The impact of monetary policy on the economic growth of a small and open economy: the case of South Africa

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Abstract

This study evaluates the impact of monetary policy on the economic growth of a small and open economy like that of South Africa. Structuralists contend that changes in money supply (M3) and inflation (CPI) are not significantly related to changes in economic growth (GDP), while orthodox economists argue that they are. Stucturalists also hold that monetary authorities cannot control M3, whereas orthodox economists believe they can. To structuralists, when monetary authorities pursue an expansionary policy, the opposite effect is achieved. Orthodox economists counter this argument. The ADT test statistic against the McKinnon critical values was used and it was found (i) that money supply changes and inflation are significantly related to changes in economic growth, and (ii) whereas monetary authorities can control M3 through the repo rate, they cannot keep it within set targets.

JEL E51. E52

1 Introduction

The primary objective of the empirical study presented in this paper was to evaluate the impact of monetary policy on a small and open economy, like that of South Africa. The study tested the effect of stimulating economic growth while keeping the money supply (M3) within set *monetary targets* or guidelines and keeping inflation (CPI) in check, for the period 1960 to 1998. Two opposing economic theories, namely the structuralist and orthodox or 'neo-liberal' theories, were used as a framework within which the evaluation was made. According to the structuralists, monetary authorities cannot control changes in M3 and CPI, and thus they cannot have any influence on stimulating the economic growth (GDP). Instead, it is believed that domestic CPI is imported from large western countries with which trade is conducted. GDP also appears to be determined by the economic growth levels of the same large trading partners. These beliefs are contrary to those of the orthodox or 'neo-liberal' economists, who take the position that 'too much', or 'too little' money and uncontrolled inflation have an adverse impact on economic growth.

This fervent debate between these two contending economic schools of thought is continuing in South Africa, despite the fact that the current inflation targeting has replaced money growth targeting (see the note below). For the structuralists, the control of either or both the money supply and CPI (targeting) is not obtainable by monetary authorities. The structuralist argument is advanced by the Congress of South African Trade Unions (COSATU), which is opposed to the official macroeconomic policy of the government, viz. Growth, Employment and Redistribution (GEAR), which one can categorise as "neo-liberal". GEAR is blamed for the soaring unemployment in the country and its failure to alleviate poverty. On the other hand, monetary policy is criticised for its almost exclusive focus on protecting the value of the rand, the domestic currency, and inflation via changes in money supply or the repo rate in this regard since the era of inflation targeting (COSATU, 1998: 2)[2].

This monetary policy (of keeping inflation low, either by controlling the money supply or imposing inflation targeting) is said to be too restrictive. It is held responsible for the relatively high domestic interest rates, which discourage investment and economic growth, thereby exacerbating the already high level of unemployment. In this regard, COSATU, in its memorandum to the Parliamentary Finance Committee in 1998, argues as follows:

> There is a serious flaw in the Bank's rationale for restrictive monetary policy. The Bank bases its views on the quantity theory of money, which argues that when the supply of money goes up, prices also go up. This theory, however, must make the assumption of full-employment (an indefensible assumption in present day South-Africa), the decrease in interest rates associated with an increase in the money supply could simulate economic activity, increase output, and create job. While prices might be bid-up during the economic expansion, the direct link between the money supply and inflation is broken. (COSATU, 1998: 7)

Accordingly, the main hypotheses that the paper will test are:

(1) Monetary authorities can *control* changes in money supply.

(2) Money supply in the current period is significantly related to that of the previous period.

(3) GDP is determined by M3 growth or the CPI and, if so, whether that relationship is predicated upon *controllability* of money supply changes.

(4) The exchange rate has a significant influence on the potency of domestic monetary policy.

Once again the era of money supply targeting was tested as proxy to test the arguments of the two schools of thought. Inflation targeting (CPIX) could be used in the same manner (as indication of monetary control on the inflation rate, but due to the small amount of observations (only four years) the authors opted for the era of money supply targeting.

2
Background to the problem studied

The structuralism orthodox debate is heir to its predecessor, the Keynesian-Monetarist debate, on the effectiveness of monetary policy. This debate *on* the contribution of monetary policy *per se* in stimulating the economy of a small and open country like that of South Africa, is an on-going one. According to Mohr and Fourie (1998: 581), the Keynesian doubt about the efficacy of monetary policy was sparked by the Great Depression (1929-1933), when the income level of the world's economies did not change significantly as monetary authorities expanded the money supply. Structuralists echo this doubt. On the contrary, monetarists, led by Milton Friedman, argue that monetary policy is effective in stimulating economic growth, claiming that "*money matters*". This is in alignment with the orthodox or 'neo-liberal' position. Friedman and Anna Scwhartz, in explaining that monetary policy was largely responsible for causing the Great Depression of the 1930s, argued as follows:

> The quantity of money in the United States fell by one-third in the course of the contraction. And it fell not because there were no willing borrowers- not because the horse could not drink. It fell because the Federal Reserve System forced or permitted a sharp reduction in the monetary base, because it failed to exercise the responsibilities assigned to it in the Federal Reserve Act to provide liquidity to the banking system. The Great Contraction is tragic testimony to the power of monetary policy – not as Keynes and so many of his contemporaries believed, evidence of impotence. (Friedman, 1969: 97)

At the centre of the Keynesian-monetarist debate is the monetary transmission mechanism. Keynesians regard the link between the monetary sector and the real sector of the economy as very tenuous. According to Keynes, fiscal policy (government works programmes for example) was a key instrument to boost economy, and monetary policy never mattered much in his analysis.) This crucial connecting link between changes in M3 and GDP via the *interest rate* is considered a two-stage process.

In the first stage, an increase in M3 leads to an excess above the demand for money (M^d), namely $M3 > M^d$, at the prevailing interest rate and level of income. This excess is reduced when money-holders switch to buying other financial assets like bonds. Consequently, the demand for these assets increases, pushing their prices up. Given the inverse relationship between prices of financial instruments like bonds and their yield, this portfolio disequilibria caused by excess money supply leads to a drop in the interest rate (i/r). In the second stage, a drop in the interest rate causes an increase in aggregate demand, resulting in an increase in investment (I). Consequently, the increase in investment leads to an increase in national income or gross domestic product (Froyen, 1996: 120). This two-stage process can be represented as follows:

$$M^s \rightarrow (M^s > M^d) \rightarrow \downarrow i/r \rightarrow \downarrow I \rightarrow \downarrow GDP \quad (1)$$

Thus, to Keynesians the transmission mechanism only operates when an increase in money supply causes a portfolio imbalance, resulting in a drop in the interest rate (i/r). What is crucial is the impact of the imbalance. If it does not cause significant changes in interest rates, the link between money and output or national income or gross domestic product (GDP) breaks down. Such a situation is the so-called Keynesian *liquidity trap*, in which the money market equilibrium condition is represented by a horizontal LM curve. This liquidity trap is said to illustrate the indifference of people between holding money and financial instruments, like bonds, at low interest rates, thus rendering monetary policy ineffective in stimulating the economy.

By contrast, monetarists consider the monetary transmission mechanism to be *direct*. The *quantity theory* of money, as a proxy of the monetarist school of thinking, is presented by Irvin Fisher's following equation of exchange:

$$MV \equiv PQ, \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where
- M = the quantity of money
- V = the velocity of money
- P = the average (or general) price level
- Q = the real value or physical quantity of goods and services produced,

In terms of this theory, velocity of money in circulation (V) is assumed constant or stable, transforming the equation of exchange into:

$$MV = \overline{PQ} \quad (3)$$

If V is constant, then changes in money, M, result in an equal proportional change in total production or output or income, PQ. This gives a *direct* monetary transmission mechanism, with changes in money supply directly changing the economy. As a counter to the Keynesian liquidity trap, monetarists consider the LM curve to be vertical rather than *horizontal*. Accordingly, the demand for money depends only on the level of income and not at all on the interest rate. Thus, changes in national income are said to be better brought about by shifts in the LM curve and not the IS curve. Consequently, monetarists consider a maximum effect on the level of national income or economic growth to come via monetary policy (Dournbusch, Mohr & Rogers, 1996: 165).

Just as the Keynesian revolution was started by the ineffectiveness of monetary policy during the Great Depression, the failure of the market economy to address the socio-economic problems in Latin America sparked an economic school of thought called *structuralism*. The structuralism theory sought to offer an alternative to what was considered a dismal failure of orthodox economics, referred to as 'neo-liberalism' by structuralism. It is the little economic progress made by the Latin American countries in transforming their socio-political problems that gave an impetus to the structuralism movement. This is the position of COSATU towards GEAR (Cosatu, 1997). The structuralism school was led by Raul Prebisch from Argentina, who was the Executive Secretary of the Economic Commission for Latin America (ECLA), a United Nations agency founded in 1947 and located in Chile. Social problems such as poverty and unemployment were receiving close attention and the emerging liberation militancy left-wing put the blame on the large and developed western countries, accusing them of impoverishing and under-developing the small and developing countries with which they

traded. Thus, domestic monetary policy could not be seen as a solution. Instead, it is said to be ineffective because the economic growth problem faced, which is not monetary but structural, remained unchanged despite any efforts by monetary authorities. (Bruce, 1980: 33)

The structuralism rationale is that domestic monetary authorities of the open and small economy cannot control money supply because they cannot control or stabilise the interest rate, via which the real sector is influenced. For instance, if expansionary policy is pursued to reduce interest rates, this policy objective will be undermined by outflows of foreign capital as interest rates drop, resulting in a contraction of money supply instead. On the contrary, contraction policy to increase interest rates is said to attract inflows of foreign assets, thereby increasing money supply and thus neutralising or reserving the intended contraction of money supply (Pinto & Knakel, 1973: 22). Therefore, monetary policy is said to be ineffective in stimulating the economic growth of a small and open economy, such as that of the Republic of South Africa (Rodriquez, 1997: 3) and indeed even of large economies.

Small economies are said to be those where neither their supply of exports nor their demand for imports has a noticeable impact on the world prices of these commodities and services. Economies are *open* in that trade or capital flows across their borders in sufficient quantities to influence the domestic economy, particularly prices and money supply (Gills, Perkins, Roemer & Snodgrass, 1992: 580).

The results of the empirical analysis and evaluation will cast further light on and contribute towards a resolution of this on-going debate between the structuralism and neo-liberal/orthodox economic theories. The results thus obtained will in turn suggest policy implications of monetary policy of a small and open economy in stimulating economic growth in general, and specifically of the official macroeconomic policy of the Republic of South Africa, GEAR and the role of domestic monetary policy.

3 Research method used to estimate the equations

The ordinary least squares (OLS) regression technique was used to test the tenability or correctness of the two contending economic schools of thought, namely structuralism theory and neo-liberal/orthodox theory, on the role of monetary policy in stimulating economic growth in a small and open economy. A single-equation model was used, to which commonly used measures, namely the coefficient of determination, R^2, the adjusted coefficients of determination, R^2 (called R-Bar-Squared), and the correlation coefficient, r, were applied to determine how well the estimated equations fitted the actual data. OLS was used because it is commonly used and not because it is the only technique. The main reason for OLS popularity is the useful properties of the estimates it generates, which are mean zero and constant variance. To fulfil the assumption of normally distributed error terms, the time series used has to be stationary, with joint and conditional distributions being time-invariant. This will produce error terms that satisfy the assumption, thereby allowing the use of t–test and F-test to test the hypotheses propounded.

However, most time series are not stationary. Consequently, performing ordinary regression on non-stationary time series will "often lead to a problem of spurious regression, whereby the results obtained suggest that there are statistically significant relationships between variables in the regression model when in fact all that is obtained is evidence of contemporaneous correlation rather than meaningful caused relations" (Harris, 1995: 14). Accordingly, to avoid spurious correlation from the regression analysis, the co-integration of non-stationary time series was tested. The error correction model (ECM) approach was not followed, because the purpose of this study was to establish the *presence* or *absence* of a significant relationship between economic variables. Short-run models or ECMs are important from a forecasting perspective, which was not part of this study (Harris, 1995: 23).

> The economic interpretation of co-integration is that if two (or more) series are linked to form an equilibrium relationship spanning the long-run, then even though the series themselves may contain stochastic trends (i.e. be non-stationary) they will nevertheless move closely together over time and the difference between them will be stable (i.e. stationary). Thus the concept of co-integration mimics the existence of a long-run equilibrium to which an economic system converges over time. (Harris, 1995: 22)

4
The estimated equations

The two estimated and tested equations are the following:

$$M3_t = f(M3_{t-1}), \quad (4)$$

and

$$GDP = f(M3, CPI). \quad (5)$$

This study covers the period 1960 to 1997. After 1997 monetary policy authorities abandoned the idea of using M3 money supply growth targets as the main monetary policy instrument as a means to affect either the inflation rate or the exchange rate. The purpose of monetary policy changed to a singular target, namely the control of the inflation rate, within certain set targets, from 2002. The repo rate (accommo-dation rate for banks) then had been introduced as the singular instrument to reach the set inflation rate targets. Annual data points are therefore not enough to conduct the estimations.

Annual data on the small and open economy of the Republic of South Africa are used, obtained mainly from the Quarterly Bulletin of the Reserve Bank of South Africa and other resources, both South African and international.

4.1 Hypotheses testing

The tested hypotheses are the following:

1. Null hypothesis (structuralism):
   $M3_t \neq f(M3_{t-1})$.
   Alternative hypothesis (orthodox):
   $M3_t = f(M3_{t-1})$.
   If $M3t \neq f(M3_{t-1})$; then $ß = 0$. This will mean that monetary policy is not able to control money supply and the null hypothesis will hold.
2. Null hypothesis (structuralism):
   $GDP \neq f(M3, CPI)$.
   Alternative hypothesis (orthodox):
   $GDP = f(M3, CPI)$.

If $GDP \neq f(M3, CPI)$, it means that the economic growth rate is not affected significantly by changes in the money supply and inflation and that the structuralism argument holds.

3. Null hypothesis (structuralists):
   Uncontrollability of money supply;
   Alternate hypothesis (orthodox):
   Money supply is controllable.

The results obtained are presented in the next section.

4.2 Results of the test equations

4.2.1 The impact of $M3_{t-1}$ on M3

The following tables present the regression results after applying collected data on equation (4) to test the null hypothesis that $M3_t \neq f(M3_{t-1})$; meaning that $ß = 0$., that is $M3_{t-1}$ is not related to $M3_t$, which is informally conducted to shed some more light on the controllability of monetary supply in terms of keeping it within set monetary targets. The results are obtained using the computer econometric package EVIEWS. Here only the t-statistic is used and not the augmented Dickey Fuller (ADF) test, since we are not measuring a long-term relationship. The results are of particular importance for this study in explaining whether or not monetary policy can have any impact or influence on the economic growth of a small and open economy by changing money supply levels, even if it cannot influence such levels.

From Table 1, with 37 observations, n, and one explanatory variable, k, our degrees of freedom, n – k – 1, become 37 – 1 – 1, becoming 35. This being over 25 degrees of freedom, and the t-statistic for M3(–1) being 139.034, which is far more than 2, the figure used for applying the rule of thumb that to determine the significance of the t-statistic we reject the null hypothesis that ß is not significantly different

from zero. Thus, the structuralist argument that there is no significant relationship between the level of money supply in the current period, t, and the money supply level in the previous period, t-1, must be rejected and the alternate orthodox hypothesis that the monetary authorities can influence the current level of money supply, $M3_t$, by applying monetary policy on that of the previous period, $M3_{t-1}$, must be accepted.

Table 1

$M3_t = \alpha + ß_1 M3_{t-1} + \mu$

Test equation (21)
LS/Dependent variable is M3
Sample (adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Co-efficient	Std. Error	t-Statistic	Prob.
α	980.6329	883.1809	1.110	0.27
M3(-1)	1.1474	0.000853	139.034	0.00

R^2	: 0.99
Adjusted R^2	: 0.99
Durbin Watson	: 1.77
Akaike's Information Criterion (AIC)	: 16.82
Schwarz Criterion	: 16.91
F-statistic	: 19330.51

4.2.2 The impact of M3 on CPI[3] and on GDP

Having found that there is a relationship between $M3_{t-1}$ and $M3_t$ money supply of a small and open economy like that of the Republic of South Africa, informally confirming the orthodox or neo-liberal argument, we still have to evaluate their other arguments on whether or not monetary authorities can control money supply, namely whether they have the ability to keep it within set monetary targets, as well as test whether or not there is a significant relationship between this country's economic growth, GDP, on the one hand, and money supply, M3, and inflation, CPI on the other hand, as advocated. As stated above, the structuralist argument is captured by the null hypothesis, H_O, stating no relationship between these variables, and the opposite orthodox or 'neo-liberal' argument as the alternative hypothesis, H_A. The collected data were applied to these hypotheses based on the following test equation:

$$GDP = a + ß_1 M3 + ß_2 CPI + \mu \quad (6)$$

as follows:

$H_O : ß_{1=} ß_2 =$ null
$H_A : H_O$ is not true.

Applying the same analytical methods used to test the controllability of money supply by the monetary authorities of a small and open economy, that of the Republic of South Africa in this case, we arrive at the results contained in Table 2. These results are found by applying empirical data in testing the above equation.

Again we start with the initial visual inspection for stationarity after using the rule of thumb method of establishing the significance of M3 and CPI in explaining real GDP. The t-statistic values of M3 and CPI from Table 2 are 12.19 and 14.78, respectively, both more than 2, thus implying significance. While M3 and CPI are individually significantly related to GDP, we must also test whether together they are similarly significant or not.

To do this, we use the F-test. Here we have k, the explanatory variables, being 2, that is the numerator for the F-table, and n – k – 1 being 38 – 2 – 1 = 35. From the F-table, we get the value 5.39 per cent at 1 per cent significance level for the sample of 30 observations and 5.18 per cent for the sample of 40 observations. Given that the calculated F-value (F) in Table 2 is 243.84, very much greater than both the critical value (*Fc*) for the sample of 30 and 40, we do not need to extrapolate.

Table 2
Test equation: GDP = a + b_1M3 + b_2CPI + m

Dependent variable	: GDP			
Sample (adjusted)	: 1960 1997			
Included observations	: 38			
Variable	**Co-efficient**	**Std. Error**	**t-Statistic**	**Prob.**
α	101157.1	5072.935	19.94	0.0000
M3	0.303833	0.024920	12.19	0.0000
CPI	7237.524	489.4733	14.78	0.0000
R-squared		: 0.93		
Adjusted R-squared		: 0.93		
Durbin Watson		: 0.89		
Log likelihood		: –417.32		
Akaike's Information Criterion (AIC)		: 22.12		
Schwarz Criterion		: 22.25		
F-statistic		: 243.84		

Applying the test criterion:

Reject: H_O if $F > Fc$

Don't reject: H_O if $F < Fc$

Given the t-value of 12.19 for M3 money supply and a t-value of 14.78 for the CPI, we reject the null hypothesis, representing no relationship between both M3 and CPI, and GDP; that is their correlation co-efficient, $ß_1 = ß_2 = 0$, and "accept" the argument that changes in the money supply, M3, and inflation, CPI, both affect the economic growth, GDP, of a small and open economy. Subsequent to this informal testing, a more formal ADF-test for stationarity was conducted to test for stationarity. The results are captured in Table 3.

According to Table 3, the ADF test statistics are –4.39328. We compare this to the calculation of the MacKinnon critical value, for $C(\rho)$. At 1 per cent significance level, now with n = 2 and T = 36, we get:

$$C(\rho) = (-3.9001 - 10.534/36 - 30.03/36^2) \approx -4.22 \quad (7)$$

We apply the criteria test that we reject the null hypothesis that there is no co-integration, when the ADF test statistic is less negative than –4.22. Since –4.39 is more negative than 4.22, we reject the null hypothesis that there is no stationarity.

Table 3
Augmented Dickey-Fuller unit root test

ADF Test Statistic	–4.349328			
Augmented Dickey-Fuller Test Equation:				
Dependent variable	: dGDP			
Method	: Least Squares			
Sample (adjusted)	: 1962 – 1997			
Included observations	: 36 after adjusting end points.			
Variable	**Co-efficient**	**Std. Error**	**t-Statistic**	**Prob.**
dGDP(-1)	–0.662753	0.152381	–4.349328	0.0001
R-squared		: 0.356991		
Adjusted R-squared		: 0.338079		
SE of regressions		: 11399.89		
SSR		: 4.42E+09		
Log likelihood		: –386.3419		

Durbin Watson Statistics	: 1.964264
Akaike's Information Criterion (AIC)	: 21.66252
Schwarz Criterion	: 21.66252
F-Statistic	: 18.87638

Accordingly, we can draw the meaningful conclusion that the economic growth (GDP) of a small and open country, the Republic of South Africa in this case, is significantly affected by changes in money supply (M3) and inflation (CPI). Thus, the neo-liberal or orthodox argument that economic growth in an open and small economy is related to changes in money supply and inflation, is confirmed.

The complement of the above empirically rejected structuralism argument is that the economic growth of a small and open economy depends on the economic growth of its big trading partners. For the sake of interest, and in the light of the fact that the crux of the structuralism argument concerning the relationship between economic growth of South Africa and money supply and inflation has already been rejected, an *informal test* of the impact of the levels of economic growth of selected big trading partners on that of South Africa was empirically conducted. Of all the selected trading partners of South Africa, namely the United States (USGDP), the United Kingdom (UKGDP), France (FGDP), Japan (JGDP), and Germany (GGDP), *none is significantly related* to the economic growth of South Africa (RSAGDP) and they collectively explain only 33 per cent of it, as shown in Table 4 on the next page.

4.2.3 The controllability of money supply changes: 1986 – 1997

Monetary targets were introduced in 1986 in South Africa (Hurn). According to the South African Reserve Bank (SARB), these targets were never regarded as rigid rules to be religiously adhered to. The Reserve Bank is said to have used its discretion and often allowed the growth of the money supply to move outside the set target ranges. To reflect on this position, the SARB changed the terminology to *monetary guidelines* in 1991, "…to convey the authorities' views as to what should happen to money growth rate in the prevailing economic conditions, rather than as a firm *forecast* of the rate of monetary expansion in the guideline year or as a binding *commitment* to the rate of monetary expansion that was to be achieved at all costs" (SARB, 1991: 25).

Table 4
Test equation RSAGDP = f(USGDP,UKGDP,FGDP,JGDP,GGDP)

Dependent variable	: RSAGDP
Sample (adjusted)	: 1960 1997
Included observations	: 37

Variable	Co-efficient	Std. Error	t-Statistic	Prob.
α	–2444.289	1476.588	–1.65	0.1079
USGDP	77.17824	184.6901	0.41	0.6789
UKGDP	345.8979	234.0246	1.47	0.1495
FGDP	64.97752	230.2551	0.28	0.7797
JGDP	352.0478	255.3303	1.37	0.1778
GGDP	16.18513	85.04126	0.19	0.8503

R-squared	: 0.42
Adjusted R-squared	: 0.33
Durbin Watson	: 0.09
Log likelihood	: –331.27
Akaike's Information Criterion (AIC)	: 15.39
Schwarz Criterion	: 15.65
F-statistic	: 4.57

Given that South Africa is a small and open economy, even if the SARB sets the repo or market rate, monetary policy is always subject to the balance of payments constraint, since government's budget deficit as a percentage of GDP has a negative influence on net capital flows in South Africa (Wesso, 2001: 71-72). This is consistent with the evidence for Latin America (Calvo *et. al*., 1993) and developing countries (Fernandez-Arias & Motiel, 1996). This was clearly stated by the Governor of the SARB when South Africa's gold and foreign reserves declined by over R3 billion in four months. The Governor argued that should the restrictive impact of such a decline on domestic liquidity continue, interest rates would not be reduced, irrespective of what is happening to the inflation rate. It was also warned that should the overall deficit on the balance of payments continue, this would lead to higher interest rates, which the SARB would not try to reduce by the creation of money (Stals, 1993: 30). However, it is not the market that sets short-term interest rates, but the central bank, even if it frequently seems to be passively following market trends. In reality, it decides the monetary *targets* or *guidelines* or inflation targets for that matter, based on its estimate of the strength and direction of other market forces. Table 5 reflects *monetary targeting* experience in South Africa between 1986 and 1997. This period covers 52 quarters, which for 31 quarters the *actual* money supply percentage changes were *overshooting* the set target or guideline ranges. These were 10 consecutive quarters, from the first quarter of 1988 to the second quarter of 1990; 5 consecutive quarters, from the first quarter of 1991 to that of 1992; and 16 consecutive quarters, from the first quarter of 1994 to 1997. On the other hand, in 11 quarters the actual money supply percentage changes were *undershooting* the set target or guideline ranges. These were 7 consecutive quarters, from the first quarter in 1986 to the third in 1987; and 4 consecutive quarters of 1993. Of the 48 quarters, only 6 were *within* the set target or guideline range. These were the fourth quarter in 1987; the last 2 quarters of 1990 and the last 3 quarters of 1993.

Thus, between 1986 and 1997, for 46 out of 52 quarters or for 88 per cent of the time, monetary policy in South Africa was *ineffective* in controlling the money supply *within* the set *money supply guidelines*, as postulated by structuralists. As shown in Table 5, of the 12 per cent of the time when money supply changes fell within the set target or guideline ranges, it was for only one quarter in 1987, namely the last; for only 2 quarters in 1990, namely the third and fourth; and for last 3 quarters in 1992. It should be noted that this one quarter within the target range in 1987 followed 7 consecutive quarters of undershooting the set money supply targets or guidelines in 1986 and 1987; the 2 quarters within the target range in 1990 occurred after 10 consecutive quarters of undershooting the set money supply targets in 1988, 1989 and the first 2 quarters in 1992; the last 3 quarters within the target range in 1992 follows 5 consecutive quarters of overshooting the set target range in 1991 and the first quarter in 1992. Accordingly, the structuralist argument that because of external foreign factors, namely international volatile capital flows, trade protectionism (like agricultural subsidies and cheap wage practices) monetary policy is ineffective in controlling money supply changes in a small and open economy, South Africa in this case must be "accepted".

Table 5
Set versus actual money supply targets

YEAR	Actual Percentage Change in M3 (Annual rate): 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Set Target Range %
1986	11.59	10.77	9.93	9.93	16 – 20
1987	8.46	9.87	11.68	15.67	14 - 18
1988	20.63	22.20	26.17	26.40	12 – 16
1989	26.99	25.81	24.88	23.54	11 – 15
1990	21.73	19.43	14.26	12.00	11 – 15
1991	13.55	15.30	14.80	14.15	8 – 12
1992	11.26	8.37	8.95	8.37	7 – 10
1993	5.90	3.50	3.78	5.39	6 – 9
1994	10.58	14.33	15.41	15.05	6 – 9
1995	12.35	15.86	15.66	14.36	6 – 10
1996	15.29	14.55	14.87	14.94	6 – 10
1997	16.38	14.63	14.52	17.28	6 – 10

Note: Percentages are calculated by comparing quarterly averages with the corresponding figure of the previous year.
Source: SARB, *Quarterly Bulletin* (Various issues)

Given the significant relationship between $M3_{t-1}$ and $M3_t$, suggesting that the monetary authorities can *influence* the *levels* of the money supply, although they are *unable to control* them *within* the *set guidelines,* it became obvious that monetary policy application was constrained. In this regard it is well known that inflation targets replaced money supply guidelines in 2002. This necessitated further examination, namely of the impact of external factors on the potency of domestic monetary policy. The United States $/South African rand foreign exchange rate (FOREX), was used as a proxy for external factors. The other domestic explanatory variables of M3 are the repo rate (previous the bank rate)[4], the three months Bankers Acceptance Rate (BA), the R150 government bond rate and Gross Domestic Expenditure (GDE). However, only two of the five explanatory variables, namely the REPO and FOREX, were found to be significant, giving the following equation:

$$M3 = f(REPO, FOREX), \quad (8)$$

After testing down from the following *general* equation:

$$M3 = f(REPO, FOREX, GDE, BA, R150), \quad (9)$$

Equation (9) was run mainly in order to start from the general and move to the specific, retaining significant variables and dropping those that are not. GDE, R150 and BA were found to be insignificant in explaining changes in M3. As a result only the REPO, as a domestic explanatory variable, and FOREX, as a proxy for external factors or influences, were used to explain M3 further. This is covered in the next section.

4.2.4 The influence of external factors on M3 changes

Furthermore, the regression results of equation (8) indicate that the REPO and FOREX are significant as explanatory variables, both individually and collectively, in explaining changes in M3. The negative relationship between movements in the M3 money supply and the REPO makes *economic* sense. If the repo rate decreases, the demand for credit by

the public will increase, and thus the money supply will increase as well. In the same manner, an appreciation of the exchange rate will lead to an increase in foreign reserves and thus also *in* the money supply. With the individual t-statistic below 2 and the calculated F-statistic of 167 for 37 included observations and 2 explanatory variables above, the F_c of 3.28 (5 per cent level) and 5.29 (1 per cent level) for 2 and 34 degrees of freedom for the numerator and denominator respectively, we *reject* the null hypothesis that the REPO and FOREX are *insignificant* in explaining changes in M3.

The following tables present the results after applying collected data on equation (8), to test the null hypothesis that the t-statistic for REPO and FOREX are 0, or that the two variables are not related to M3. Although for this study, as stated above, only the t-statistic and the Augmented Dickey Fuller (ADF) test results are of importance in explaining why M3 is related to $M3_{t-1}$, while monetary authorities fail to meet *set* monetary targets, other standard regression analysis results will be given for the sake of completeness.

It is apparent from Table 6, with 37 observations (n), and two explanatory variables (k), that the degrees of freedom, n-k-1, become 37-2-1, which equals 34. This being over 25 degrees of freedom, with the t-statistic for REPO and FOREX being above absolute 2, used as the rule of thumb to determine the significance of the t-statistic, we reject the hypothesis that REPO and FOREX are not significantly different from 0. Thus, we conclude that while the monetary authorities in South Africa can influence M3 by applying the REPO to $M3_{t-1}$, external forces represented by FOREX as a proxy also impact on M3. Accordingly, on the issue of the *controllability of money supply*, both structuralists and neo-liberals are correct. The results obtained confirm the neo-liberal argument that money authorities of a small and open economy can control the money supply, in this case using the REPO. Simultaneously, the structuralism argument that external forces, with FOREX as a proxy, render monetary policy impotent is confirmed. The next step is to determine the stationarity of the time series used in arriving at the above conclusion. The stationarity test will tell whether the conclusion is meaningful or nonsensical. To determine the stationarity of the time series, this study uses the augmented Dickey Fuller (ADF) test on the residuals.

Before the formal ADF test was used to test for the presence of unit roots, an initial and informal visual inspection of the first and second-order moments was conducted. During this initial stage, correlograms were used in addition to time plots to determine how long it takes the auto correlations to die down. If they die down rapidly, the time series are stationary, and, in the case of non-stationarity, they fade away slowly with a positive value. After establishing that the equation (8) is co-integrated by this initial visual inspection, the formal test on the results was conducted.

Table 6
Test equation M3 = f (REPO, FOREX)

Dependent variable	: M3
Sample (adjusted)	: 1960 1997
Included observations	: 37

Variable	**Co-efficient**	**Std. Error**	**t-Statistic**	**Prob.**
α	293031.9	24135.42	12.14	0.0000
REPO	–4203.034	659.6000	–6.37	0.0000
FOREX	33943.76	2817.209	12.04	0.0000

R-squared	: 0.91
Adjusted R-squared	: 0.90
Durbin Watson	: 1.18
Log likelihood	: –396.41
Akaike's Information Criterion (AIC)	: 18.75
Schwarz Criterion	: 18.88
F-statistic	: 167.61

The formal test for co-integration involved taking the ADF statistics, -12.46415 in Table 7, and measuring it against a MacKinnon (1991) set of parameters of an equation of the response surfaces. The following relation of response surfaces:

$$C(\rho) = 0\alpha + 0_1T^{-1} + 0_2T^{-2} \qquad (10)$$

Where $C(\rho)$ is ρ per cent critical value and T is the number of observations making it possible to get the appropriate critical t-Test residuals from an Ordinary Least Squares (OLS) equation where the number of regresses (excluding the constant and trend) lies between: $1 \leq n \geq 6$. For instance, with 105 observations and n = 3, by looking at MacKinnon table for a constant, 0α, and no trend, at the 5 per cent significance level we get $0\alpha = -3.7429$; $0_1 = -8352$ and $0_2 = -13.41$ and substituting into these figures in equation (10), we get:

$$C(\rho) = (-3.7429 - 8.352/105 - 13.41/105^2) \approx -3.82 \qquad (11)$$

The test criterion for testing the null hypothesis that there is no integration, is to compare the ADF test statistic with the MacKinnon calculated value. We reject the null hypothesis of no co-integration at 5 per cent significance level if the ADF test statistic, that is the t-value, is more negative than –3.82 (Harris, 1995: 54 – 550).

The calculated critical value, based on the MacKinnon table (Harris, 1995:158), where constant is –3.4336, 01 = 5.999, 02 = 29.25, with n = 2 and observations, T is 31, we get:

$$C(\rho) = (-3.9001 - 10.534/31 - 30.03/31^2) \approx -4.37 \qquad (12)$$

Since the ADF test statistic, according to Table 7, is –12.46415 and is less negative than –4.37, we reject the null hypothesis that there is no co-integration. Therefore, we can conclude, at 99 per cent confidence level, that money supply, M3, is significantly related to the repo rate, REPO, and the foreign exchange rate between the United States dollar and the South African rand, FOREX, as a proxy for external influences on money supply, without fear that this conclusion might be spurious.

Table 7
Augmented Dickey-Fuller unit root test

ADF Test Statistic	–12.46415			
Augmented Dickey-Fuller Test Equation:				
Dependent variable	: dM3			
Method	: Least Squares			
Sample (adjusted)	: 1998:09 – 2001:03			
Included observations	: 31 after adjusting end points.			
Variable	**Co-efficient**	**Std. Error**	**t-Statistic**	**Prob.**
dM3(–1)	–2.721861	0.218375	–12.46415	0.0000
R-squared		: 0.90		
Adjusted R-squared		: 0.89		
SE of regressions		: 9647.389		
SSR		: 270E+09		
Log likelihood		: –327.3611		
Durbin Watson Statistics		: 2.557310		
Akaike's Information Criterion (AIC)		: 18.41123		
Schwarz Criterion		: 18.50374		
F-Statistic		: 266.3744		

6 Conclusion

As shown in **Table 6,** monetary policy failed dismally to control money supply changes. Also evaluated was the relationship between $M3_t$ and $M3_{t-1}$, namely whether or not there is a significant relationship between these two variables. A significant relationship between them was found to exist, contrary to the structuralist argument. This result means that the monetary authorities can *influence* the current period money supply, $M3_t$, by manipulating money supply of the previous period, $M3_{t-1}$, despite *their failure to control* the money supply changes within set money supply targets. The inability of the monetary authorities to control money supply changes is explained by the impact of external factors. Both the REPO and FOREX (proxy for external factors influencing money supply changes) were found to be individually and collectively significant in explaining $M3_t$ and have a stronger effect on the money supply than the repo (bank) rate. This explains why the monetary authorities of an open and small country, South Africa in this case, can influence the current money supply level and yet fail to keep it within the set monetary targets**.** This explanation also applies to the inflation targeting era starting in 2002, namely that the exchange rate plays a dominant role in affecting not only the M3 money supply, but also the ability of the monetary policy makers to control CPIX within the set targets. It appears that the an appreciation in the exchange rate leads to a drop in the inflation rate, which in turn results in interest rate cuts. Thus, it still has to be proven that the monetary authorities are successful in stabilising the inflation rate via cuts in the interest rates.

It was found, as shown in Table 2, that both M3 and CPI significantly determine or stimulate GDP. For the sake of completeness, an informal and non-rigorous empirical test was also conducted to evaluate the structuralism claim that large countries as trading partners determine the economic growth of a small and open economy. The empirical result found was that no significant relationship existed between the growth rates of small and large trading countries.

After applying the augmented Dickey-Fuller (ADF) test, the time series used were found to be stationary, thereby avoiding spurious conclusions. Accordingly, the following conclusions are drawn from this empirical study:

(1) The structuralist argument that monetary authorities cannot control the money supply (M3) changes, namely keep them within set monetary targets, are "*accepted".* However, this result must be read with (3).

(2) The neo-liberal or orthodox theory argument that economic growth (GDP) of a small and open economy, South Africa in this case, is influenced or determined by M3 and CPI is "*accepted*"; and in addition, the economic growth of South Africa is not significantly related to the levels of economic growth of its big trading partners. The movements in South Africa's repo-rate (inflation rate) as well as exchange rate, are anti-cyclical with that of its big international trading partners, therefore the levels of economic growth also tend not to be in tandem.

(3) The neo-liberal or orthodox theory argument that money supply in the current period ($M3_t$) is related to money supply in the previous period $M3_{t-i}$) in an open and small economy, that of Republic of South Africa in this case, is "*accepted"*; meaning, in the light of (1), that monetary authorities can *influence* changes in money supply, but c*annot control it* because of external influences.

(4) While the repo rate explains *changes* in the money supply in South Africa, its impact is diluted by external forces. This explains why monetary authorities are able to influence money supply in the current period but are unable to control it within set target levels.

Endnotes

[1] The authors express their appreciation for the valuable comments and recommendations by the referees.

[2] This monetary policy framework introduced by the *De Kock Commission* was used under Dr Stals' governorship prior to 1999. See for example: Stals, C.L, 1996, "Money Supply Guidelines for 1996" of 24 April 1996, available on the SARB website. The speech by Mr Mboweni on 6 September 1999 effectively changed the way monetary policy is conducted in the RSA. See Mboweni, T.T, 1999, "Inflation targeting in SA", also available on the SARB website. Under the latter's governorship money supply no longer *plays* a prominent role, i.e. under the inflation targeting regime. Mboweni argued that "Commitment to an intermediate target (money supply) would be inconsistent with inflation targeting except if it is the only determining factor of inflation … which cannot be"

[3] In this section, prior to 2000, the impact of M3 money growth on CPI and not on CPIX as CPIX as inflation target was only introduced in 2003.

[4] In this regard the data used are the accommodation rate from the Quarterly Bulletin of the Reserve Bank. The time series used here refers to the repo rate, although during the 1990s the term "bank rate" was used.

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