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THE ENDOGENOUS/EXOGENOUS NATURE OF SOUTH AFRICA'S MONEY SUPPLY UNDER DIRECT AND INDIRECT MONETARY CONTROL MEASURES

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Abstract

The main purpose of this paper is to describe South Africa's money supply process along several competing, but not mutually exclusive, theoretical paradigms over the period 1966-1997. The most important conclusion to be drawn from the empirical results is that irrespective of the monetary system at the time, the money supply process in South Africa is endogenously determined. The empirical analysis further shows that the inability of the South African Reserve Bank (SARB) to reach predetermined M3 monetary growth targets on a consistent basis since the mid 1980s is the direct result of an endogenous money supply and not, as a previous study claims, because of an unstable M3 velocity. Although the M3 velocity is stable over the whole period 1966-1997, money income determined an endogenous money supply, so that the M3 money supply lost its effectiveness as a *leading indicator* for monetary policy. The policy implication is that the SARB controlled the M3 money supply indirectly over the period 1980-1997, through an increase in interest rates, and at the potential cost of a slowdown in economic activity.

JEL Classification: C22, E51, E52, E58

Keywords: Exogenous/endogenous money supply, M3 velocity, Causality tests

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THE ENDOGENOUS/EXOGENOUS NATURE OF SOUTH AFRICA'S MONEY SUPPLY UNDER DIRECT AND INDIRECT MONETARY CONTROL MEASURES

I Introduction

Following the significant financial reforms in 1980, the South African Reserve Bank (SARB) adopted a policy of setting predetermined monetary growth targets for M3 since the mid 1980s[1]. In contrast to empirical studies which have found evidence of a stable M3 money demand function[2], Moll (1999) recently identified the presence of an unstable M3 velocity over the period 1960-1996 as one of the underlying causes to explain the failure of the SARB to reach predetermined monetary growth targets on a regular and consistent basis.

After the publication of Kaldor's seminal work in 1982, it became apparent that although a stable money demand function is a necessary condition for there to be a stable and predictable link between money and money income, it does not necessarily validate the monetarist contention that the money supply is causal in the process of inflation[3]. Thus, even when velocity is perceived to be stable, one way causality from money income to money or even bi-directional causality could provide alternative explanations why monetary growth targeting was less successful in South Africa. A stable velocity implies that the relevant

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[1] It is important to note that monetary growth targeting since the mid 1980s has not been based on direct monetary control measures as proposed by the orthodox monetarist approach, but indirectly through the SARB's interest rate policy. A more detailed discussion of the different monetary systems that characterised the period 1966-1997 will be presented in section III.

[2] Hurn and Muscatelli (1992) provide evidence of a cointegrating relationship between M3, income, prices and interest rates. Nell (1999) finds evidence of a stable real M3 money demand function over the period 1965-1997.

[3] Hendry and Ericsson (1991), for example, find a stable real money demand function for the United Kingdom over the period 1878 to 1970, but at the same time show that money is endogenously determined. By applying the same methodology, Macdonald and Taylor (1992) find similar results for the United States.

monetary aggregate could serve as a *broad* indicator for monetary policy, but that it loses its effectiveness as a *leading indicator* when the money supply is endogenous or partly endogenously determined.

The main purpose of this paper is to describe South Africa's money supply process along several competing, but not mutually exclusive, theoretical paradigms over the period 1966-1997. The paper will show that M3 velocity is indeed stable over the period 1966-1997 when the broadest definition is considered, and that a stable velocity necessitates a reassessment of the endogenous/exogenous nature of M3 money to provide a possible explanation for the failure of monetary growth targeting in South Africa. According to Niggle (1991), over a long period the money supply may be regarded as exogenous or endogenous depending on the degree of financial development and the nature and conduct of monetary policy. To determine the exogenous/endogenous nature of South Africa's money supply over the period 1966-1997, Niggle's (1991) analysis suggests a periodisation over the sub-periods 1966-1979 and 1980-1997 to capture the impact of direct and more market-oriented monetary control measures respectively. Such an analysis would seem important to capture the long-run causes of inflation in South Africa.

The plan of the paper is as follows. Section II sets out the hypotheses to be tested in the empirical section together with a theoretical overview to distinguish between the two main competing theoretical paradigms on the endogenous/exogenous nature of the money supply. In this section a distinction will also be drawn between the dissident views that remain within the Post-Keynesian camp on the nature of the endogeneity of the money supply. Section III provides an overview of the salient features of monetary policy in South Africa. Section IV discusses the econometric methodology to test the hypotheses outlined in section II, while section V presents the empirical results. Section VI ends with some conclusions and policy implications.

II An Overview of the Main Theoretical Paradigms on the Exogenous/Endogenous Nature of the Money Supply

Table I summarises the hypotheses of three empirical studies which are representative of three theoretical views on the exogenous/endogenous nature of the money supply. The main empirical content of each study is based on Granger causality type tests.

[Table I here]

II.i The Accommodationist View versus the Monetarist View

The main exponents of the accommodationist view can be found in the writings of Kaldor (1982); Kaldor and Trevithick (1981); and Moore (1988, 1989a). The accommodationist view is a direct challenge to the orthodox monetarists' approach who believe that the money supply is some multiple of the monetary base. Reserves therefore make deposits and the deposits that result from an increase in the monetary base are exogenously determined by the monetary authorities. Explicit in this approach is that the money multiplier is stable and predictable, so that restrictive (expansionary) monetary policy will not be offset by an increase (decrease) in the money multiplier (Lavoie, 1984).

In direct contrast, the accommodationist view argues that the monetarist approach is incompatible with the real world where commercial banks are price setters and quantity takers (Moore, 1989b). If banks are in the business of selling credit, Central Banks inevitably play a crucial role to supply the necessary currency and reserves on demand. According to Moore (1989a, 1989c), reserves must always be provided on demand by Central Banks to ensure the liquidity of the financial system and to fulfil their role as lender of last resort. If accommodation occurs through the discount window, then banks will base their lending rates as some mark-up over the cost of borrowing from the discount window. The money supply process described by the accommodationist approach therefore implies that loans make

deposits and that the resulting deposits are endogenously determined. It follows that changes in the money supply are a *result* and not a *cause* of changes in money income, and vary in relation to prices and output (Kaldor and Trevithick, 1981).

If reserves are fully accommodated by the Central Bank and the loan supply schedule of commercial banks is horizontal, then the empirical hypotheses of the accommodationist view in Table I predict unidirectional causality from the M3 money supply (*LM3*) to base money (*Lh*), and unidirectional causality from total bank credit (*Lcredit*) to *LM3*. Although not explicitly included in Moore's empirical study (1989b), the accommodationist approach implies that there is unidirectional causality from money income (*Lmi*) to *LM3*.

II.ii The Structuralist View

Although it is fully acknowledged that the endogenous nature of the money supply process has its origins in the views expressed by the accommodationist approach, structuralists argue that full accommodation is an unrealistic real world assumption and assert that the demand for credit is at least, to some extent, quantity constrained by the Central Bank and commercial banks[4]. Structuralists such as Palley (1994) and Pollin (1991) argue that accommodation depends on both the stance of the monetary authorities and the private initiatives of banks[5]. Through open market operations, Central Banks have the option to place significant quantity constraints on reserve availability (Pollin, 1991). In the structuralist view,

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[4] Davidson (1988) for example, associates an exogenous money supply with a perfectly inelastic money supply function and an endogenous money supply with a less than perfectly inelastic money supply function. Thus, an endogenous money supply does not necessary imply that the money supply function should always be perfectly elastic (Davidson, 1989; Goodhart, 1989).

[5] A related idea presented by Dow (1996), although not prominent in the writings of structuralists, is that private banks express their liquidity preferences in terms of risk assessment. Credit rationing occurs with respect to particular classes of borrowers and during the downturn of the business cycle.

discount window borrowing is not a close substitute for nonborrowed funds restricted by open market operations. Structuralists stress that the marginal cost of borrowing from the discount window rises each time banks use this option, since the discount rate is positively related to the level of borrowed funds (Palley, 1994). In contrast to the accommodationist approach, the loan supply schedule of banks is positively sloped and not horizontal.

An important feature of the structuralist endogeneity approach is their emphasis on liability management practices that allow banks to partly overcome reserve constraints imposed by the Central Bank. Although liability management can go a long way to overcome reserve constraints, structuralists emphasise that liability management need not necessarily create an adequate supply of reserves to meet demand (Pollin, 1991)[6].

The structuralist hypothesis in Table I can be described as a mixed model which incorporates some of the ideas of the monetarist approach and the accommodationist view. The accommodationist part of the model depicts causality from *Lcredit* (total bank credit) to *Lh* and the monetarist part of the model causality from *Lh* to *Lcredit*. The monetarist part of the model also depicts causality from the *Lm* (M3 money multiplier) to *Lcredit*. Although the relations described by the accommodationist view in Table I could be used to test the structuralist view, Palley's (1994) relations test the monetarist version indirectly, where it is assumed that excess reserves that result from expansionary monetary policy ($Lh \Rightarrow LM3$) are lent out to the general public (i.e. $Lh \Rightarrow Lcredit$). If the structuralist view holds true, then an additional test should indicate bi-directional causality between money income (*Lmi*) and *LM3*. Finally, if *Lh* does not proportionately support an increase in the demand for *Lcredit*, i.e. a less

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[6] The accommodationist view also recognises the important role of liability management practices and the growth of off-balance-sheet items (loan commitments) to overcome reserve constraints (Moore, 1989a). However, unlike structuralists, the accommodationists believe that these practices will fully offset any amount of reserve constraints.

than unitary long-run elasticity conditional on *Lcredit* being exogenous, then structuralists identify liability management practices as an alternative to supplement the shortage in reserves. Increased lending causes liability transformations so that *Lcredit* causes an increase in *Lm*. Given that the main components of the money multiplier consist of the currency deposit ratio (*cd*) and reserve deposit ratio (*rd*), Palley's test implies that liability management - bidding up rates to attract funds from demand deposits with high reserve requirements into time deposits with lower reserve requirements - frees up reserves which subsequently alters *cd* and *rd*[7].

II.iii The Liquidity Preference View

This approach fully supports the accommodationists' core theoretical arguments in favour of an endogenously determined money supply. However, the liquidity preference view's main criticism is based on the assumption made by accommodationists that money can never be in 'excess' supply, and hence that there is not an independent money demand function that plays its traditional role (Arestis and Howells, 1996; Howells, 1995; Howells, 1997; Goodhart, 1989; Palley, 1991). According to Howells (1995), the main controversy revolves around the identification of a reconciliation mechanism to ensure that the supply of new deposits created by the flow of new net lending is just equal to the quantity demanded. Kaldor and Trevithick (1981) identify the automatic repayment of loans as an appropriate

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[7] According to Pollin (1991), one way to describe liability management is by attracting funds out of demand deposit accounts which have relatively high reserve requirements, into instruments within the short-term money market. When banks borrow short-term money market instruments the reserve requirement associated with their liability will be lower compared to demand deposits. One implication of liability management as described by Palley (1994) and Pollin (1991), is that the former case implies a rise in the velocity for a narrow definition of money while the latter case may be associated with a rise in velocity for a broader definition of money.

mechanism. Moore's (1991) treatment is more explicit and states that since money is always acceptable as a means of payment, the deposits that result from loans are willingly held by new deposit holders[8].

The empirical hypothesis of the liquidity preference view in Table I predicts causality from *Lcredit* to *LM3* if the money supply is endogenously determined. However, if the demand for money and the demand for loans are *independent*, it follows that the supply of deposits created by the net flow of new bank lending are not willingly held by new deposit owners who have liquidity preferences about the amount of money they wish to hold. If this is the case, then the demand for money places a constraint on the ability of loans to create deposits so that causality can also be expected from *LM3* to *Lcredit*[9].

III Monetary Policy in South Africa over the period 1966-1997

This section provides a brief overview of the salient features that characterised monetary policy over the sub-periods 1966-1979 and 1980-1997. An analysis of this nature will clearly show why it is necessary to test the relations in Table I over two different sub-periods.

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[8] Also see the debate between Howells (1997) and Moore (1997) on an appropriate reconciliation mechanism.

[9] The reconciliation problem can be explained in terms of a demand for money function and a demand for loans function which both include prices and real income. Under an endogenously determined money supply the demand for loans will be driven by prices and income. Without a reconciliation problem we would expect identical price and income elasticities in the money demand and loan functions, so that the deposits created by loans are willingly held by deposit holders. If the elasticities are not similar, then there is a reconciliation problem which may induce new deposit holders to dispose of any excess by either spending it or buying bonds. The actions by deposit holders could trigger further price and income changes so that the supply of deposits is eventually reconciled with the demand for deposits. The reconciliation problem is further exacerbated when it is considered that the individuals or agents who demand loans, are different from the set of agents who eventually hold the deposits created by loans (Howells, 1995).

III.i Direct Control Measures: 1966-1979

Direct control measures were mainly based on credit ceilings, cash reserve requirements, liquid asset reserve requirements and interest rate control measures. In its Final Report, the De Kock Commission (1985) mentioned several reasons why monetary policy based on direct control measures was less successful in moderating and controlling credit expansion and money supply growth[10].

First, it is widely acknowledged that liquid asset reserve requirements during this period did not prevent large expansions in credit and money supply growth (Gidlow, 1995; Meijer, 1992). Second, direct control measures such as credit ceilings and liquid asset reserve requirements, led to 'disintermediation' since the mid 1970s[11]. In addition to primary lenders and ultimate borrowers, banks also participated in 'disintermediation' on a large scale by entering money broking fields and arranging off-balance-sheet financing for their clients (Black and Dollery, 1989).

The 'disintermediation' phenomena is captured in Figure I by the movements in the velocities (in logarithms) for the different monetary aggregates.

[Figure I here]

Two striking features stand out. First, Figure I shows a gradual increase in the M1 and M2 velocities (trended) during the 1960s, whereas the increases become more precipitous since the mid 1970s. After the financial reforms in 1980, the decline in M1 and M2 velocities

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[10] See Black and Dollery (1989) for a summary of the Final Report.

[11] 'Disintermediation' refers to the replacement of credit normally extended by banks, by non-intermediated credit extended between primarily lenders and ultimate borrowers. Liquid asset reserve requirements forced banks to use some of their own deposits to buy low-yielding statutory liquid assets. This caused banks to offer a low interest on deposits and a higher charge to borrowers. Liquidity constraints imposed by banks through higher lending rates and additional direct control measures such as credit ceilings, could largely explain the 'disintermediation' phenomena experienced over the period 1976-1979.

describes the 'reintermediation' phenomena where credit extensions outside the banking system returned to the balance sheets of banks. One implication is that the M1 and M2 velocities are not stable over the period 1966-1997, nor over the sub-periods 1966-1979 and 1980-1997. Second, the M3 velocity remains fairly stable along its trend value over the whole period under analysis. The descriptive evidence strongly suggests that velocity becomes more stable as we move from a narrow to a broader definition of money, and further implies that the instability in the different velocities can be found in the demand for deposits and currency components which define a narrow M1 definition of money[12]. It is of paramount importance to note that a stable velocity over the period 1966-1997 will ultimately depend on whether we use the broadest definition or not[13].

The analysis thus far suggests that the unstable and stable velocities for M1, M2 and M3 respectively, may have an important bearing on the interpretation of the empirical hypotheses described in Table I. Over the period of direct monetary control measures the relation between the M3 money multiplier and total credit may not necessarily describe liability management,

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[12] More specifically, the rise in velocity can be described as an increase in nominal GDP relative to currency and demand deposits that define a narrow definition of money. Using an extreme example, the decline in velocity following the financial reforms in 1980 is similar to moving from a barter economy to one with a financial system. The visual evidence supports the main results of a previous study, which showed that the demand for real M1 and M2 money balances display instability features following the financial reforms in 1980, while the demand for real M3 money balances remain stable over the period 1965-1997 (Nell, 1999).

[13] The increase in the instability of velocity as we move from a M3 definition to a narrow definition, may well provide an explanation why Moll (1999) found no evidence of a stable M3 velocity. The M3 definition used in this study is obtained from the SARB's historical data set on the internet (http://www.resbank.co.za/Economics/econ.html), and defines the broadest measure of money in South Africa. In contrast, Moll's (1999: 63) data are obtained from International Financial Statistics, where M3 is defined as M1 plus time and savings deposits. According to Moll (1999) "*…..the figure for M1 + time and savings deposits is closer to the SARB's M3 than it is to the SARB's M2*" (p.64). Clearly as the visual evidence suggests, empirical support for a stable velocity will crucially depend on whether we use the broadest definition of money. Any definition which is M1, M2 or somewhere between M2 and M3, may yield unstable results.

but rather the growth of off-balance-sheet items. If credit extensions took place outside the banking system to overcome reserve constraints imposed by the Central bank, then the relevant question is what happens when the loans are spent? A possible answer is that some of the funds find their way back to the balance sheet of banks and appear as deposits on the liability side. The potential implication is that in the long-run banks can fulfil their role as financial intermediaries despite loan arrangements initially taking place outside the banking system. Thus, in the short-run we would expect that an increase in the demand for credit causes the *cd* and *rd* ratios in the M3 money multiplier to rise (rise in velocity), so that an increase in credit demand impacts negatively on the M3 money multiplier. In the long-run, if some of the credits extended outside the banking system find their way back as deposits on the balance sheet of banks, we would expect the *cd* and *rd* ratios in the M3 money multiplier to fall (fall in velocity), so that credit demand impacts positively on the M3 money multiplier.

III.ii Indirect Monetary Control Measures: 1980-1997

Following the De Kock Commission's recommendations in its Interim Report in 1978 and eventually its Final Report in 1985, the period after 1979 witnessed a significant change in monetary policy from direct control measures to more market-oriented measures. Some of the major changes included the abolition of deposit rate controls in March 1980, the abolition of bank credit ceilings from September 1980, and lower liquid asset and cash reserve requirements. In addition, the SARB abolished the direct link between its rediscount rate and the prime overdraft rate of banks in 1982.

With the exception of some minor amendments over the period 1980-1997 (Schoombee, 1996), the SARB's monetary policy was primarily based on the cost of borrowing from the

discount window[14]. Through its open market operations the SARB always ensures that financial institutions remain indebted to it. When financial institutions seek accommodation at the discount window, the SARB can charge an interest rate slightly above or equal to its chosen bank rate (Whittaker, 1992). Short-term market interest rates will closely approximate the discount rate since financial institutions will not lend at a rate which is below the discount rate nor will they borrow at a rate which is higher than the prevailing discount rate[15].

In 1985 the SARB adopted a policy of setting predetermined monetary growth targets for M3. According to the SARB, however, monetary growth targeting has never been based on a rigid monetary growth rule as proposed by monetarists, but could rather be described as a more flexible approach (Mohr and Rogers, 1995).

It should be clear from the above that the market-oriented monetary policy measures adopted since 1980 closely reflect an accommodationists' view of how the banking system operates (Rogers, 1985, 1986; Moore and Smit, 1986). The Central Bank will set the supply price of reserves and be ready to supply any amount of reserves on demand. Commercial banks, who are in the business of selling credit, will then base their lending rates as some mark-up over the cost of borrowing from the discount window and supply any amount of credit on demand. Structuralists, however, will argue that the marginal cost of borrowed funds increases, which induces banks to seek alternative options such as liability management practices.

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[14] In March 1998, the SARB adopted the repo rate system which is a more flexible system compared to the old system where the SARB set its lending rate at the discount window. The cost of borrowing under this new system is determined by daily tenders, so that the cost of borrowing ultimately depends on the amount of money the SARB is willing to make available to commercial banks on a daily basis.

[15] Nel (1994) showed that after the gradual implementation of the current monetary policy in the early 1980s, the SARB established a closer link between the bank rate and short-term market interest rates during the later part of the 1980s.

IV Econometric Methodology

To test the different models outlined in Table I, all the empirical tests will be based on Granger causality type tests. By adopting the approach proposed by Granger (1988), the empirical tests will not only detect *short-run* causality through the standard Granger procedure, but also *long-run* causality through cointegration analysis. Given that all the models in Table I are bivariate, it is important that the procedure used to estimate the single cointegrating vectors complies with the basic criteria for efficient estimation (Gonzalo, 1994: 224)[16]. In this regard, the analysis will consider the Auto Regressive Distributed Lag (ARDL) procedure developed by Pesaran and Shin (1999).

Consider the following ARDL(p,q) model when the underlying variables are I(1) and there exists a stable long-run (cointegrating) relationship between y_t and x_t:

$$y_t = \alpha_0 + \sum_{i=1}^{p} \phi_i y_{t-i} + \beta' x_t + \sum_{i=0}^{q-1} \beta_i^{*'} \Delta x_{t-i} + \eta_t, \tag{1}$$

where x_t is the I(1) variable and η_t the disturbance term.

The long-run relationship between y_t and x_t solved from equation (1) is given by:

$$y_t = \alpha_1 + \delta x_t + \mu_t, \tag{2}$$

where α_1 is the long-run parameter estimate of the constant, δ is the long-run parameter estimate of the variable x_t, and μ_t is the long-run random disturbance term.

Pesaran and Shin (1999) have shown that even when the x_t's are endogenous, valid asymptotic inferences on the short-run and long-run parameters can be drawn once an appropriate choice of the order of the ARDL model is made. According to Pesaran (1997), the Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC) perform

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[16] Inder (1993), for example, shows that the omission of dynamics in the first-step static OLS procedure may be detrimental to the performance of the estimator in finite samples.

relatively well in small samples, although the SBC is slightly superior to the AIC (Pesaran and Shin, 1999).

By utilising the residuals from equation (2) consider the following error correction model:

$$\Delta y_t = \alpha_2 + \sum_{i=1}^{r} \beta_{yi} \Delta y_{t-i} + \sum_{i=0}^{s} \beta_{xi} \Delta x_{t-i} + \alpha_3 \mu_{t-1} + \varepsilon_t, \qquad (3)$$

where μ_{t-1} is the lagged error correction term obtained from the residuals in equation (2) and ε_t is the short-run random disturbance term. From equation (3), the null hypothesis that *x* does not Granger cause *y* would be rejected if the lagged coefficients of the β_{xi}'s are jointly significant based on a standard F-test (or Wald test). Conversely, when Δx_t replaces Δy_t as the left-side variable, then the null hypothesis that *y* does not cause *x* would be rejected if the lagged coefficients of the β_{yi}'s are jointly significant.

The error correction term (μ_{t-1}) in equation (3) provides a useful alternative to the standard Granger causality test described above. The standard Granger causality procedure is based on *past changes* in one variable explaining *current changes* in another. If, however, variables share a common trend (long-run relationship), then *current* adjustments in *y* towards its long-run equilibrium value are partly the result of *current* changes in *x*. Such causality can be detected if the error correction term in equation (3) is statistically significant. So, if the relevant variables are cointegrated, then causality must exist in at least one direction which is not always detectable if the results are only based on the standard Granger procedure (Granger, 1988)[17].

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[17] The standard procedure to follow when testing for Granger causality is to difference non-stationary variables. However, after the publication of Engle and Granger's (1987) two-step procedure it became apparent that these models could be misspecified, since they omit the error correction term.

It is important to highlight some caveats related to the concepts of causality and exogeneity. Standard Granger causality tests are only indicative of whether one variable *precedes* another (Maddala, 1988; Urbain, 1992). In many empirical studies, causality through the error correction term is used as a test for *weak exogeneity*, since it shows how the short-run coefficients of the variables adjust towards their long-run equilibrium values (Engle and Granger, 1987; Harris, 1995). Thus, in addition to first showing that a variable is *weakly exogenous* through the error correction term, the definitions developed by Engle *et. al*. (1983) can be used to determine whether a variable is *strongly exogenous* (Charemza and Deadman, 1997). So, if a variable is *weakly exogenous* through the error correction term and the lagged values are also jointly significant, then the variable is said to be *strongly exogenous*. Since weak exogeneity is a necessary condition for efficient estimation, more weight will be attached to causality through the error correction term as opposed to causality through the standard Granger procedure which only detects short-run causality.

V Empirical Results

All the data are quarterly and seasonally unadjusted over the sub-periods 1966q1-1979q4 and 1980q1-1997q4[18]. Before we apply the ARDL procedure outlined in the previous section, it is first necessary to determine whether the variables in Table I are I(1) and whether the I(1) variables cointegrate to form an I(0) time series. Standard Dickey Fuller (DF) and

[18] The data are available from the SARB's historical data series published on the internet. Data for the monetary base (see Table I) are obtained from International Financial Statistics (various issues). Based on Ericsson *et. al's* (1994) assertion that variance dominance is not always a necessary condition for encompassing, all the data are seasonally unadjusted.

Augmented Dickey Fuller (ADF) tests (not reported here) over the two sub-periods, showed that all the variables in levels are non-stationary but stationary in first differences[19].

Following Granger's (1997) suggestion, preliminary cointegration tests were based on the simple first step procedure proposed by Engle and Granger (1987). The cointegration tests indicated that most of the relations in Table I are cointegrated at least at the 10% significance level. However, Kremers *et. al.* (1992) have shown that their error correction procedure can generate more powerful cointegration tests than those based on Engle and Granger's first step procedure, because the residuals of the static cointegrating relationship ignore valuable information[20]. An application of the error correction procedure showed that all the relations in Table I are cointegrated at the 5% significance level although, according to Kremers *et. al.* (1992: 341), the critical values based on Mackinnon (1991) are only a 'conjecture'[21].

Alternatively, Table II reports cointegration tests based on Johansen's maximum likelihood systems procedure[22]. The maximum eigenvalue and trace test statistic verify that all the variables in the bivariate models are cointegrated at the 5% significance level. Moreover, evidence of cointegration also implies that causality must exist in at least one direction.

[Table II here]

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[19] All the unit root test results are available on request from the author. Similar results were obtained when the DF and ADF tests included seasonal dummies.

[20] The Kremers *et. al.* (1992) procedure is based on the significance of the error correction coefficient rather than the residuals in a static long-run relationship as proposed by Engle and Granger (1987). The loss of power arises because the residual based tests assume that the dynamics are error dynamics, rather than structural dynamics.

[21] All the cointegration results based on the Engle-Granger and error correction procedures are available on request from the author.

[22] See Johansen and Juselius (1990). Although the Johansen procedure is generally seen as one of the most powerful tests for cointegration (Harris, 1995), an insufficient lag length (over-parameterisation) could lead to the over-rejection of the null hypothesis (Boswijk and Franses, 1992). However, this could effectively be avoided with a rigorous pre-testing procedure of the optimal lag length (see the endnote of Table II).

V.i Empirical Results under Direct Control Measures: 1966q1-1979q4

The long-run elasticity estimates and the corresponding error correction models based on the ARDL procedure are reported in Table III[23]. From the first set of regressions it can be seen that there is bi-directional causality between *Lh* and *Lcredit*. Thus, under direct control measures, the monetary authorities managed to exert some direct influence on the expansion of total credit through their control over the monetary base. However, even under direct control measures, credit also determined the monetary base. The long-run elasticity estimate shows that a one percent increase in *Lcredit* only leads to 0.75 percent increase in *Lh*. The corresponding Wald test statistic indicates that the long-run elasticity estimate of 0.75 is significantly different from unity (or less than proportionate), which supports the contention that the monetary authorities exerted some direct control over the money supply.

[Table III here]

The second set of causality tests in Table III shows that there is unidirectional causality from *LM3* to *Lh*. This is an interesting result, given that the first and second set of causality tests are theoretically equivalent, although the second set is a direct test of the money supply process proposed by monetarists. The distinguishing feature between the first and second set of causality tests could be that in the second set the money multiplier plays an important role, whereas in the first set the role of the money multiplier is effectively circumvented. If the money multiplier is unstable, causality will not be detected *directly* from *Lh* to *LM3*, but *indirectly* from *Lh* to *Lcredit*. One important similarity between the first and second set of

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[23] The Johansen and ARDL procedures yielded almost identical long-run estimates over both sub-periods. Alternatively, causality tests can also be based on Johansen's cointegrating vectors by adopting a general-to-specific modelling approach in the error correction models. However, because we are also interested in the joint significance of the lagged values of the variables, the ARDL procedure is used where the optimal lag length is determined by the AIC and SBC in the ARDL and error correction models.

causality tests is that the 0.78 elasticity estimate in the second set, conditional on *LM3* being exogenous, again reflects that the amount of reserves was not enough to support increases in the money supply.

The third set of tests in Table III shows unidirectional causality from *Lcredit* to *Lm*. In addition, the joint significance of the lagged variables indicate that *Lcredit* is *strongly exogenous*. From Table III, a one percent increase in total credit leads to a 0.21 percent increase in the money multiplier. The importance of this test is that it may explain how agents effectively avoided the direct control measures imposed by the monetary authorities. When reserve shortages developed under direct control measures, loan arrangements initially took place outside the banking system. Once the loans were spent, they re-entered the banking system as deposits; reduced the *cd* and *rd* ratios in the money multiplier, and eventually led to an increase in the money multiplier[24]. The 0.21 elasticity estimate therefore acts as a supplement to the 0.75 elasticity estimate in the first regression (or the 0.78 elasticity in the second regression), so that credit demand is supported by an almost proportionate increase in the level of reserves.

The absence of causality from *Lm* to *Lcredit*, may support our previous contention that the monetary authorities' control over the money supply is not directly observable if the regressions are based on the second set in Table III, but only indirectly through the first set of regressions. This result does not imply that the monetary authorities had no direct control over the money supply, but merely suggests that the money multiplier is unstable.

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[24] The negative coefficient in the error correction model (not reported here), reflects the short-run where credit extended outside the banking system initially increases the *cd* and *rd* ratios in the money multiplier (see the theoretical discussion in section III). The positive long-run coefficient is indicative of credit extended outside the banking system returning to the balance sheet of banks.

The fourth set of regressions provides a summary of the results obtained thus far. Bi-directional causality between *Lmi* and *LM3* first reiterates the direct control monetary authorities exerted over the money supply. Second, through the mechanisms described previously, agents effectively avoided direct control measures so that that *Lmi* also determines *LM3*. The long-run elasticity estimates are very close to unity, although the Wald tests show that the exogenous impact of the money supply is slightly higher than the exogenous impact of money income. Also note that in addition to a significant error correction term, the joint significance of the lagged variables indicates that *Lmi* is *strongly exogenous*.

The final causality tests in Table III supports the contention that the money supply is endogenously determined, with *Lcredit* causing a proportionate increase in *LM3* and *Lcredit* also being *strongly exogenous*. Causality from *LM3* to *Lcredit* may be interpreted in two ways. First, it could reflect the exogenous influence of the monetary authorities on the money supply. Second, the result may support the theoretical suppositions of the liquidity preference view, where agents do not willingly absorb any amount of new deposits created by bank lending. The result may therefore be interpreted as evidence of a demand for money function which acts independently from a demand for loans function. Since the results earlier suggested that the money multiplier is unstable, the cointegrating relationship between *Lcredit* and *LM3* may well support the liquidity preference view, rather than being reflective of direct control by the monetary authorities.

V.ii Empirical results under indirect control measures: 1980q1-1997q4

The long-run elasticity estimates and the corresponding causality results from the error correction models for the second sub-period are given in Table IV. The results from the first regressions reflect the significant change towards more market-oriented monetary policy measures, with unidirectional causality from *Lcredit* to *Lh*.

[Table IV here]

Similarly, the second set of regressions shows unidirectional causality from *LM3* to *Lh*, while the elasticity estimate of 0.98 (and corresponding Wald test) indicates that reserves proportionately supported increases in the money supply. Thus far, the results clearly support the accommodationist view of how the banking system operates under indirect control measures.

Although the third set of regressions in Table IV depicts unidirectional causality from *Lcredit* to *Lm*, the magnitude of the long-run elasticity of 0.03 suggests that unlike the period of direct control measures, more market-oriented monetary policy measures did not induce agents to seek finance outside the banking system or encourage liability management practices.

The fourth set of regressions in Table IV again provides a summary of the results presented thus far. Unidirectional causality from *Lmi* to *Lm3*, conditional on *Lmi* being *strongly exogenous*, reflects the endogenous nature of the money supply over the period of more market-oriented monetary policy measures[25].

Since the results unconditionally show that the SARB imposed no direct liquidity constraints, bi-directional causality between *LM3* and *Lcredit* in the fifth set of regressions supports the theoretical propositions of the liquidity preference view. Causality from *Lcredit* to *LM3* with *Lcredit* being *strongly exogenous* emphasises the endogenous nature of the money supply, while reverse causality can again be interpreted as evidence of an independent money demand function.

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[25] The results for the first, second and fourth regressions all yield consistent results, insofar as the null hypothesis of a unitary long-run elasticity cannot be rejected conditional on *Lcredit*, *LM3* and *Lmi* as the exogenous variables.

VI Conclusions and Policy Implications

The different theoretical approaches tested in the empirical analysis have proved to be most informative in describing South Africa's money supply process over the periods of direct and indirect monetary control measures. The analysis further suggests that it is a combination, rather than a single approach, that enables us to draw some concrete conclusions on the endogenous/exogenous nature of the money supply.

From a monetarist perspective, the inflationary impact of 'excess' money is only relevant over the period of direct control measures. It remains an empirical matter to determine whether excessive monetary expansion over this period can be regarded as one of the underlying causes of inflation. This contention is borne out by the fact that the money supply is also endogenously determined over this period.

Over the two sub-periods under analysis, the empirical results further show that even under an endogenously determined money supply, 'excess' money may come into existence because agents do not automatically absorb any amount of deposits created by the flow of new bank lending. It is unlikely, however, that this process described by the liquidity preference view could be regarded as an independent cause of inflation. The main causes of a self-perpetuating inflationary process under an endogenously determined money supply are more likely to be of a cost-push and/or structural nature.

The most important conclusion to be drawn from the empirical results is that irrespective of the monetary system at the time, the money supply in South Africa is endogenously determined over the period 1966-1997. 'Disintermediation', together with an ineffective liquid asset reserve system, were some of the underlying reasons why the money supply was mainly credit-driven and beyond the direct control of the SARB. In sharp contrast to the period of direct control measures, more market-oriented measures over the period 1980-

1997 ensured that loan arrangements took place within the banking system. The SARB fulfilled its role as lender of last resort and supplied reserves on demand.

One of the underlying reasons to explain the failure of the SARB to reach predetermined M3 monetary growth targets on a consistent basis since the mid 1980s can be found in the endogenous nature of the money supply and not, as Moll's (1999) study claims, because of an unstable M3 velocity. Although the M3 velocity is stable over the whole period under analysis, the stable long-run relationship between money and money income is only valid conditional on money income being exogenous, while it is invalid to regard money as exogenous over the whole period 1966-1997[26]. Over the period of monetary growth targeting, money income determined an endogenous money supply, so that the M3 money supply lost its effectiveness as a *leading indicator* for monetary policy. The most important policy implication is that the SARB controlled the money supply indirectly during the period 1980-1997, through an increase in interest rates, and at the potential cost of a slowdown in economic activity.

[26] The stable long-run relationship (cointegrating) between money and money income is supported by the empirical evidence over the two sub-periods. First, money income remains exogenous to the M3 money supply irrespective of the monetary system. Second, the long-run elasticities of 0.98 and 1.00 conditional on money income being exogenous, are indicative of parameter constancy over the whole period under analysis.

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Table I

Three Empirical Hypotheses on the Exogenous/Endogenous Nature of the Money Supply

Accommodationist view (Moore, 1989b)	**Structuralist view** (Palley, 1994)	**Liquidity preference view** (Howells and Hussein, 1998)
$LM3 \Rightarrow Lh$ $Lcredit \Rightarrow LM3$ $Lmi \Rightarrow LM3$	$Lcredit \Leftrightarrow Lm, Lh$ $Lmi \Leftrightarrow LM3$	$Lcredit \Leftrightarrow LM3$

Note:
Definition of variables:

- *Lcredi*t = log-level of total bank credit
- *Lh* = log-level of the monetary base (currency and reserves held by commercial banks)
- *Lm* = log-level of the M3 money multiplier
- *LM3* = log-level of the M3 money supply
- *Lmi* = log-level of money income (nominal GDP)

Table II

Johansen's Cointegration Tests

Johansen's cointegration tests for the period 1966q1-1979q4				
Variables included in VAR		λ Max eigenvalue	λ Trace	*k*
1.	*Lh*, *Lcredit*	19.57**	25.52**	2
2.	*LM3*, *Lh*	20.65**	35.26**	6
3.	*Lm*, *Lcredit*	29.42**	34.42**	2
4.	*LM3*, *Lcredit*	16.17**	21.50**	4
5.	*Lmi*, *Lm3*	33.30**	38.80**	6

Johansen's cointegration tests for the period 1980q1-1997q4				
Variables included in VAR		λ Max eigenvalue	λ Trace	*k*
1.	*Lh*, *Lcredit*	69.36**	75.31**	1
2.	*LM3*, *Lh*	25.05**	28.35**	2
3.	*Lm*, *Lcredit*	67.42**	78.20**	1
4.	*LM3*, *Lcredit*	30.64**	34.44**	2
5.	*Lmi*, *LM3*	27.86**	31.69**	2

Notes:

1. ** denotes significance at the 5% level where H_0: r = 0 and H_a: r = 1 and *k* is the order of the VAR model.
2. The critical values computed by Osterwald-Lenum (1992) were used to determine the deterministic components in the underlying VAR model (Harris, 1995). In each case the constant was restricted to lie inside the cointegration space without a trend. In addition, three seasonal dummies were included in all the VAR models.
3. The Akaike Information and Schwartz Bayesian selection criteria were used to determine the order of the VAR. In cases where the two selection criteria contradicted each other, a likelihood ratio test was performed to eliminate lags from a general to a more specific model.

Table III

Causality Results based on Error Correction Models (ECM), 1966q1-1979q4

	Regression	Long-run elasticities solved from ARDL models	Wald tests for unitary long-run elasticities	Order of lags in ECM	Joint significance (β_{yi} and β_{xi})	Error term (α_3)	Final results
1	ΔLh *on* $\Delta Lcredit$	0.75*** [18.90]	36.87***	(0,0)	–	2.91*	*Lcredit* ⇔ *Lh*
	$\Delta Lcredit$ *on* ΔLh	1.35*** [26.89]	48.39***	(2,0)	–	7.62***	
2	ΔLh *on* $\Delta LM3$	0.78*** [31.13]	75.81***	(0,3)	4.94	7.71***	*LM3* ⇒ *Lh*
	$\Delta LM3$ *on* ΔLh	1.36*** [5.03]	na	(3,0)	–	0.01	
3	$\Delta Lcredit$ *on* ΔLm	6.51*** [2.76]	na	(2,0)	–	0.76	*Lcredit* ⇒ *Lm*
	ΔLm *on* $\Delta Lcredit$	0.21*** [60.04]	na	(0,4)	9.23*	12.63***	
4	ΔLmi *on* $\Delta LM3$	1.02*** [140.00]	8.84***	(4,0)	–	27.39***	*Lmi* ⇔ *LM3*
	$\Delta LM3$ *on* Δ *Lmi*	0.98*** [163.37]	6.60**	(5,5)	14.82**	17.80***	
5	$\Delta LM3$ *on* $\Delta Lcredit$	0.95*** [29.61]	1.81	(3,3)	11.99***	3.89**	*Lcredit* ⇔ *LM3*
	$\Delta Lcredit$ *on* $\Delta LM3$	1.05*** [44.19]	6.14**	(2,0)	–	12.12***	

Notes:

1. Table entries for β_{yi}, β_{xi} and α_3 are Wald test statistics which have a chi-squared distribution.
2. The table entry 'na' indicates that the relevant variable is either not weakly exogenous, or the elasticity is sufficiently small or statistically insignificant, so that the Wald test for a unitary long-run elasticity is not reported.
3. *** denotes significance at the 1% level; ** at the 5% level; and * at the 10% level.
4. The AIC and SBC were used to determine the optimal lag-lengths in the ARDL and error correction models.
5. The numbers in [ ] brackets are t-statistics to test whether the long-run elasticities are significantly different from zero.
6. Seasonal dummies (when significant) were included as deterministic components in the ARDL models.

Table IV

Causality Results based on Error Correction Models (ECM), 1980q1-1997q4

	Regression	Long-run elasticities solved from ARDL models	Wald tests for unitary long-run elasticities	Order of lags in ECM	Joint significance (β_{yi} and β_{xi})	Error term (α_3)	Final results
1	ΔLh *on* $\Delta Lcredit$	0.92*** [17.53]	1.87	(3,0)	–	5.94**	*Lcredit* $\Rightarrow$ *Lh*
	$\Delta Lcredit$ *on* ΔLh	0.97*** [8.93]	na	(2,0)	–	2.61	
2	ΔLh *on* $\Delta LM3$	0.98*** [25.15]	0.20	(4,0)	–	9.69***	*LM3* $\Rightarrow$ *Lh*
	$\Delta LM3$ *on* ΔLh	0.79** [2.16]	na	(0,1)	7.84***	0.01	
3	$\Delta Lcredit$ *on* ΔLm	-29.30 [-0.64]	na	(1,0)	–	0.47	*Lcredit* $\Rightarrow$ *Lm*
	ΔLm *on* $\Delta Lcredit$	0.03* [1.67]	na	(5,0)	–	10.35***	
4	ΔLmi *on* $\Delta LM3$	0.87*** [5.97]	na	(4,0)	–	0.82	*Lmi* $\Rightarrow$ *LM3*
	$\Delta LM3$ *on* Δ *Lmi*	1.00*** [77.37]	0.01	(2,1)	22.91***	23.54***	
5	$\Delta LM3$ *on* $\Delta Lcredit$	0.92*** [41.91]	10.91***	(2,2)	6.62**	4.01**	*Lcredit* $\Leftrightarrow$ *LM3*
	$\Delta Lcredit$ *on* $\Delta LM3$	1.05*** [45.86]	4.81**	(0,0)	–	5.01**	

Notes:

1. Table entries for β_{yi}, β_{xi} and α_3 are Wald test statistics which have a chi-squared distribution.
2. The table entry 'na' indicates that the relevant variable is either not weakly exogenous, or the elasticity is sufficiently small or statistically insignificant, so that the Wald test for a unitary long-run elasticity is not reported.
3. *** denotes significance at the 1% level; ** at the 5% level; and * at the 10% level.
4. The AIC and SBC were used to determine the optimal lag-lengths in the ARDL and error correction models.
5. The numbers in [ ] brackets are t-statistics to test whether the long-run elasticities are significantly different from zero.
6. Seasonal dummies (when significant) were included as deterministic components in the ARDL models.

Figure I

Nominal Velocities (VM) of the Different Definitions of Money, 1966q1-1997q4