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THE STABILITY OF MONEY DEMAND IN SOUTH AFRICA, 1965-1997

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Abstract

After the adoption of more market-oriented monetary policy measures in 1980, the South African Reserve Bank primarily relied on setting predetermined growth targets for M3 to achieve its primary objective of price stability. The main purpose of this paper is to test empirically whether there exists a stable long-run demand for money function over the period 1965-1997. The empirical results suggest that there exists a stable long-run demand for money function for M3 in South Africa, while the demand for M1 and M2 display parameter instability following financial reforms since 1980. The results largely support the South African Reserve Bank's view that the M3 money stock could serve as an indicator for monetary policy.

JEL Classification: C22, E41

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I Introduction

An important issue concerning monetary policy is to identify a stable money demand function (Friedman, 1959; Friedman and Schwartz, 1982; Laidler, 1977; Laidler, 1982)[1]. In turn, a stable money demand function is a necessary condition to establish a direct link between the relevant monetary aggregate and nominal income. The presence of a stable money demand function will thus enhance the ability of monetary authorities to reach predetermined monetary growth targets if price stability is the main objective[2].

In a South African context, it is important from a policy point of view to establish whether there exists a stable long-run relationship for M3 money demand. After the adoption of more market-oriented monetary policy measures in 1980, the South African Reserve Bank chiefly relied on setting predetermined growth targets for M3 to achieve its primary objective of price stability (Mohr and Rogers, 1995). Recently, the Reserve Bank conceded that M3 has lost some of its credibility as a reliable indicator and should be supplemented with other financial indicators such as changes in bank credit extension, and movements in the exchange rate of the rand (Stals, 1997). However, the Reserve Bank still perceives changes in the rate of growth of M3 as important, since inflation cannot be sustained over the long-term if it is not

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[1] According to Laidler (1982) the demand for money holdings is stable when money holdings can be explained by functional relationships which have statistical significance, and that the same equation can be applied to different countries using different data, without it being necessary to change arguments of the relations to achieve satisfactory results.
[2] Although empirical support for a stable money demand is a necessary condition for there to be a predictable link between money and prices, it does not necessarily validate the monetarist contention that the money supply is causal in the process of inflation (Kaldor, 1982). However, if price stability is the main policy objective, a stable money demand function is important irrespective of whether the money supply is exogenous or endogenous. When the money supply is endogenous, price stability could be achieved through a discretionary variable such as the interest rate.

accommodated by excessive growth in the money supply (Stals, 1997).

Although the study of money demand has always been a popular subject in applied econometrics it has recently gained in popularity. Following significant financial deregulation and innovation in many countries it has become important to establish whether the underlying properties of the money demand function still hold (Melnick, 1995). More importantly, recent econometric techniques effectively avoid problems of spurious regressions that have been associated with previous studies (Miller, 1991; Hoffman *et al*., 1995; Taylor, 1994).

The main purpose of this paper is to assess whether there exists a stable long-run demand for money function in South Africa. Three different definitions of money demand will be considered: M1 which consists of coins, banknotes and other demand deposits; M2 which also includes other short and medium-term deposits; and M3 which additionally includes long-term deposits. In addition, the study will adopt two different estimation procedures that include the single equation techniques developed by Engle and Granger (1987) and the maximum likelihood systems procedure developed by Johansen and Juselius (1990).

The paper is organised as follows. Section II provides a theoretical overview and considers the relevant money demand function to be estimated for South Africa. Section III estimates the long-run model while section IV looks at the dynamic short-run model. Section V considers whether the estimated results satisfy the theoretical properties of a stable money demand function. Finally, section VI ends with some summary remarks. The money demand functions for South Africa are estimated over the period 1965-1997 using annual data[3]. The data are from the South African Reserve Bank's Quarterly Bulletin (various issues).

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[3] Taylor (1993) cites Shiller and Perron (1985) who argue that when analysing long-run relationships, the length of the time series is far more important than the number of observations.

II Theoretical Issues

II.i A Money Demand Function for South Africa

A standard demand for money function can be expressed as (Laidler, 1977):

$$\left(\frac{M}{P}\right)^d = f(y, i) \tag{1}$$

where: y = real income

i = the appropriate nominal interest rate that reflects the opportunity cost of holding money

$(M/P)^d$ = the demand for real money balances

Economic theory further states that money demand is positively related to income and negatively to the interest rate. Furthermore, the demand for money is treated as the demand for real balances, implicitly assuming that the function is homogenous of degree one in the level of prices.

Some doubts have been raised on whether real income (y), as measured by real gross domestic product, is an appropriate scale variable for narrow definitions of money (Mankiw and Summers, 1986). In their study for the United States, Mankiw and Summers (1986) show that consumer spending generates more M1 and M2 money demand compared to investment and government spending, which favours real consumption expenditure as a more suitable scale variable.

To capture the influence of foreign variables in determining an appropriate money demand function, more recent studies have considered the impact of the exchange rate and foreign interest rate (Carruth and Sanchez-Fung, 1997; Choudhry, 1995; Chowdhury, 1997). The exchange rate variable captures the impact of currency substitution on money demand, where an expected depreciation of the exchange rate leads to a decline in the demand for domestic money and an increase in the demand for foreign money. In addition, capital mobility is proxied by an appropriate foreign interest rate variable, where an increase in the foreign interest rate increases the return on foreign bonds and subsequently leads to a decline in the demand for domestic currency (McKinnon, 1983).

Equation (1) can be modified in the following way:

$$\left(\frac{M}{P}\right)^d = f(y, i, fi, exr) \tag{2}$$

where *fi* is the foreign interest rate and *exr* the expected exchange rate. The rapid globalisation of economies during the 1980s and 1990s, the liberalisation of foreign exchange controls and the adoption of more market-oriented exchange rate systems, suggest that the demand for money cannot realistically be estimated without considering the impact of foreign influences.

An overview of the South African economy during the period 1965-1997 casts some doubt on the validity of equation (2) as an appropriate money demand function. Until 1982, South Africa's exchange rate was not market-related while, at the same time, strict exchange controls were used to prevent capital flight. It was only in 1995, after the successful democratic election in 1994, that the financial rand mechanism[4] was finally abolished and the Reserve Bank continued to relax exchange control measures.

In 1983 the South African Reserve Bank adopted a managed floating exchange rate system that witnessed a sharp depreciation of the nominal effective exchange rate. Whether currency depreciation had a major impact on the demand for money, however, is not clear-cut.

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[4] The financial rand mechanism was an exchange control measure imposed to protect the capital account of the balance of payments against capital outflow. Theoretically speaking, disinvestment had no influence on the capital account because trade took place through the financial rand market between non-residents only.

Political instability that prevailed during the 1980s and early 1990s played a major role in determining macroeconomic policy. Disinvestment campaigns emanating mainly from Western nations, accompanied by stricter trade and financial sanctions, forced the government to declare a moratorium on foreign debt in 1985. Disinvestment together with the repayment of foreign debt contributed to net capital outflows of around R5 billion per annum during the period 1985-1993.

The above considerations, coupled with the fact that South Africa had been isolated from international capital and financial markets during the 1980s and early 1990s, indicate that equation (1) is the relevant money demand function for South Africa.

II.ii Descriptive Evidence on the Stability of Money Demand in South Africa

Thus far, the overview has essentially argued why the inclusion of variables to capture foreign influences may not be plausible in a South African context. However, a crucial issue is whether money demand in South Africa displays stability following financial reforms in 1980 and the debt standstill in 1985[5].

Figure 1 depicts the income velocities in nominal terms of the three different definitions of money over the period 1965-1997. A striking feature of Figure 1 is the sharp rise in the income velocities of M1 and M2 until 1980 and the preciptuous decline thereafter. The rise in velocity over the period 1965-1979 can mainly be ascribed to the “disintermediation” phenomenon experienced at the time, whereby credit extensions took place outside the banking system to avoid direct credit constraints imposed by the Central Bank (Black and Dollery, 1989). The subsequent fall in velocity since 1980 can mainly be attributed to

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[5] Some of the major financial reforms since 1980 included the abolition of bank credit control measures, the abolition of deposit rate controls, and lower liquid asset and cash reserve requirements.

"reintermediation" which saw the return of disintermediated credit to the balance sheet of banks. The most important implication is that the money demand functions for M1 and M2 may not be the same over the sub-periods 1965-1979 and 1980-1997.

[Figure 1 here]

Figure 1 shows that the income velocity for M3 remained fairly stable over the period 1965-1979, with a slight rise in (detrended) velocity since 1980. From the visual evidence it would thus appear that velocity is more stable for a broader definition of money[6]. To show this in a different way, Figure 2 plots nominal GDP (money income) against the nominal money supply for the three different definitions of money. From a policy point of view Figure 2 contains the most important information, since the visual displays provide evidence whether money demand is stable, and hence whether the relation between money income and the relevant money supply is close and predictable.

[Figure 2 here]

Figure 2 shows that the relationship between nominal GDP and money becomes more conspicuous as we move from a narrow definition of money towards a broader definition (see footnote 6). More importantly, the Figure shows that the relationships for M1 and M2 are closer in the period 1965-1979 compared to 1980-1997. The visual displays suggest that not only do the income velocities for M1 and M2 differ markedly over the sub-periods, but that

[6] Over the period 1965-1979 the rise in velocity is more conspicuous for a narrow definition of money, i.e. a rise in nominal GDP without a proportional increase in currency and demand deposits that define the narrow definition of money. A possible explanation could be that once the disintermediated credit is spent, it returns as deposits on the liability side of the balance sheet of banks with a subsequent rise in medium and long-term deposits and hence a more stable velocity for a broader definition of money. Over the period 1980-1997, the return of disintermediated credit induced agents to hold more money in the form of currency and demand deposits and hence the subsequent decline in velocity for narrower definitions of money. Using an extreme example, the effect of financial reforms is similar to moving from a barter economy to one with a financial system, so that the immediate effect is a rise in the demand for currency relative to medium and long-term deposits that define a broader definition of money.

the velocities became more unstable following financial reforms since 1980.

From Figure 2 it can also be seen that there is a conspicuous relationship between M3 and nominal GDP. Some notable exceptions are the period immediately following financial reforms in 1980 where, for a brief period, credit extended probably rose relative to the M3 money supply, and the immediate repayment of debt since 1985. In addition, these two events may explain why the velocity for M3 is slightly higher over the sub-period 1980-1997. The visual evidence suggests that we may have uncovered a stable money demand function for M3, but not necessarily for narrower definitions of money.

Figure 3 illustrates the different income velocities as expressed in real terms. In accordance with Figure 1 that expressed the income velocity of M1 in nominal terms, Figure 3 shows the preciptuous decline in velocity for M1 following financial reforms since 1980. Figure 3 also depicts a decline in velocity for M2 since 1980 (from a relatively high level in the mid-1970s), while the velocity for M3 remained fairly stable over the period of financial reforms. However, the movements of both velocities seem to be closely related since 1985.

[Figure 3 here]

Figure 4 displays the relationships between real income and real money demand.

[Figure 4 here]

For the M1 definition of money, Figure 4 illustrates that the relationship is inconspicuous over the entire period. For M2 in Figure 4, the relationship becomes less clear from the mid-1970s until the mid-1980s compared to M3. Since the mid-1980s the movements of M2 and M3 are relatively close although the relation between real income and real money demand seems to be closer for the M3 definition of money. Although there is a clear relationship following financial reforms in 1980, real M3 money balances seem to decline after the debt standstill in 1985. Despite this, the relationship between real M3 and real income still holds over the entire period. Although more visible when the variables are measured in nominal terms, the evidence thus far suggest that irrespective of whether we use nominal or real variables, the demand for money seems to be more stable for a broader definition.

II.iii Opportunity Cost Variable

In deciding on an appropriate opportunity cost variable it is important to acknowledge that South Africa is characterised by a well-developed and integrated financial system that largely differs from Montiel's (1996) extensive review for the rest of the Sub-Saharan African countries. On the other hand, theory suggests that if the interest rate variable is not market-related or has been subjected to regulatory measures such as interest rate ceilings, then the inflation rate is a more reliable proxy for the opportunity cost of holding money. Before 1980 the interest rate was mildly repressed but since 1980 the Reserve Bank adopted more market-oriented policy measures. However, the adverse political and economic conditions that prevailed during the 1980s and 1990s forced the Reserve Bank to change the interest rate on a regular basis to maintain price stability.

Many demand for money studies for high-inflation countries use the inflation rate as an alternative proxy for the opportunity cost of holding money, since asset substitution is likely to be between money and real assets rather than between money and financial assets (Deadman, 1995). A casual overview of South Africa's inflationary experience for the period 1965-1997 shows that the inflation rate has been relatively mild and stable compared to typical high-inflation countries. However, since it is uncertain to what degree the interest rate has been market-related in South Africa, the interest rate and the inflation rate as an alternative will both be considered as appropriate opportunity cost variables.

To arrive at a working definition of a stable demand for money function, Laidler's (1982) definition (footnote 1) can be extended to state that a stable money demand function can normally be explained by just a few observable economic variables while the parameter estimates should be relatively small; an income elasticity ranging between 0.5 and 1.0 or a little greater, and the interest rate elasticity between -0.1 and -0.5. Moreover, the estimated quantitative values of the parameters should not change too much over a long period (Laidler, 1982).

In Friedman’s early writings, the real demand for money was seen as a function of real income and the interest rate, although Friedman (1959) later stated that in practice the interest rate did not feature in the money demand function. The reason for the secondary importance of the interest rate can be found in the extreme monetarist view that money is not a close substitute for a small range of financial assets, but for a much wider range of assets that include real or financial assets (Goodhart and Crockett, 1970).

In a comprehensive overview of empirical money demand studies, Goodhart and Crockett (1970) showed that the interest rate has featured in most of the money demand functions although, generally, the effect has been very small. The important point is that the variables entering the demand for money function will, to a large extent, depend on the money definition being used. For example, when a narrow definition for money (M1) is used, the interest rate effect is likely to be higher compared to a broader definition. The reason is that for a broad definition of money, the interest rate effect is largely captured by the movement between current and time deposits that define the relevant broad monetary aggregate. Thus, for a broader definition of money, the interest rate is unlikely to show whether money has close substitutes or not. Furthermore, since short-term interest rates are subject to a greater degree of variation than long-term interest rates, the interest rate effect is likely to be smaller when a short-term interest rate is used.

III Estimating Long-Run Money Demand

First it is necessary to test whether the relevant variables in equation (1) are stationary and to determine the orders of integration of the variables. To test for unit roots in the levels and first differences of the variables, a standard Augmented Dickey Fuller (ADF) test is performed. Table 1 shows that the null hypothesis of a unit root in levels cannot be rejected for all of the variables, but that it is rejected when the variables are measured in first differences. The exception is *Lp*, where the null hypothesis of a unit root cannot be rejected in levels and in first differences. Most of the variables are therefore integrated of order one, i.e. I(1).

[Table 1 here]

Engle and Granger (1987) showed that when two non-stationary variables of the same order {I(1)} cointegrate to form a stationary series {I(0)}, then a standard OLS procedure can be used. In addition, cointegration between two non-stationary variables allow the inclusion of stationary variables such as shift dummies. The main drawback of the Engle-Granger (1987) procedure is that it is only applicable to the bivariate case while the Johansen procedure tests for more than one cointegrating vector and is thus tailor-made for the multivariate case.

When the relevant variables cointegrate to form a stationary series, the first step of the Engle-Granger (1987) procedure involves estimating the long-run demand for money by OLS,

$$L\,m/p_t = a_0 + a_1 Ly_t + a_2 Li_t + \varepsilon_t\,, \tag{3}$$

where all the variables are defined as before and the different definitions of the demand for money are treated as the demand for real money balances[7]. Because the Johansen procedure

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[7] When the Johansen procedure is used, it is important that the variables entering the demand for money function are all I(1). The ADF-test in Table 1 revealed that the logarithm of the price level (*Lp*) is I(2). Alternatively, the demand for money is treated as the demand for real money balances to ensure that all the variables are I(1) (see, for example, Harris, 1995).

searches for more than one cointegrating vector, the analysis will first focus on the more sophisticated Johansen procedure.

III.i The Johansen Procedure

Turning to the Johansen Maximum Likelihood procedure, it is first necessary to estimate the number of lags required in the VAR system. By arbitrarily starting from a VAR system of order 3, the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) indicate that a VAR system of order 2 is the appropriate lag-length for all three money demand functions, irrespective of whether *Ly* or *Lpcons* is the scale variable.

In Table 2, panel A indicates that the null-hypothesis of no-cointegrating vector cannot be rejected at the 5% level of significance for *Lm1/p*, *Lm2/p* and *Lm3/p* when *Lpcons* is the scale variable. The result is not surprising for *Lm3/p*, since theory predicts that *Lpcons* is a more suitable scale variable for narrow definitions of money (see Mankiw and Summers, 1986).

[Table 2 here]

From panel B of Table 2, it can be seen that the null hypothesis of no-cointegrating vector for *Lm1/p* and *Lm2/p* cannot be rejected at the 5% level of significance when *Ly* is the scale variable, but that the maximum eigenvalue and trace test statistics reject the null of no-cointegration for *Lm3/p*. A unique long-run cointegrating relation therefore exists between *Lm3/p*, *Ly* and *Li*.

An economic interpretation of the results can be obtained by normalising the cointegrating vector on *Lm3/p*. Panel B(i) indicates that the long-run elasticity estimates of *Ly* and *Li* are of the correct theoretical signs although the elasticity estimate of *Li* is close to zero. The likelihood ratio test from panel B(ii) shows that the interest rate elasticity is not statistically different from zero at the 5% level of significance. The restricted version of the cointegrating relation therefore indicates that a long-run relationship exists between *Lm3/p* and *Ly*. The result basically accords with the theoretical exposition discussed earlier, which shed some doubt on whether interest rates have truly been market-related in South Africa. In addition, the interest rate effect is likely to be smaller for a broad definition of money.

I also searched for cointegration when the inflation rate was the relevant opportunity cost variable. No cointegrating relationship could be found for any of the three money definitions, so that the discussion hereafter will treat the interest rate as the appropriate opportunity cost variable.

The absence of a cointegrating relationship for M1 and M2 tends to support the visual evidence presented earlier. The theoretical and empirical implications of no-cointegration for M1 and M2 will be discussed in Section V.

To obtain a robust elasticity estimate for *Lm3/p*, Table 3 includes a shift dummy variable in the VAR model that captures the debt standstill in 1985 and substantial capital outflows thereafter[8]. The shift dummy variable takes the value of one for the period 1985-1997 and zero otherwise.

[Table 3 here]

The maximum eigenvalue and trace test statistics in panel A from Table 3, show that the null hypothesis of no-cointegration can be rejected at the 5% level. The conclusion can be reached that there exists a unique long-run relationship between *Lm3/p* and *Ly*. Panel C illustrates that the income elasticity of 1.29 in panel B, is statistically greater that one at the

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[8] Recall from the visual displays in section 2, that the decline in the demand for real M3 money balances occurred since 1985, while the demand for real M3 money balances remained unaffected following financial reforms since 1980. However, also note from Figure 4 that the dummy variable could possibly capture the higher volatility of RM3 since 1985, and not necessarily an overall decline in RM3. The shift dummy variable is included as an I(0) variable in the VAR model. The estimated coefficient will therefore not be shown in the results.

1% level of significance.

III.ii Engle-Granger Procedure

The ADF-test in model 1 from Table 4 indicates that the null-hypothesis of no-cointegration can be rejected at the 5% level of significance. However, since *Li* is insignificantly different from zero the long-run relationship is most probably between *Lm3/p* and *Ly*. The inclusion of DUM_{85} in model 1 illustrates that the debt standstill and ensuing capital outflow had a negative and significant impact on the demand for real M3 money balances. When the restriction of a zero interest rate elasticity is imposed, the ADF-test in model 2 indicates that the variables are cointegrated at the 5% level of significance.

[Table 4 here]

The income elasticity of 1.32 is similar to the income elasticity estimate of 1.29 obtained from the Johansen procedure. Furthermore, model 2 is well-determined and passes the range of diagnostic tests.

A crucial question concerning money demand functions is whether the estimates display parameter constancy (Hendry and Ericsson, 1991; Ericsson *et al*., 1994)[9]. The parameter constancy of the model is illustrated in Figure 5, which plots the recursively estimated

[9] Chow-tests for structural breakpoints in 1980 and 1985 indicate that we cannot reject the null hypothesis of structural stability at the 1% level of significance for the breakpoint since 1980, but that the null is rejected at the 1% level of significance for the breakpoint since 1985. It is important to acknowledge that the Chow-test is indicative whether there has been a change in the intercept *and/or* slope (i.e. elasticity). Since we have already established that there exists a long-run relationship between the variables through cointegration analysis, we expect the purported structural instability since 1985 to reflect a change in the intercept and *not* to be indicative of non-constancy of the elasticity. When both a slope and shift dummy variable were entered into the equation, the results (not reported here) showed that both dummies were not statistically different from zero. When entered separately, however, the slope dummy was statistically significant but the magnitude of the parameter estimate (-0.004) shows that the income elasticity estimate would not change if rounded. To improve the explanatory power of the model we therefore decided to include the shift dummy variable.

coefficient on *Ly*. In addition, Figure 6 plots the cumulative sum of squares (CUSUMQ) of the recursive residuals of model 2, and shows that the null hypothesis of parameter constancy cannot be rejected at the 5% level of significance.

[Figures 5 and 6 here]

IV The Short-Run Dynamic Model

Since the variables *Lm3/p* and *Ly* are cointegrated, the second step of the Engle and Granger (1987) procedure shows how the short-run dynamic version of the long-run relationships estimated from model 2 in Table 4, can be specified as an error correction model of the following form:

$$\Delta L\, m3/p_t = b_0 + b_1 EC_{t-1} + \sum b_2 \Delta L\, m3/p_{t-i} + \sum b_3 \Delta L y_{t-i} + \varepsilon_t \qquad (4)$$

where the error correction term (EC_{t-1}) is the residuals of model 2 in Table 4.

A crucial question concerning the error correction model is what the optimal lag-length should be. A popular technique is Hendry's general-to-specific methodology which proceeds by eliminating lags with insignificant parameter estimates (Gilbert, 1986; Hoque and Al-Mutairi, 1996; Miller, 1991). Accordingly, an error correction model with three lags was initially estimated; those parameter estimates with insignificant lags were eliminated and the model was re-estimated. The following parsimonious model was estimated (standard errors in parentheses):

$$\underset{}{\Delta L\, m3/p_t} = \underset{(1.58)}{-8.12} - \underset{(0.17)}{0.88} EC_{t-1} + \underset{(0.13)}{0.39} \Delta L\, m3/p_{t-1} + \underset{(0.24)}{0.87} \Delta L y_t + \varepsilon_t \qquad (5)$$

$R^2 = 0.68$	Standard Error of Regression = 0.029
Durbin's-h = 1.49	Heteroscedasticity: $F(1,29) = 0.44$
Normality: $\chi^2(2) = 0.80$	LM (serial correlation): $F(1,26) = 1.24$
RESET: $F(1,26) = 0.60$	$Chow_{1980,\ 1983,\ 1985}$: $F(4,23) = 0.96, 0.80, 0.81$

The error correction model is well-determined and passes all the diagnostic tests proposed by Hendry and Ericsson (1991). A standard Chow-test is performed to test for the structural stability of the model. Besides 1985, two potential structural breakpoints are identified: 1980 when more market-oriented monetary policy measures were adopted; and 1983 when the Reserve Bank adopted a managed floating exchange rate system that witnessed a sharp depreciation of the nominal exchange rate. The Chow-test for all three potential breakpoints confirm that the model is structurally stable, i.e. the parameter estimates are constant over the whole period. The error correction term indicates that the speed of adjustment is swift with about 88% of any disequilibrium between actual and equilibrium M3 money balances being made up during the course of a year.

V Stability Properties for the Different Definitions of Money

The results reported in this study provide evidence that *Lm3/p* is the only money demand function that yields a long-run demand relationship. The estimation results for the long-run and short-run models showed that *Lm3/p* displays parameter constancy over the entire period, while the interest rate, although having the correct theoretical sign, is insignificantly different from zero. The real demand for broad money is solely explained by real income (*Ly*) which provides some support for the monetarists' theoretical proposition that there exists a direct link between the M3 money stock and money income. Moreover, the long-run income elasticity estimates that range between 1.29 and 1.32 indicate that the results are robust[10].

[10] The long-run income elasticity of 1.29 to 1.32 for *Lm3/p* roughly accords with the magnitudes reported in other studies that have used a broad definition of money. Ghatak (1995) estimated money demand functions for India that spanned the period 1950-1986 and reported long-run income elasticity estimates for M3 that ranged between 1.1 and 1.7; Chowdhury (1997) reports an elasticity of 1.29 for Thailand; and Thornton (1996) estimates an elasticity of 2.04 for Mexico.

The absence of a long-run cointegrating relationship for M1 and M2 intuitively suggests that financial reforms since 1980 and/or the debt standstill of 1985, could have induced a change in the long-run relationships of both monetary aggregates. In addition to the visual evidence presented earlier, Figures 7 and 8 plot the cumulative sum of squares (CUSUMQ) of the recursive residuals and show that *Lm1/p* and *Lm2/p* display parameter instability when the relevant money demand definition is regressed on real income (*Ly*)[11].

[Figures 7 and 8 here]

To capture the impact of financial reforms in 1980 and the debt standstill in 1985, I included shift and slope dummies for the *Lm1/p* and *Lm2/p* regressions[12]. However, the results (not reported here) showed that the dummy variables to capture the debt standstill in 1985 were statistically insignificant. This suggests that the dominant source of instability in the M1 and M2 definitions of money was the financial reforms in 1980. In Table 5, model 1 and model 2 report the income elasticity estimates as measured by *Ly* when shift and slope dummy variables are included for *Lm1/p* and *Lm2/p* respectively. By adopting the dummy variable approach, model 1 and model 2 capture the impact of financial reforms since 1980, where the shift dummy variable (DUM_{80}) takes the value of zero for the period 1965-1979 and one otherwise. Both the slope and shift dummy variables are statistically significant, which indicate that financial reforms since 1980 may have induced a significant change in the parameter estimates of both monetary aggregates.

[Table 5 here]

The dummy variable approach allows the direct interpretation of the parameter estimates obtained from model 1 and model 2. For *Lm1/p* the income elasticity estimates are 0.65 and

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[11] Identical pictures were presented when *Lpcons* was the scale variable.
[12] Recall that we argued in section II that the M2 definition of money demand may be unstable due to the financial reforms in 1980 and the debt standstill in 1985.

3.35 over the sub-periods 1965-1979 and 1980-1997 respectively; and for *Lm2/p* 1.32 and 2.86 over the same sub-periods. However, the elasticity estimates seem unrealistically high[13] in the second sub-period despite the advantage of the dummy variable approach[14]. It is uncertain whether the elasticity estimates are sensible since the regressions over the two sub-periods could be spurious. Given the small sample size for the two sub-periods, tests for cointegration would not necessarily indicate whether the variables entering the money demand function are related over the long-run.

Alternatively, model 3 and model 4 estimate the money demand functions in first differences[15]. The first difference estimates show that the parameter estimates of 0.84 and 1.13 for *Lm1/p* and *Lm2/p* respectively are not markedly different for the first sub-period compared to the level estimates. However, over the sub-period 1980-1997 the parameter estimates of 2.55 and 1.96 differ widely compared to the level estimates of 3.35 and 2.86.

Irrespective of whether the demand for money functions are estimated in levels or first differences, the results indicate that both *Lm1/p* and *Lm2/p* suffer from parameter instability over the period 1965-1997. The high parameter estimates for income over the period 1980-1997 may be indicative of increased monetisation of the economy following financial reforms since 1980[16].

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[13] Friedman (1971) for example, postulates that the income elasticity for economies experiencing rapid economic development ranges between 1.5 and 2.0.
[14] The main advantage of the dummy variable approach is that it estimates the model over the whole period and thus preserves observations (Gujarati, 1995).
[15] The intercepts for the equations measured in differences were not statistically significant so we excluded them from the regressions. In addition, the substantially lower standard errors (not reported here) of the parameter estimates for real income without intercepts, suggest that the regressions in differences should not include intercepts (see e.g. Gujarati, 1995).
[16] Note that the magnitude of the income elasticity estimates supports our prior contention that money demand in South Africa is more stable for a broader definition of money. A close to unity parameter estimate for real income in the money demand function can therefore be associated with a more conspicuous relationship between money income and the relevant monetary aggregate.

VI Conclusion

The main findings of this paper have shown that there exists a stable long-run demand for money function for M3 in South Africa, while the demand for M1 and M2 display parameter instability following financial reforms since 1980. The results largely support the South African Reserve Bank’s view that the M3 money stock could serve as an indicator for monetary policy.

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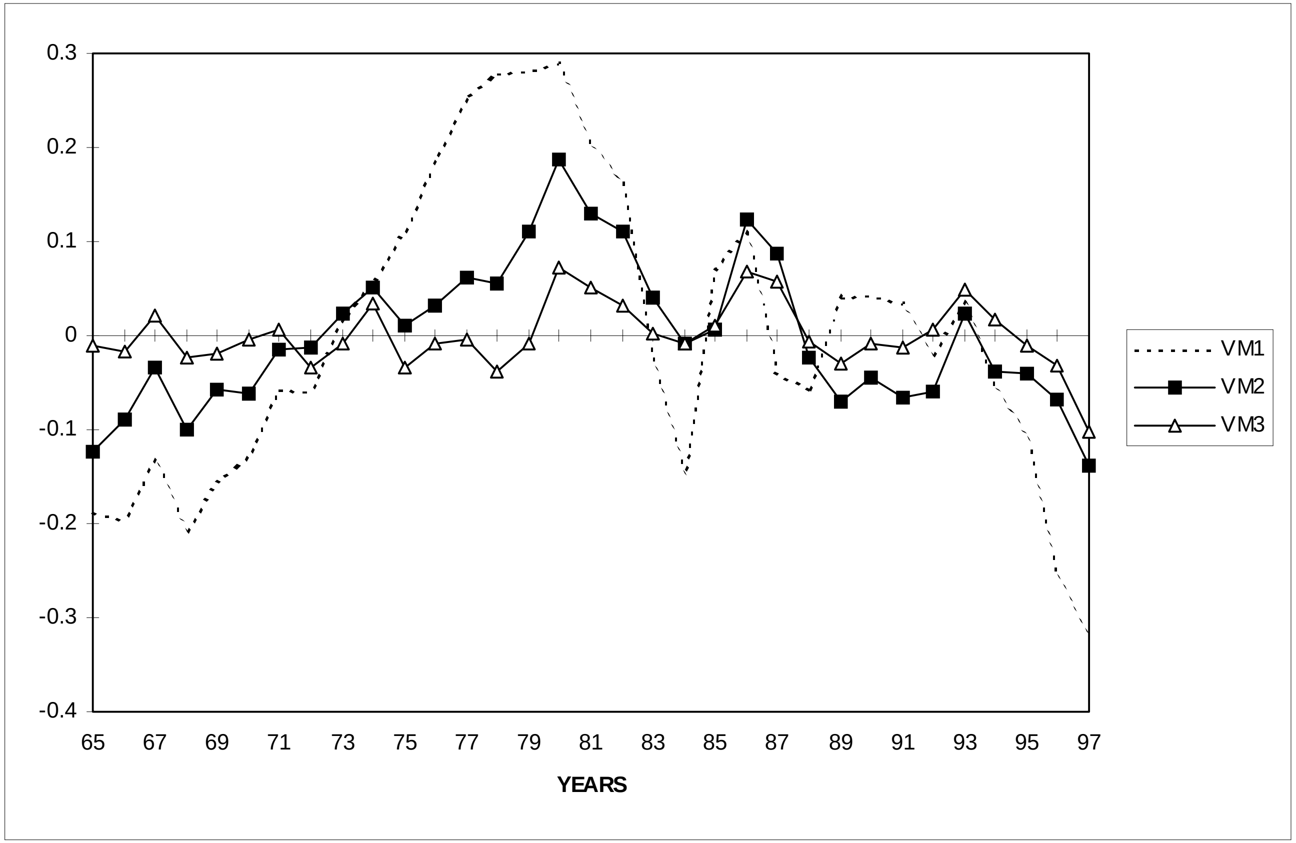
Figure 1

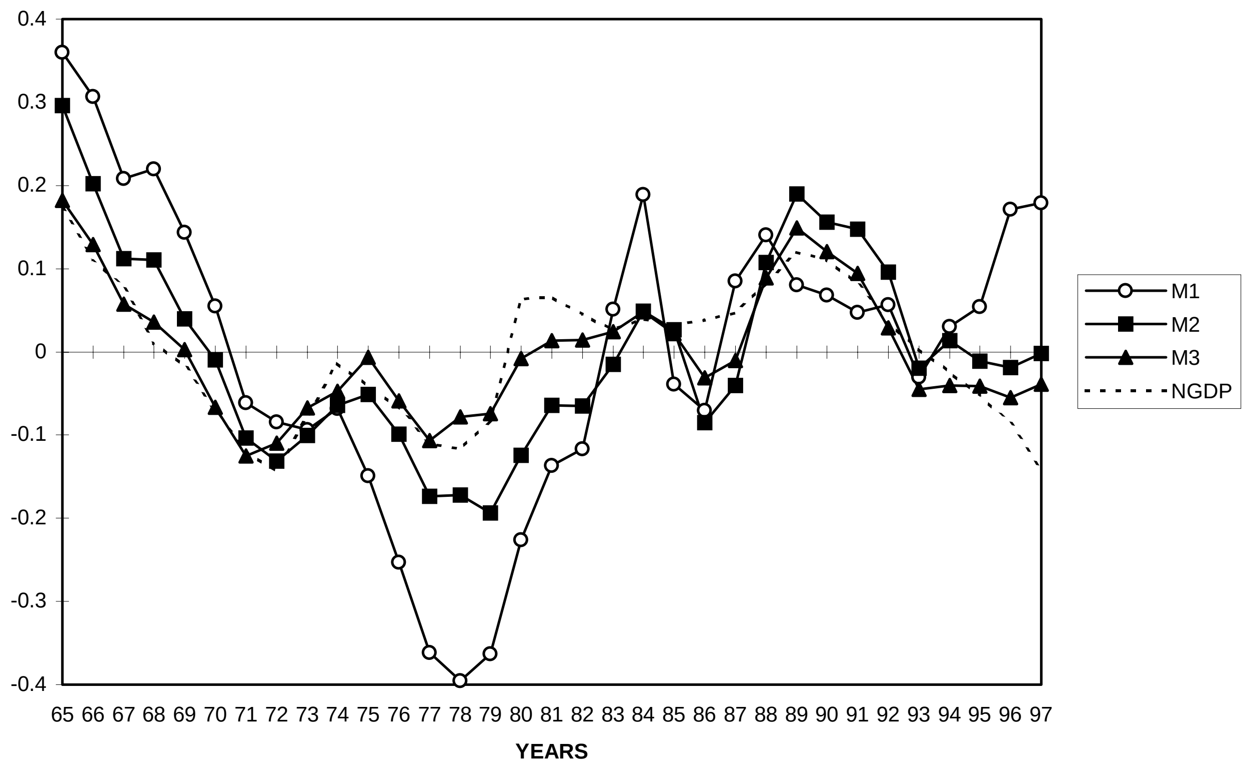
Nominal Velocity (VM) of the Different Definitions of Money



Note: All the variables were detrended by regressing them on an intercept and time variable.

Figure 2

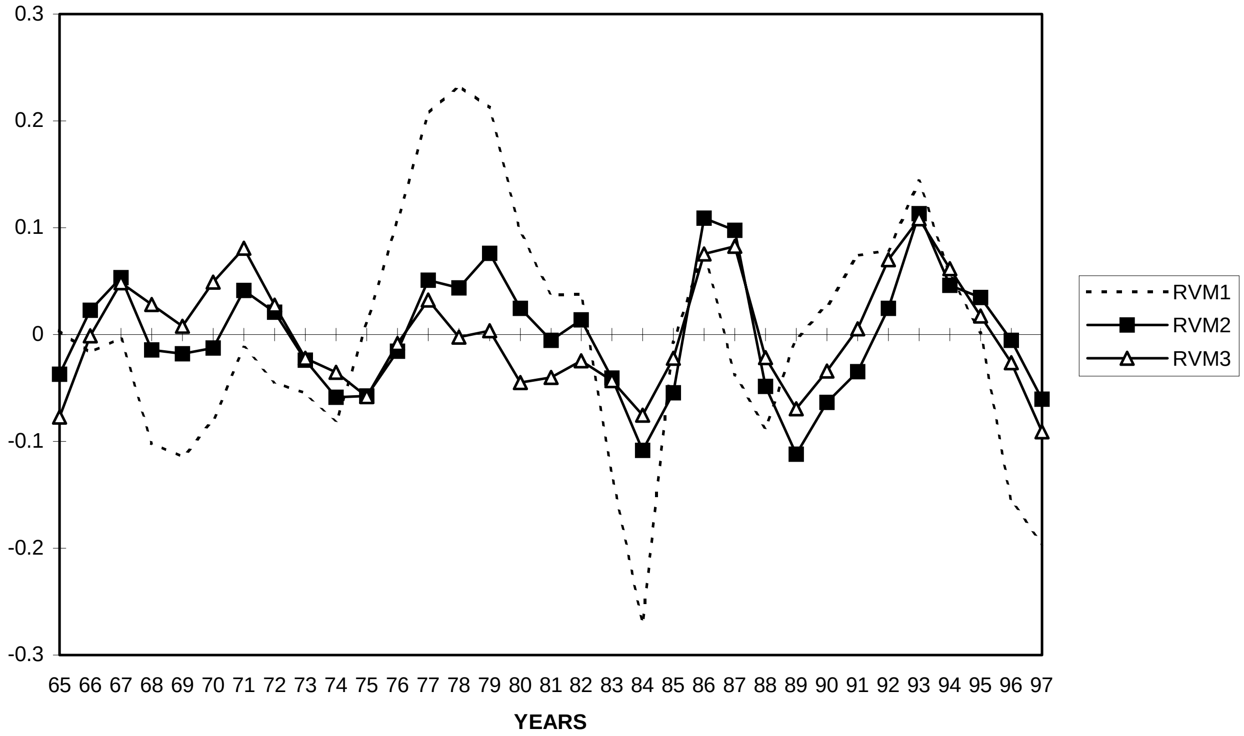
The Relation between Money Income (NGDP) and Nominal Money Supply (M1, M2, M3)



Note: All the variables were detrended by regressing them on an intercept and time variable.

Figure 3

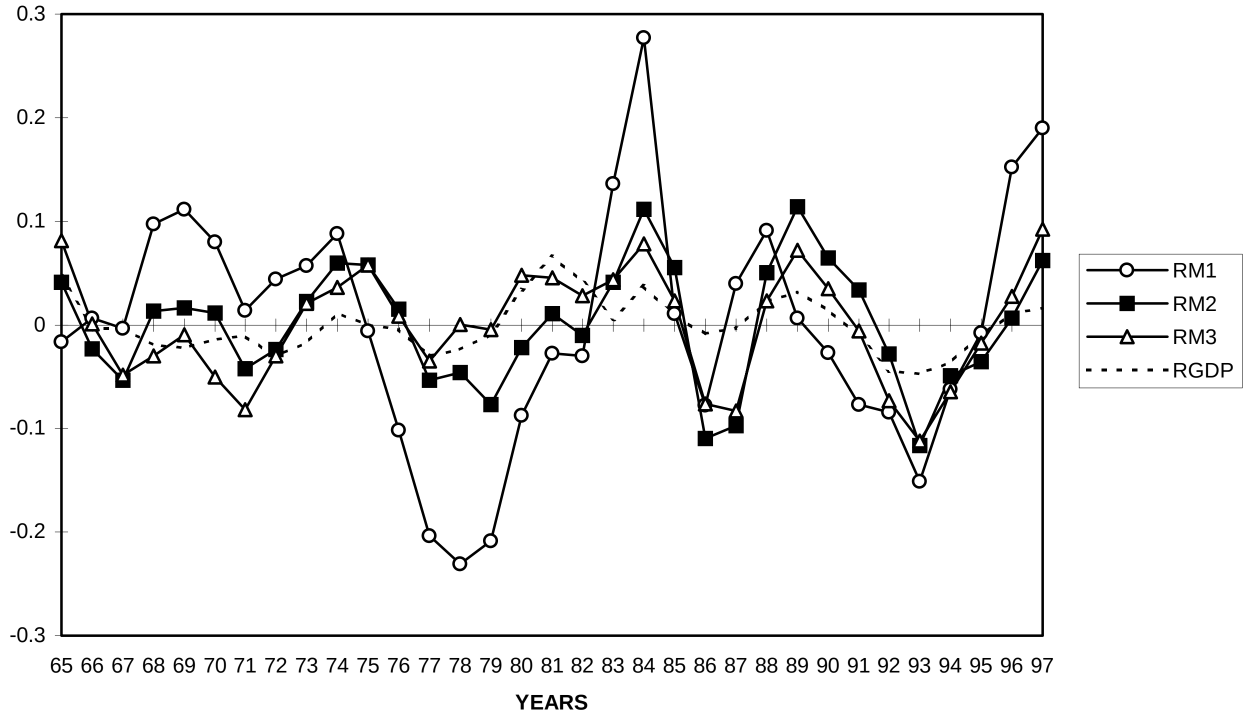
Real Velocity (RVM) of the Different Definitions of Money



Note: All the variables were detrended by regressing them on an intercept and time variable.

Figure 4

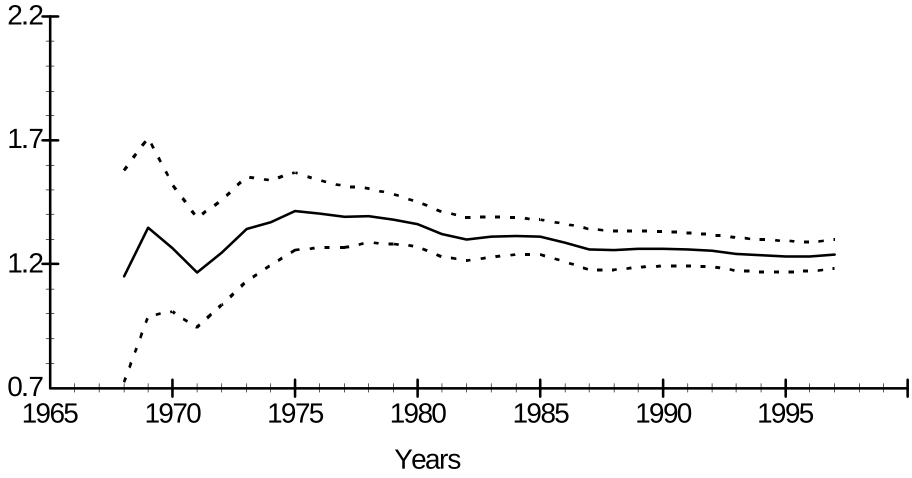
The Relation between Real GDP (RGDP) and Real Money Demand (RM) for the Different Definitions of Money



Note: All the variables were detrended by regressing them on an intercept and time variable.

Figure 5

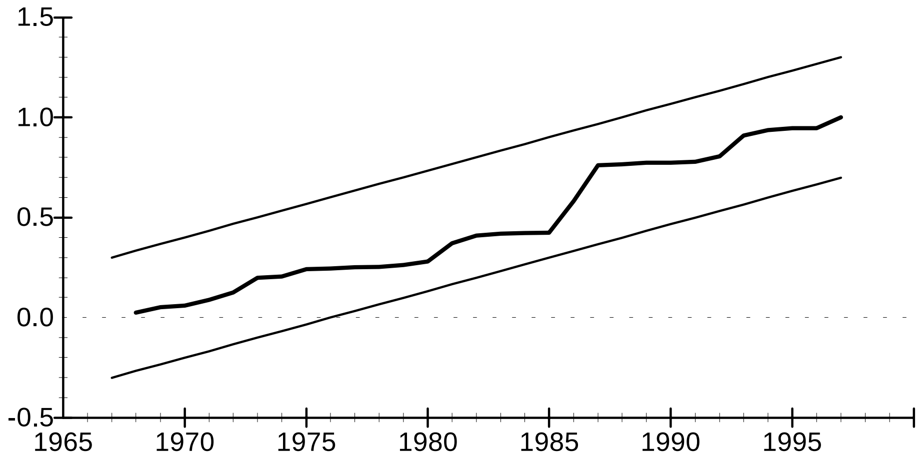
Recursive Estimation of the Coefficient on *Ly* and its Estimated Standard Error



Note: '—' coefficient estimate; '….' ± 2 standard errors

Figure 6

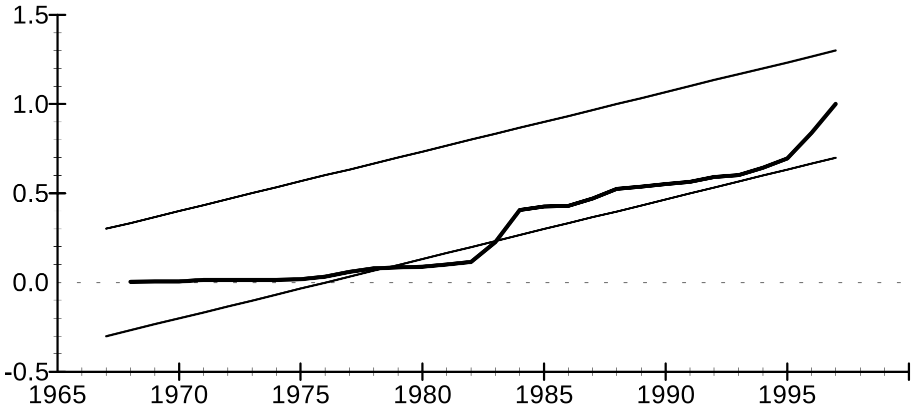
CUSUMQ Test for the *Lm3/P* Regression



Note: Straight lines represent critical bounds at the 5% level of significance

Figure 7

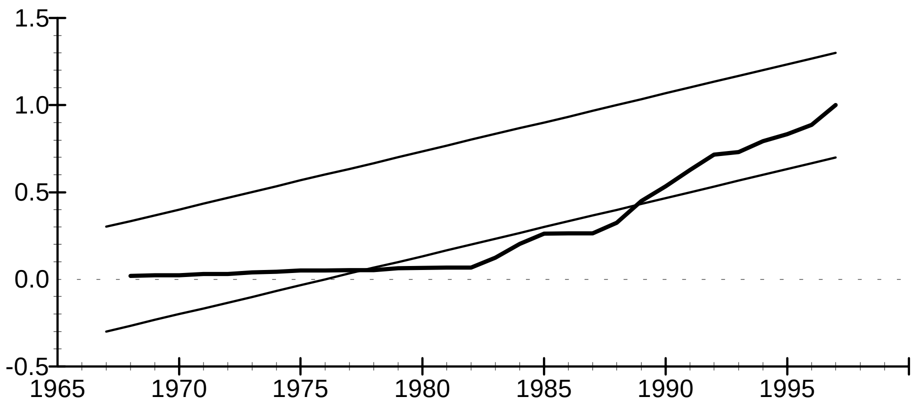
CUSUMQ Test for the *Lm1/P* Regression



Note: Straight lines represent critical bounds at the 5% level of significance

Figure 8

CUSUMQ Test for the *Lm2/P* Regression



Note: Straight lines represent critical bounds at the 5% level of significance

Table 1

Augmented Dickey Fuller Test Statistics

Variable	**ADF test statistics (including a constant)**
$Lm1/p$	-0.17
$Lm2/p$	-0.95
$Lm3/p$	-1.68
Ly	-2.66
$Lpcons$	-2.18
Li	-1.44
$\dot{p}$	-1.95
Lp	-0.90
$\Delta Lm1/p$	-4.68*
$\Delta Lm2/p$	-5.52*
$\Delta Lm3/p$	-4.51*
ΔLy	-3.55*
$\Delta Lpcons$	-3.13*
ΔLi	-6.52*
$\Delta \dot{p}$	-4.57*
ΔLp	-2.33

Notes:

1. $Lm1/p$, $Lm2/p$ and $Lm3/p$ are the different definitions of money divided by the consumer price (CPI) and transformed into logarithms.
2. Ly is the logarithm of real income as measured by real gross domestic product.
3. $Lpcons$ is the logarithm of real income as measured by real private consumption expenditure.
4. Li is the logarithm of the government bond yield.
5. Lp is the logarithm of the price level and $\dot{p}$ is the inflation rate.
6. * denotes that the null hypothesis of a unit root is rejected at the 5 % level of significance. In each case the optimal lag-length was determined by the maximised log-likelihood test and Akaike Information Criterion.

Table 2

Johansen Cointegrating Vectors with *Lpcons* and *Ly* as the Scale Variables, 1965-1997

VAR (lag length 2)			
Panel A: Tests for Cointegration between Money, *Lpcons* and *Li*			
Monetary aggregate	H_0	λ max eigenvalue	λ trace
	r = 0	12.80	17.80
$Lm1/p$	r ≤ 1	4.08	5.00
	r ≤ 2	0.92	0.92
	r = 0	12.39	25.04
$Lm2/p$	r ≤ 1	8.41	21.65
	r ≤ 2	4.24	4.24
	r = 0	12.39	22.19
$Lm3/p$	r ≤ 1	6.78	9.79
	r ≤ 2	3.01	3.01
Panel B: Tests for Cointegration between Money, *Ly* and *Li*			
Monetary aggregate	H_0	λ max eigenvalue	λ trace
	r = 0	14.55	23.09
$Lm1/p$	r ≤ 1	7.57	8.54
	r ≤ 2	0.97	0.97
	r = 0	12.78	25.73
$Lm2/p$	r ≤ 1	7.60	12.94
	r ≤ 2	5.34	5.34
	r = 0	22.60*	39.08*
$Lm3/p$	r ≤ 1	9.64	16.48
	r ≤ 2	6.83	6.83
Panel B(i): Long-run Elasticities			
Monetary aggregate	Real Income (*Ly*)	Government Bond Yield (*Li*)	
$Lm3/p$	1.28	-0.1	
Panel B(ii): Likelihood Ratio Test Statistic			
Monetary aggregate	$\eta Li = 0$		
$Lm3/p$	0.81		

Note: * denotes significance at the 5% level.

Table 3

The Johansen Procedure with the Inclusion of a Dummy Variable in the VAR Model

VAR (lag length 2)			
Panel A: Tests for cointegration between *Lm*3/*p* and *Ly*			
Monetary aggregate	H_0	λ max eigenvalue	λ trace
$Lm3/p$	r = 0 r ≤ 1	26.66* 6.78	30.77* 9.79
Panel B: Long-run Elasticity			
Monetary aggregate	Real Income (*Ly*)		
$Lm3/p$	1.29		
Panel C: Likelihood Ratio Test Statistic			
Monetary aggregate	η*Ly* = 1		
$Lm3/p$	15.70**		

Notes:

1. The likelihood ratio test in panel C has a $\chi^2(1)$ distribution under the null hypothesis; the one percent critical value is 6.63.
2. ** and * denote significance at the 1% and 5% level respectively.

Table 4

Long-run Static OLS Estimations for *Lm3/p*, 1965-1997

Variables	**Model 1**	**Model 2**
constant	-9.80 (-9.48)	-9.17 (-19.82)
Ly	1.38 (14.39)	1.32 (34.84)
Li	-0.04 (-0.67)	
DUM_{85}	-0.04 (-2.48)	-0.05 (-3.04)
Diagnostic tests		
R^2	0.98	0.98
LM-test	F(1,28) = 3.15	F(1,29) = 2.84
Ramsey's RESET test	F(1,28) = 0.01	F(1,29) = 0.00
Normality	$\chi^2(2) = 1.34$	$\chi^2(2) = 1.13$
Heteroscedasticity	F(1,31) = 0.47	F(1,31) = 0.39
ADF(1) test	-4.13	-4.15

Note: t-statistics in parentheses.

Table 5

Structural Stability of *Lm1*/p and *Lm2/p*

Variables	**Model 1** $Lm1/p$	**Model 2** $Lm2/p$	**Model 3** $\Delta Lm1/p$ 1965-1979	**Model 3** $\Delta Lm1/p$ 1980-1997	**Model 4** $\Delta Lm2/p$ 1965-1979	**Model 4** $\Delta Lm2/p$ 1980-1997
constant	-2.28 (-1.34)	-9.59 (-10.55)				
Ly	0.65 (4.62)	1.32 (17.60)	0.84 (2.44)	2.55 (3.34)	1.13 (4.52)	1.96 (4.18)
DUM_{80}	-33.42 (-7.63)	-19.15 (-8.20)				
$DUM_{80} \times Ly$	2.70 (7.69)	1.54 (8.22)				
Diagnostic tests						
R^2	0.95	0.98				
LM-test	F(1,28) = 9.64	F(1,28) = 2.48	F(1,12) = 0.33	F(1,16) = 0.09	F(1,12) = 0.06	F(1,16) = 0.02
Ramsey's RESET test	F(1,28) = 0.40	F(1,28) = 0.29	F(1,12) = 0.02	F(1,16) = 0.75	F(1,12) = 1.09	F(1,16) = 0.19
Normality	$\chi^2(2) = 1.82$	$\chi^2(2) = 0.56$	$\chi^2(2) = 0.67$	$\chi^2(2) = 0.93$	$\chi^2(2) = 0.82$	$\chi^2(2) = 0.24$
Heteroscedasticity	F(1,31) = 0.22	F(1,31) = 1.18	F(1,12) = 2.01	F(1,16) = 1.06	F(1,12) = 0.05	F(1,16) = 0.65

Note: t statistics in parentheses.