literature indicates that, across countries, there is agreement as to what should be included in M0, the monetary base and in M1 components of narrow money as well as the application of functional and empirical approaches to define monetary aggregates, Lim and Sriram (2003).

Nevertheless, Table 6.1 reveals that the compositions of higher order monetary aggregates such as M2, M3 and so on differs across countries. These differences include the exclusion of government deposits in the monetary aggregates; the inclusion of mutual funds (unit trusts funds), inclusion of foreign currency deposits and maturity and divisibility concerns. Sims (1972), using U.S. data, established that money led income in Granger causality test between two variables money and output. Using VAR, Sheppard (1993); Davis and Lewis (1977) and Boehm (1983) all came to the conclusion that in Australia monetary aggregates lead real activity. Baek (1993) established that money supply shocks gave stronger and longer run effects to prices whereas real output growth was neutral to money growth. Meanwhile in the U.K, Astley and Haldone (1997) established that, in the 1990's, none of the monetary aggregates offered sufficiently early -warning signals to justify monetary targeting.

Table 6.1 Components of Monetary aggregates for selected countries

Country	M1	M2	M3 and higher order monetary aggregates	Monetary Policy target
<i>Industrial countries</i>				
Australia	CC+ current deposits of the private non-bank sector		M3=M1+ term deposits+ certificates of deposits (CD) +other deposits Broad Money=M3+borrowing from the private sector by NBF is less their holdings of currency and bank deposits	Inflation targeting
Canada	CC+DD	M1+SD+non-personal deposits	M3=M2+FCD+ nonpersonal TDs	-do-
Japan	CC+DD	M1+deposits with agreed maturity of up to (and including) two years+ and deposits redeemable at notice of up to (and including) two years	M3=M2+PSD+CD+ cooperatives, trusts	M2+CDs
Euro Area	CC+ overnight deposits	M1+ deposits with agreed maturity of up to (and including) Two years+ and deposits redeemable at short notice of up to (and including) two years	M2+repurchase agreements, money market fund shares and units +debt securities with a maturity of up to (and including) two years	Inflation targeting
U.S.	CC+DD at banks thrifts + other checkable deposits including (NOW),ATS accounts, credit union share drafts+ travelers checks	M1+ SD at banks and non-bank thrifts+ TD (small denomination) at banks and non-bank thrifts+ money market deposits +retail money market mutual funds	M3=M2+TD (large denomination) at banks and non-bank thrifts +institution-only money market mutual funds+ overnight/term Eurodollar balances at depository institutions	Interest rate

Table 6.1 (cont)

Country	M1	M2	M3 and higher order monetary aggregates	Monetary Policy target
U.K.	CC+DD	M2 (retail M4)=Notes and coins, and retail deposits in M4	M4=CC+ sterling liabilities of banks and building societies NBNBSPS	Inflation targeting

Developing Countries

Brazil	CC+DD	M1+SD+Special remunerated funds+ securities issued by depository institutions	M3=M2+RP+fixed yield funds M4=M3+highly liquid government Securities held by the public	Inflation targeting
Thailand	CC+DD	M1+ SD + TD M2A=M2+promissory notes	M3=M2A+ deposits taken by the six specialized financial institutions from the public	Inflation targeting
India	CC+DD+OD with central bank	NM2=M1+TD(short term)	NM3=NM2+TD (long term)+ call/ term funding from financial institutions	Inflation targeting
Korea	CC+DD NM1=DD+ instant access accounts at banks and non bank financial institutions (including MMFs at ITMCs)	M1+SD+TD+FCD New M2= M1+SD+RP+CD+ cover bills+ money in trust +beneficial certificates of investments trust companies and merchant banking corporation+ debentures+ other financial instruments(<2 years) at depository corporations	M3=M2+RP+CD+ OFI deposits+ debentures issued+ commercial bills sold +cover bills MCT=M2+CD+money in trust(excl. CD & money in trust of development institutions	

Table 6.1 (cont)

Country	M1	M2	M3 and higher order monetary aggregates	Monetary Policy target
Malaysia	CC+DD	M1+SD+FD+FCD+NIDs+repos	M3=M2+deposits placed with OBF is (excl. inter- placement of deposits between these institutions)	Overnight (policy) rate
Singapore	CC+DD	M1+SD+TD+OD+RP	M3=M2+ net deposits with NBFIs	Exchange rate targeting
South Africa	M1A=DD+ checks & transmission deposits of the domestic private sector M1=M1A+DD(other than check & transmission deposits)	M1+SD+TD+PSD	M2 +long term deposits held by the domestic private sector with monetary institutions (including national savings certificates issued by Post Bank)	Inflation targeting
Pakistan	CC+DD	M1+TD+RFCD		Inflation targeting
Zimbabwe	CC+DD	M1+TD	M3=M2+TD	M3

Source: Lim and Sriram (2003); Websites of the Central Banks. N refers to New; CD: certificate of deposits; DD: demand deposits; TD: time deposits; SD: savings deposits; FCD: foreign currency deposits; CC: currency in circulation;

5.6 FUTURE RESEARCH

The quantity theory offers valid explanations for the behaviour of inflation and output based on the increase or decrease of money supply. However, in as far as determining the existence of a relationship, it proves that such a relationship does exist. It is not however able to establish the strength of that relationship or direction of causality. This requires the use of, Granger causality, variance decomposition and impulse responses. Other areas for future investigation include; the inclusion of monetary aggregates such as private sector credit, nominal income, currency in circulation, M1 and M2; the causality relationship between currency devaluation and inflation.

6

CONCLUSION

This paper investigated, using annual data for the period 1991-2005, whether there is stable and predictable relationship between the monetary aggregates and macroeconomic variables such as output and prices. In so doing the study seeks to determine how relevant the current designated monetary target M3 is for policy formulation. To this end, three hypotheses were tested, that is; (1) does the M3 Granger cause inflation? (2) does money supply Granger cause economic growth/ output? (3) does inflation Granger cause economic growth/output? In other words, testing whether money can forecast inflation or output; the stability and predictability was determined through Granger causality test and VARs. The empirical results suggest that there is a bi-directional causality between inflation and money supply. The relationship between output and money supply, on the other hand, indicates that money supply does not Granger cause output. Finally, with regard to the relationship between inflation and output the null hypothesis is accepted that inflation does not Granger cause output.

This raises the question; should the Reserve Bank of Zimbabwe be targeting monetary aggregates in the light of these findings? The answer is a clear and emphatic no. Having said that the problem runs much deeper and makes a strong case for the reform of the Central bank and in particular, its relationship with government, Nhavira (2009). The Reserve Bank of Zimbabwe has never announced a specific monetary target and by implication not been accountable to the public, thus pointing to the existence of a time inconsistency problem, Kydland and Prescott (1977).

Many countries that attempted monetary targeting in the 1980's have since abandoned it because where Friedman and Schwartz's two conditions precedent are absent, monetary targeting will not work and consequently not solve the inflation expectations, Lim and Sriram (2003) and Mishkin (2007). The new approach is monetary transparency and inflation targeting for managing inflation expectations. Based on the empirical findings, it is recommended that the Reserve Bank of Zimbabwe adopt monetary policy transparency and inflation targeting in order to gain credibility and dampen inflationary expectations, Nhavira (2009). Finally an overriding lesson of Zimbabwe's troubled monetary history is that money is something not to trifle with.

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