MONEY DEMAND, OWN INTEREST RATES AND DEREGULATION

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ABSTRACT

This paper reports estimation and testing of general lag formulations of demand for M1, M3 and broad money (BM) using new data for the own rates of return on money. Own rate effects have become more important in the recently-deregulated financial environment. Own interest rates are found to be very important in explaining all three aggregates, although it is found that there is no contemporaneous interest rate effect on BM. BM appears to have the most stable econometric relationship with income and interest rates of the three aggregates, with M3 remaining unstable despite the introduction of own rates to the equation.

Own rate effects may enhance the efficiency of achieving low-inflation objectives by controlling money supply growth. Excessive interest sensitivity is reduced by the presence of own rates, as is the possibility of real interest rate overkill.

While the BM equation is found to have desirable properties, the econometric results are preliminary. The results certainly do not support BM as a target variable, since the lag structure is complex with respect to interest rates. Targeting BM would amount to little more than targeting nominal income directly, which requires knowledge of a wide range of influences on GDP.

TABLE OF CONTENTS

MONEY DEMAND, OWN INTEREST RATES AND DEREGULATION

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1. Introduction

One objective of monetary policy is the stabilisation of nominal demand, and hence inflation, over the medium term. Monetary aggregates can be an important indicator of potential inflationary pressures, so their behaviour is generally considered in the policy formulation process.

Growth of monetary aggregates has played an important (though by no means exclusive) role in conditioning policy decisions in Australia over the past decade. Prior to January 1985 a conditional projection for M3 was announced. In the early 1980s it became apparent that M3 growth was being affected by financial deregulation, and in December 1984 the projection was suspended. Nevertheless, the growth of monetary aggregates continues to be one of the items on the Reserve Bank's checklist approach to monetary policy.

Chart 1 shows the behaviour of M1, M3 and broad money (BM) in recent years. M1 growth fell from just under 17 per cent in 1981, to -0.8 per cent growth by the end of 1982. It then rose very sharply in 1983, and fell equally markedly again in 1985. M3 grew noticeably more slowly than BM in the late 1970s and early 1980s. By the end of 1982, however, its growth had accelerated relative to BM. In the second half of 1984, there was an even more dramatic acceleration of M3 growth compared to BM. BM did not begin to grow noticeably more quickly until the second half of 1985, when the economic upturn had been under way for some time.

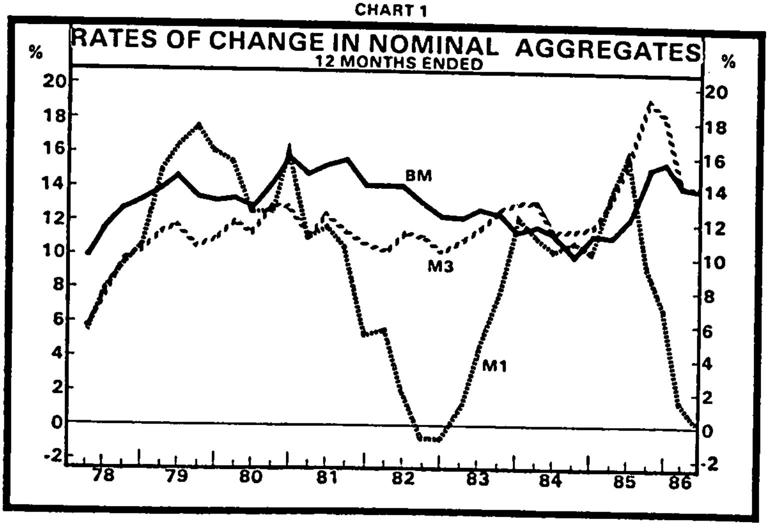
The behaviour of these three aggregates appear to paint quite different pictures of recent monetary growth. In its Annual Reports and Bulletin the Bank has downgraded emphasis on M3 relative to BM. The Bank has never given much weight to M1 and, indeed, has ceased to publish this narrower aggregate. The primary aim of this paper is to examine whether or not any of these aggregates are, in the face of financial deregulation, suitable indicators for the formulation of monetary policy.

The usefulness of monetary aggregates as indicators for policy purposes can be approached from a number of perspectives. The most basic issue is whether the demand for the aggregate is stable. The relationship between money and variables influencing demand (such as real income, the price level and interest rates) must be predictable if money growth rates are to convey information to policy makers. Issues concerning the econometric stability of money demand functions are examined in Section 2.

A second issue is whether control of monetary aggregates is sufficient to stabilise nominal demand in the economy. Even if money demand is stable, it does not always follow that achieving a particular growth rate for a chosen aggregate will influence nominal demand and inflation in the desired way. Certain additional conditions must be satisfied before this can be established. It is possible, for example, that interest rate policies may slow monetary growth in a predictable fashion while inflation continues accelerating. The parameters of the money demand function and the presence or absence of an own rate of interest are shown in Section 3 to have an important bearing on the relationship between monetary growth and nominal demand.

A related issue is the relative effectiveness of monetary aggregates as intermediate targets. Stable money demand coupled with some assurance that controlling the aggregate in question will influence inflation in the medium term does not guarantee that monetary targeting is the optimal policy rule. Real interest rates affect economic activity. Consequently, there may be costs associated with adjusting interest rates to restrain the growth of

CHART 1



monetary aggregates in the face of increasing inflationary pressures. The characteristics of the money demand function and the role of own interest rates on money are again shown to be important in determining the extent of these cost

Some concluding remarks are made in Section 4.

2. The Stability of Money Demand

Previous studies of money demand in Australia do not include data affected by deregulation in the mid 1980s. Only recently has sufficient data come to hand t test whether the old relationships have been robust to the changes. The starti point for the present study is a paper by Stevens, Thorp and Anderson (1986), which re-estimates functional forms used in earlier literature on money demand functions.

Four representative studies of money demand in Australia were selected by Steve et. al. These were replicated and updated with the purpose of assessing their stability over original and extended sample periods. Three M3 equations and one M1 equation were subjected to a variety of stability tests. The M3 equations estimated were those of Sharpe and Volker (1977), Porter (1979) and Freeland (1984). All three used primarily double log, Koyck adjustment formulations with the real money stock explained by gross domestic product and interest rates. Pagan and Volker (1981) estimated a more general equation for M1.

All the earlier demand functions for M3 were found by Stevens et. al. to break down when updated to early 1986. This may have resulted from the effects of deregulation, or errors in the specification of the original equations. This wa less clear for the Pagan and Volker M1 equation. There is no earlier literature for the relatively new BM aggregate.

A different methodology is applied in this paper to assess the stability of mone demand. We begin with a general formulation of a money demand function, and the impose parameter restrictions accepted by the data to obtain preferred specifications. These are then subjected to stability tests over the sample period.

A single equation approach is adopted in line with previous Australian and international literature in this area. In principle, both the money supply and demand processes could be modelled in a full system context, particularly if one is interested in examining monetary policy transmission mechanisms. This ensures simultaneity problems are fully accounted for.[1] The aim of this paper is more limited. It attempts to examine the nature of relationships between money income and interest rates over the recent period of deregulation, using some new data for own rates of interest on holding money balances. The sample period is relatively short, and the focus is on how the simple relationships behave as deregulation impacts on both competing and own rates of interest.

Following previous studies we postulate a long-run equilibrium relationship of the form:

$$(1) \qquad m - p = \alpha_o + \sum_{i=1}^{I} \alpha_i x_i$$

where M is money, P the price level (GNE deflator), x_i ($i = 1, \ldots.. I$) are other variables, α_i ($i = 0, \ldots.. I$) are parameters, and lower case letters denote logarithms. The general form of the short-run dynamic analogue to equation 1 in distributed lag form is:

$$(2) \qquad m - p = \beta_o + \sum_{j=0}^{J} \left(\sum_{i=1}^{I} \beta_{ij} x_{i,t-j} + \gamma_j (m-p)_{t-j-1} \right)$$

Demand functions of this general form were estimated on quarterly data over the sample period 1974Q2 to 1986Q2 for M1, and 1977Q1 to 1986Q2 for M3 and BM.[2] The independent variables were real income, Y, the two-year government bond rate, R, and constructed own interest rates for M3 and BM, R_{M3} and R_{BM}.[3] Details of the data are supplied in Appendix C.

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1. This approach has been taken in the Bank's econometric model RBII. See, for example, Jonson and Trevor (1981), Jonson, McKibbin and Trevor (1982) and Fahrer, Rankin and Taylor (1984).

2. The sample periods chosen are the longest possible given data constraints. For example, it was possible to construct the own rate for M3 only back to 1974. See Evans (1986).

3. The construction of the own rate of interest for M3 and BM is discussed in Appendix D.

An important part of the Bank's recent empirical research motivating the present study has been the construction of own interest rates for M3 by Evans (1986), and the updating of this work and construction of a BM own rate by Thorp (1986).[4] Own interest rates must be included with the competing rates to measure the opportunity cost of holding money. Furthermore, while other rates may also be important, the rate of return available on a broader definition of money is likely to be the most relevant competing rate for narrower definitions. Thus, the M3 own rate is an important aspect of the opportunity cost of holding current deposits. Similarly, rates available from financial institutions outside of the banking system may be the most relevant competing rate for bank deposits.

The specification of the opportunity cost argument was also carefully tested, along with the relevant lag structure. Results are reported in full for M1, M3 and BM (for the case of J=1) in Tables 1, 2 and 3, respectively.[5]

(a) Money demand estimates

The coefficients on the second lag of real money balances were insignificantly different from zero for all three aggregates, and F tests confirm that the restriction $\gamma_2=0$ is accepted by the data. Restrictions on the income terms were also similar between the aggregates. However, the way in which interest rates enter the equations differs between BM and the other aggregates.

Consider first the interest rate terms. Collinearity problems preclude the inclusion of a spectrum of rates. For M1 the main competing rate was found to be the rate of interest on M3.[6] Exclusion of the lagged interest rate ($\beta_{21}=0$) was accepted by the data, while excluding the current rate was not. For M3, the main competing rate was found to be that available on broad

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4. As yet the importance of market interest rates on cheque accounts is not sufficient to warrant an own rate for M1. The practice of banks at present is far from uniform and the emergence of interest bearing current accounts mainly involves absorption of service charges rather than the provision of market rates of return.

5. Tests were conducted for the case of J=3 and J=2. Zero restrictions on all variables subscripted j=2,3 were accepted at the 5 per cent level. Presentation of the results is greatly simplified if we restrict ourselves to the case of j=0,1.

6. The M3 own rate was acceptable at a higher level of probability on the basis of t tests but, more importantly, the M1 equation proved more stable with this specification.

TABLE 1: MONEY DEMAND M1: OLS SAMPLE PERIOD JUNE 1974 TO JUNE 1986[a]

Equation $D\ln(\frac{M}{P}) = \beta_0 + \beta_{10}\ln y_t + \beta_{11}\ln y_{t-1} + \beta_{20}R_{M3,t} + \beta_{21}R_{M3,t-2} + \gamma_1\ln(\frac{M}{P})_{t-1} + \gamma_2\ln(\frac{M}{P})_{t-2}$

Restrictions	β_0	β_{10}	β_{11}	β_{20}	β_{21}	γ_1	γ_2	F test of restric.	Critical Value 5%	Fit	h
1. Unrestricted	-0.606 (-0.556)	0.485 (2.868)	-0.232 (-1.26)	-3.378 (-2.753)	1.724 (1.339)	-0.251 (-1.555)	0.045 (0.379)	-	-	$\bar{R}^2$=.73	undefined
2. $\gamma_2 = 0$	-0.458 (-0.455)	0.478 (2.875)	-0.238 (-1.314)	-3.317 (-2.757)	1.751 (1.377)	-0.204 (-1.993)	0.00	0.144	4.08	$\bar{R}^2$=.73	-0.161
3. $\gamma_2 = 0$ $\beta_{11} = 0$	-0.507 (-0.499)	0.275 (4.462)	0.00	-3.39 (-2.795)	1.618 (1.266)	-0.233 (-2.304)	0.00	0.917	3.23	$\bar{R}^2$=.73	0.218
4.* $\gamma_2 = 0$ $\beta_{11} = 0$ $\beta_{21} = 0$	0.22 (0.27)	0.289 (4.739)	0.00	-1.93 (-5.09)	0.00	-0.324 (-4.576)	0.00	1.143	2.84	$\bar{R}^2$=.72 RMSE[b] =0.029	0.097
5. $\gamma_2 = 0$ $\beta_{11} = 0$ $\beta_{20} = 0$	1.354 (0.634)	0.264 (3.981)	0.00	0.00	-1.779 (-4.151)	-0.416 (-5.027)	0.00	3.205	2.84	$\bar{R}^2$=.68	-0.145

Note (a) t statistics in parenthesis.
(b) Root mean square error from a dynamic simulation over the full sample period for (m-p).

TABLE 2: MONEY DEMAND M3: OLS SAMPLE PERIOD MARCH 1977 TO JUNE 1986[a]

Equation $D\ln\left(\frac{M}{p}\right) = \beta_0 + \beta_{10}\ln y_t + \beta_{11}\ln y_{t-1} + \beta_{20}(R_{BM,t} - R_{M3,t}) + \beta_{21}(R_{BM,t-1} - R_{M3,t-1}) + \gamma_1 \ln\left(\frac{M}{p}\right)_{t-1} + \gamma_2 \ln\left(\frac{M}{p}\right)_{t-2}$

Restrictions	β_0	β_{10}	β_{11}	β_{20}	β_{21}	γ_1	γ_2	F test of restric.	Critical Value 5%	Fit	h
1. Unrestricted	-0.750 (-1.772)	0.384 (3.099)	-0.115 (-0.764)	-4.785 (-2.268)	2.941 (1.441)	-0.222 (-1.140)	0.036 (0.212)	-	-	$\bar{R}^2=.56$	undefined
2. $\gamma_2 = 0$	-0.717 (-1.852)	0.380 (3.161)	-0.113 (-0.765)	-4.840 (-2.350)	3.032 (1.545)	-0.187 (-1.818)	0.00	0.045	4.20	$\bar{R}^2=.59$	-0.582
3. $\gamma_2 = 0$ $\beta_{11} = 0$	-0.740 (-1.929)	0.317 (3.641)	0.00	-5.184 (-2.597)	3.009 (1.544)	-0.232 (-2.758)	0.00	0.306	3.34	$\bar{R}^2=.60$	-0.303
4.* $\gamma_2 = 0$ $\beta_{11} = 0$ $\beta_{21} = 0$	-0.797 (-2.043)	0.329 (3.712)	0.00	-2.375 (-2.824)	0.00	-0.237 (-2.769)	0.00	0.962	2.95	$\bar{R}^2=.58$ RMSE[b] =0.014	-0.087
5. $\gamma_2 = 0$ $\beta_{11} = 0$ $\beta_{20} = 0$	-0.706 (-1.694)	0.287 (3.055)	0.00	0.00	-1.601 (-1.831)	-0.207 (-2.275)	0.00	2.347	2.95	$\bar{R}^2=.52$	-0.097

<u>Note</u> (a) t statistics in parenthesis.
(b) Root mean square error from a dynamic simulation over the full sample period for (m-p).

TABLE 3: MONEY DEMAND BROAD MONEY: OLS SAMPLE PERIOD MARCH 1977 TO JUNE 1986[a]

$$\text{Equation } D\ln(\tfrac{M}{P}) = \beta_0 + \beta_{10}\ln y + \beta_{11}\ln y_{t-1} + \beta_{20}(R_t - R_{BM,t}) + \beta_{21}(R_{t-1} - R_{BM,t-1}) + \gamma_1\ln(\tfrac{M}{P})_{t-1} + \gamma_2\ln(\tfrac{M}{P})_{t-2}$$

Restrictions	β_0	β_{10}	β_{11}	β_{20}	β_{21}	γ_1	γ_2	F test of restric.	Critical Value 5%	Fit	h
1. Unrestricted	-0.416 (-1.037)	0.282 (2.610)	-0.193 (-1.576)	0.623 (1.886)	-0.857 (-2.471)	-0.281 (-1.599)	0.237 (1.581)	-	-	$\bar{R}^2$=.71	Undefined
2. $\gamma_2 = 0$	-0.432 (-1.052)	0.293 (2.644)	-0.195 (-1.558)	0.594 (1.755)	-0.881 (-2.482)	-0.050 (-0.500)	0.00	2.50	4.20	$\bar{R}^2$=.70	-1.053
3. $\gamma_2 = 0$, $\beta_{11} = 0$	-0.773 (-2.171)	0.240 (2.226)	0.00	0.500 (1.467)	-0.869 (-2.395)	-0.150 (-1.8921)	0.00	2.53	3.34	$\bar{R}^2$=.68	-0.220
4. $\gamma_2 = 0$, $\beta_{11} = 0$, $\beta_{21} = 0$	-0.769 (-2.010)	0.309 (2.762)	0.00	-0.057 (-0.213)	0.00	-0.215 (-2.683)	0.00	3.79	2.95	$\bar{R}^2$.63	-0.780
5.* $\gamma_2 = 0$, $\beta_{11} = 0$, $\beta_{20} = 0$	-0.889 (-2.514)	0.289 (2.764)	0.00	0.00	-0.506 (-1.872)	-0.185 (-2.392)	0.00	2.47	2.95	$\bar{R}^2$=.67 RMSE[b] 0.014	-0.217

Note (a) t statistics in parenthesis.
(b) Root mean square error from a dynamic simulation over the full sample period for (m-p).

money. The M3 own rate was also significant, and the restriction of equal and opposite signs on the two rates was accepted by the data. Again, it was the contemporaneous opportunity cost that was included in the equation.

For BM, the competing rate is the two-year government bond rate. The differential between the competing and own rates was again included in the equation. As with M3, the restriction of equal and opposite signs on the competing and own interest rates was accepted. However, restricting the parameter β_{20} on the current interest rate differential to zero was accepted by the data, whereas excluding the lagged term is not. This finding contrasts strongly with that for M1 and M3. <u>The evidence suggests the absence of a contemporaneous impact of interest on broad money demand</u>.

The long-run semi-elasticities of money demand with respect to interest rates are shown in Table 4. It is interesting that these are high for M1 and for M3, but markedly smaller for BM.

With regard to the income terms, the coefficient β_{11} on lagged income is constrained to zero for all three aggregates. The long-run income elasticities of money demand implied by estimates of β_{10} are also shown in Table 4. As the aggregate becomes broader, the income elasticity tends to rise. This is consistent with the role of money as a store of wealth in the case of the broader aggregates.

Also shown in Table 4 are the estimated mean lags. These are short for the narrow transactions aggregate M1, but lengthen somewhat for M3 and again for BM. Transactions costs associated with shifting between interest bearing deposits and/or less liquid government bonds would be consistent with this finding.

<u>TABLE 4: LONG-RUN EQUILIBRIUM COEFFICIENTS AND MEAN LAGS</u>

	M1	M3	BM
Income elasticity	0.89	1.39	1.56
Interest rate semi-elasticity	-5.96	-10.02	-2.74
Mean lag (quarters)	3.09	4.83	5.41

(b) Stability tests

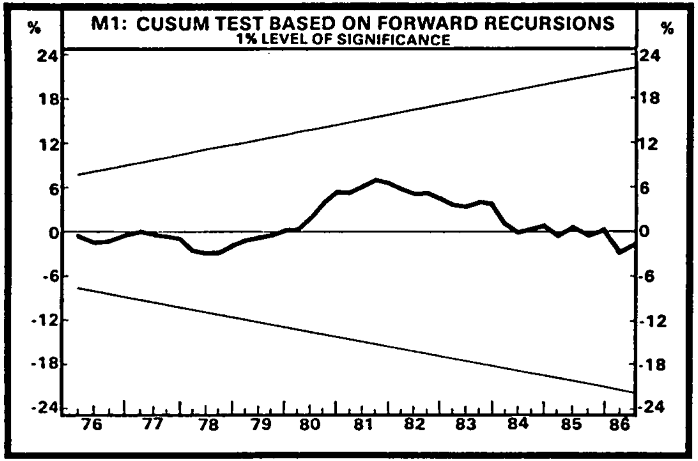
The preferred money demand equations (shown with an asterisk in each of Tables 1 to 3) were subjected to stability tests. Particular attention was given to the 1980s. Recursive regression (cusum and cusum of squares) and moving regression (homogeneity statistic) tests were used. Quandt's likelihood ratio helped identify potential periods of structural breaks in the data generating process. The significance of the potential break in the data associated with the global minimum of Quandt's likelihood ratio was subjected to a Chow or F test. A Chow test was also conducted for 1985Q1, the quarter in which monetary targeting was suspended because of the impact of deregulation. The main findings are summarised in Table 5; more detailed results are set out in Appendix B. Appendix A explains the test procedures in full.

The M1 equation shows some evidence of instability under the procedures adopted. The equation seems reasonably stable on the basis of the Brown, Durbin and Evans (1975) tests (see Chart 2), with the possible exception of the forward cusum of squares case. However, the Chow test based on the break point identified by the minimum of Quandt's likelihood ratio was significant even at the less demanding 1 per cent level. This occurs in 1979. At this time, there was a shift in monetary policy operating procedures, with the introduction of the Treasury note tender system. The level of cash in the economy was less influenced by fluctuations in the budget deficit than had previously been the case.

The M3 equation shows even more distinct signs of instability during the 1980s. The smallness of the sample size suggests that particular care should be taken in interpreting the results. Nevertheless, the normalised cumulative sum of squared recursive regression residuals move outside of the significance bounds during the early 1980s, even at the 1 per cent level, as is shown in Chart 3.

The official M3 projection was suspended in early 1985 mainly because of distortions associated with deregulation. A Chow test confirms that this break is significant even at the 1 per cent level. This result offers some support for the judgement made at that time. Similarly, a Chow test confirms rejection of the null hypothesis of stability for the break point identified by the minimum of Quandt's likelihood ratio (1983Q1).

CHART 2


M1: CUSUM TEST BASED ON FORWARD RECURSIONS
1% LEVEL OF SIGNIFICANCE
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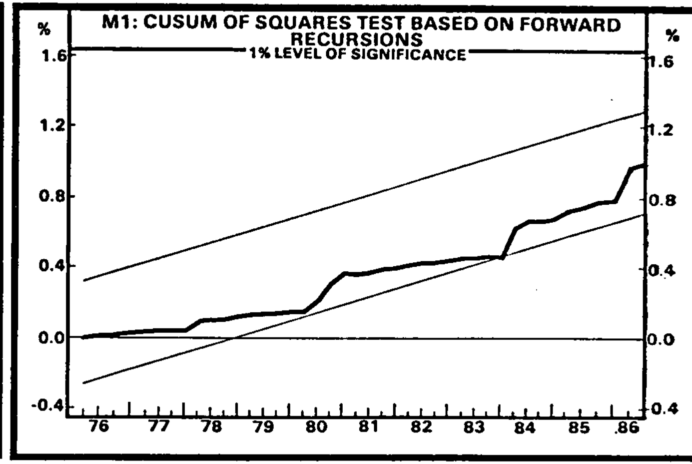
M1: CUSUM OF SQUARES TEST BASED ON FORWARD RECURSIONS
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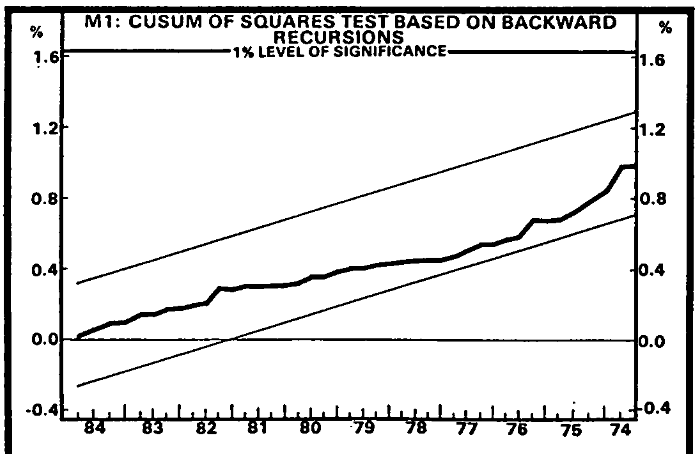
M1: CUSUM OF SQUARES TEST BASED ON BACKWARD RECURSIONS
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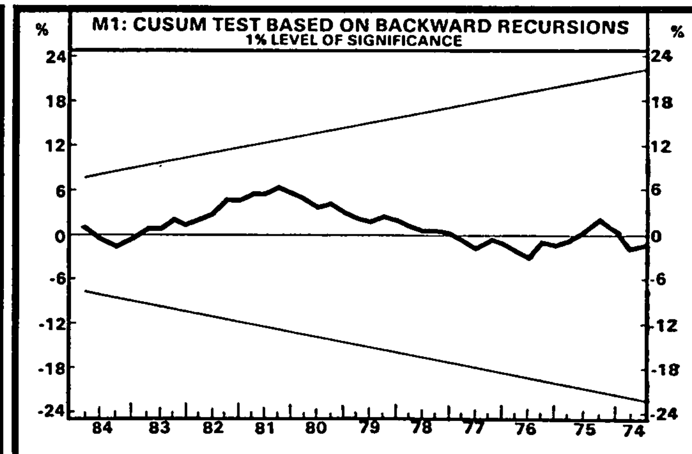
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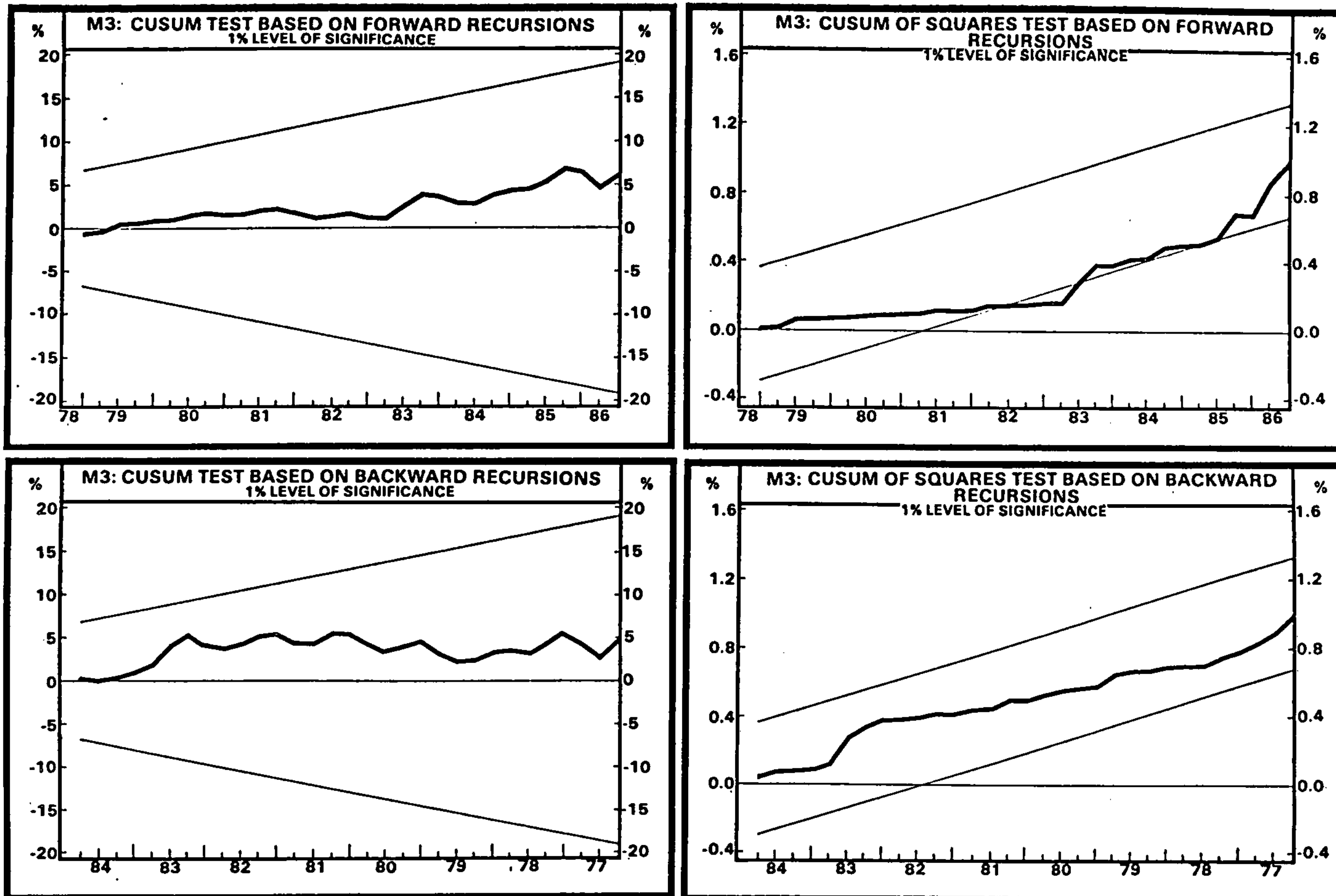
CHART 3


M3: CUSUM TEST BASED ON FORWARD RECURSIONS
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M3: CUSUM OF SQUARES TEST BASED ON FORWARD RECURSIONS
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M3: CUSUM OF SQUARES TEST BASED ON BACKWARD RECURSIONS
1% LEVEL OF SIGNIFICANCE

The results for the relatively new BM aggregate also provide an interesting contrast (see Chart 4). While also being qualified by the small sample size, the initial findings are relatively encouraging. The null hypothesis of stability cannot be rejected at the 1 per cent level for all of the tests conducted. At the 5 per cent level there are very marginal rejections by the forward cusum of squares test and the Chow test at 1985Q1.

Table 5: Overview of Stability Results

Test	Equation		
	M1	M3	BM
Cusum			
- forward	-	-	-
- backward	-	-	-
Cusum of Squares			
- forward	*	**	*
- backward	-	-	-
Moving Regression Homogeneity (at largest sample size)	-	-	-
Chow Test			
- 1985 Q1	*	**	*
- Min Quandt	**	**	-

Notes: An ** denotes rejection of the null hypothesis of stability at the 1 per cent level. An * indicates rejection at the 5 per cent level.

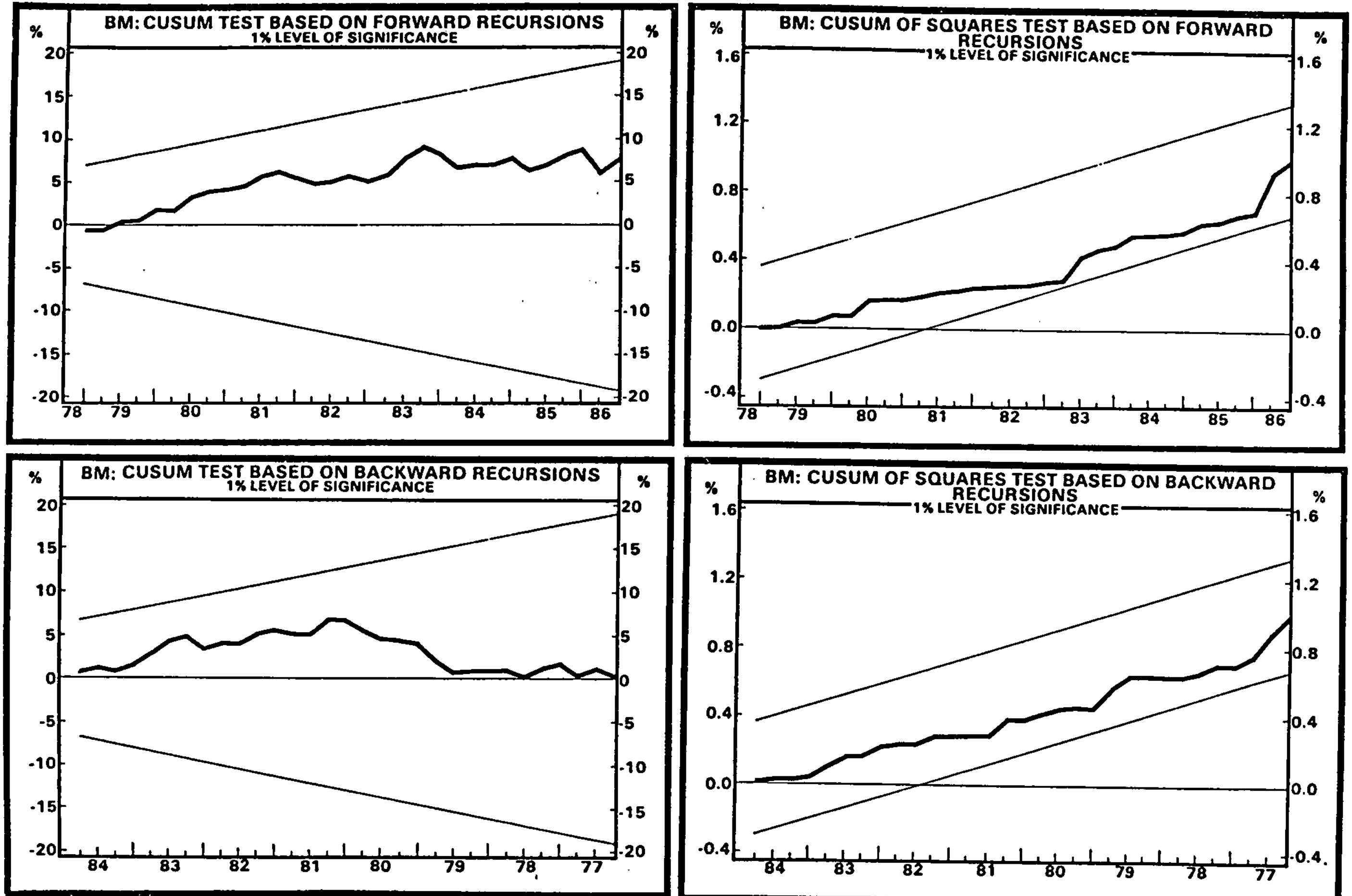
(c) Interpreting deregulation

A period of financial deregulation impacts on monetary aggregates through four main channels:[7]

- movements in relative interest rates;
- measurement of the aggregates;
- measurement of the relative pecuniary costs and non-pecuniary returns on holding money; and
- changes in money holdings for precautionary motives.

7. Milbourne (1986) characterises the specific deregulatory changes according to three of these channels of influence.

CHART 4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BM: CUSUM OF SQUARES TEST BASED ON BACKWARD RECURSIONS
1% LEVEL OF SIGNIFICANCE

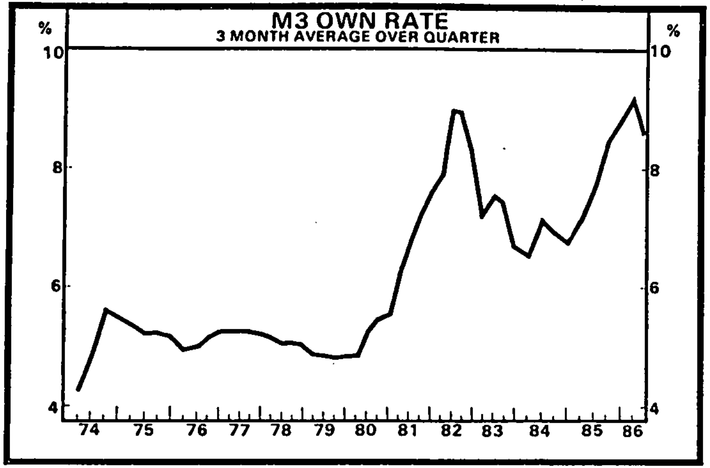
Deregulation affects relative interest rates. For example, banks are now permitted to set market interest rates on all deposits. Maturity controls which previously prevented banks from paying interest on current deposits and from competing for call funds were removed in August 1984 and April 1985. Chart 5 shows the main relative interest rates used in this paper: the own rate of interest on M3, which acts as a proxy for the opportunity cost argument for M1; the BM own rate minus the M3 own rate, which acts as the opportunity cost for M3; and the bond rate minus the BM own rate, which is the opportunity cost variable for BM. The bond rate is also shown on its own, as an indicator of the stance of monetary policy. Its upward trend reflects higher inflation during the 1970s, with peaks during periods of monetary restriction, most notably early 1982 and late 1985.

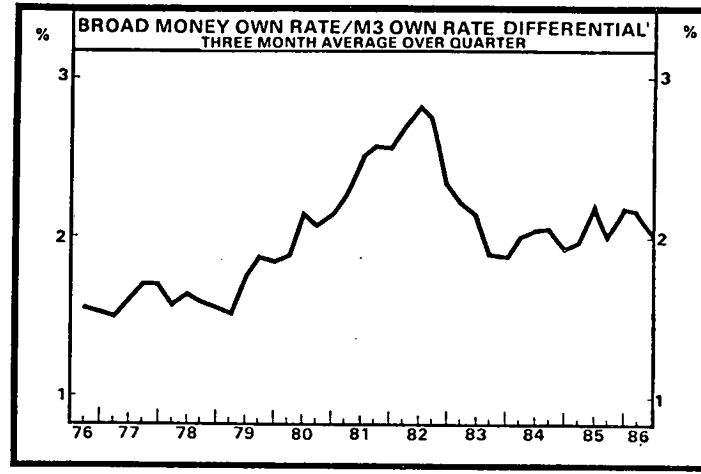
The opportunity cost for M1 (the rate on M3) was flat until the early 1980s. The impact of deregulation on the rate is apparent. Its rises and falls go some way towards explaining the fluctuations in M1 during the 1980s shown in Chart 1.

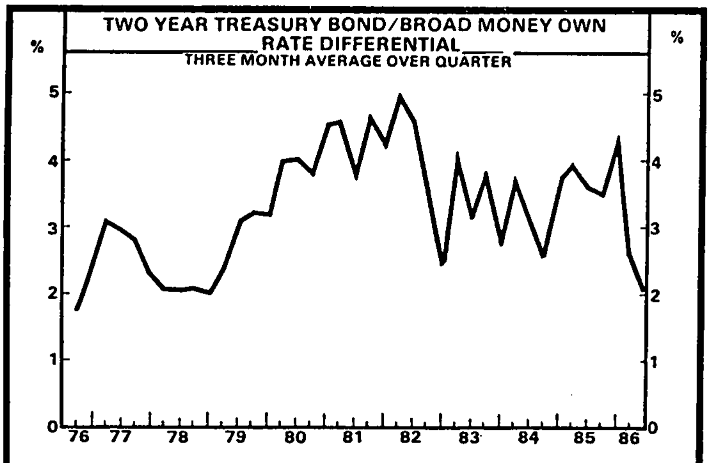
The opportunity cost for M3 (the differential between the BM rate and the M3 own rate) fluctuates within a range of 1-1/2 to 3 percentage points, while that for BM (the bond rate minus the BM own rate) lies within a range of 2 to 5 percentage points. Prior to deregulation, the M3 own rate was less able to keep pace with the competing rate during periods of monetary restriction in 1981 and 1982. This gives rise to a distinct peak, which is not repeated in 1985 when monetary policy was tight but financial markets were fully deregulated. While the differential between the bond rate and the rate on BM is more volatile, it has a distinctly flatter profile. Non-bank financial institutions included in broad money were better placed to compete in financial markets during periods of monetary restriction.

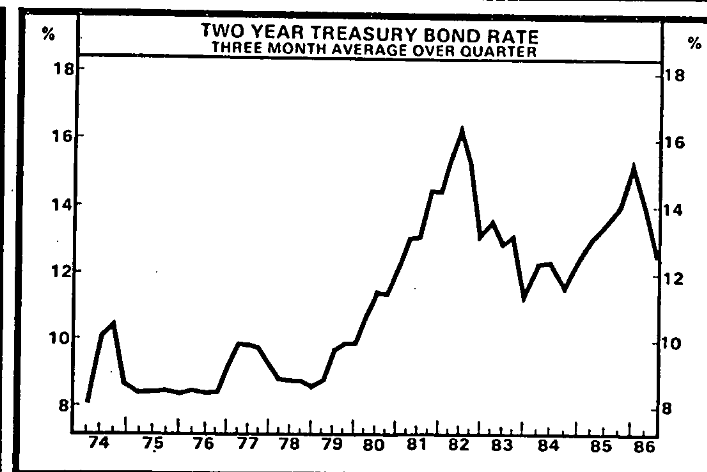
To the extent that these relative interest rate arguments are appropriate, they provide some explanation for recent patterns in monetary growth. The marked slowdown in the growth of M1, for example, is explained in part by the high level of competing interest rates during 1982 and 1985, which are not offset by any significant own rate effect. However, one has to be a little sanguine about the relative stability of the M1 equation. The impact of deregulation may have been of a compensatory nature specific to the period under consideration. For example, improved services and reduced costs implied by automatic teller machines and point of sale electronic funds transfer (EFT)

CHART 5


M3 OWN RATE
3 MONTH AVERAGE OVER QUARTER
%
10
8
6
4
74
75
76
77
78
79
80
81
82
83
84
85
86


BROAD MONEY OWN RATE/M3 OWN RATE DIFFERENTIAL'
THREE MONTH AVERAGE OVER QUARTER
%
3
2
1
76
77
78
79
80
81
82
83
84
85
86


TWO YEAR TREASURY BOND/BROAD MONEY OWN RATE DIFFERENTIAL
THREE MONTH AVERAGE OVER QUARTER
%
5
4
3
2
1
0
76
77
78
79
80
81
82
83
84
85
86


TWO YEAR TREASURY BOND RATE
THREE MONTH AVERAGE OVER QUARTER
%
18
16
14
12
10
8
74
75
76
77
78
79
80
81
82
83
84
85
86

could have increased the use of currency and reduced reliance on cheques. The ratio of currency to current deposits has risen over the past couple of years. If competition from non-bank financial intermediaries has also just kept pace with banks in providing these services, the appearance of relative stability in the aggregate relationships may be cosmetic.

The failure of the own rate of interest on M3 to match interest rates on deposits with financial institutions other than banks in the late 1970s and early 1980s helps explain the slow growth of M3 relative to BM until 1982. The late 1970s and early 1980s were associated with increased intermediation by non-bank financial institutions at the expense of banks. The subsequent sharp narrowing of the differential after the middle of 1982 by a full percentage point, helps explain the faster growth of M3 compared to BM, even as monetary restriction gathered pace in 1985. These movements in relative yields help explain the process of disintermediation affecting M3 in the late 1970s and early 1980s, as well as the subsequent reintermediation after deregulation. However, despite the fact that relative interest rates explain a considerable proportion of the variability of M3, signs of econometric instability remain.

It is likely that this instability is related to the other three channels through which deregulation influences monetary aggregates: measurement of the aggregate; measurement of the pecuniary costs and non-pecuniary returns; and precautionary motives. If the appropriate measurement of an aggregate changes during the sample period, attempts to estimate a stable demand function would normally be frustrated. This typically occurs when new assets are created, such as banks offering deposit terms which compete more favourably with other financial institutions. Substitution towards these new bank assets will shift the demand function. The aggregate is simply not comparable before and after the changes.

The pecuniary costs and non-pecuniary returns on holding money are unobservable, and are treated as constant in empirical money demand functions. The introduction of automatic teller machines and EFT may greatly alter these costs and returns, causing money demand functions to shift. As specific variables to measure these costs cannot be included in the equation, the shifts will tend to be reflected in changes to the constant term during a period of deregulation.

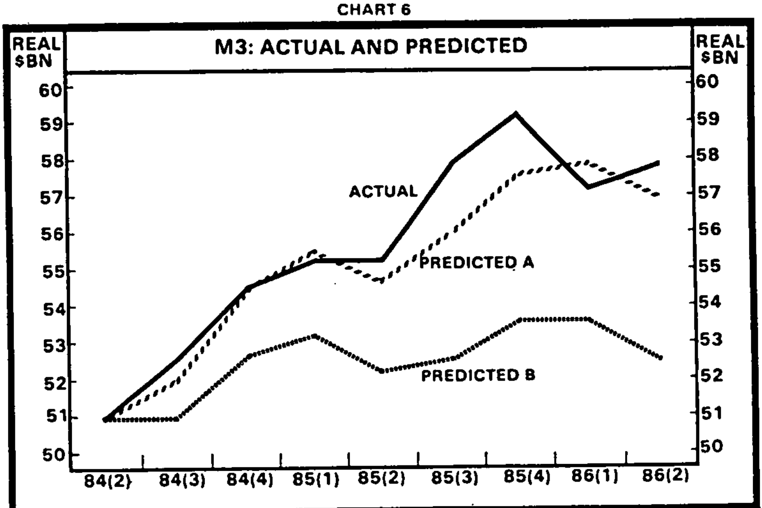
It is also possible that precautionary motives for holding deposits may vary as competition within the financial system increases.

Evidence that the M3 equation is unstable does not distinguish effectively between these types of instability. The approach may, however, give some idea of the size of the overall impact of deregulation.

Chart 6 presents estimates of the size of the impact of deregulation and financial innovation on M3. It will be recalled that 1984Q2 was identified as a possible break in the data generating process. The equation estimated over the full sample period was dynamically simulated over the period 1984Q2 to 1986Q2. It predicts the actual pattern of M3 reasonably well. However, the same equation estimated to 1984Q2 underpredicts subsequent M3 developments. The gap between the two predictions gives an indication of the problems of interpreting M3 on the basis of relationships observed up to 1984. By 1986Q2 the gap between the two predictions is equivalent to 8 per cent of the money supply.

In contrast to M3, the BM equation is relatively stable. It is unlikely that movements in the differential between the bond rate and the own rate on BM before and after 1982 explain much of the behaviour shown in Chart 1. The differential is more volatile around a flatter trend throughout the period. Moreover, the interest semi-elasticity is smaller than for M1 or M3, no contemporaneous interest rate effect was identified, and the adjustment lag is

CHART 6



A. Dynamic simulation from 84(2) using equation estimated over the complete sample.
B. Dynamic simulation from 84(2) using equation estimated up to 84(2) only

noticeably longer than for the other aggregates. On the other hand, the income elasticity is relatively high. It is likely that the behaviour of broad money is much more closely tied to the pattern of economic activity.

3. Parameters of Money Demand, Own Rates and the Effectiveness of Intermediate Targets

In section 2 demand functions for M1, M3 and BM were estimated and tested for stability, in the sense of having a predictable relationship with other variables. BM appeared to be relatively more stable in this econometric sense than either M1 or M3. Three other general findings were:

- the parameters of the three demand functions differ, with the two narrower aggregates having lower income elasticities and higher interest rate elasticities;
- own interest rates were found to be an important part of the opportunity cost arguments in the equations for M3 and BM; and
- there is no contemporaneous interest rate effect on BM.

Aside from issues of econometric stability, these empirical findings concerning the nature of money demand and the role of own rates of interest also have implications for the effectiveness of monetary aggregates as intermediate targets

Even if monetary aggregates have a predictable relationship with other variables (econometric stability), it does not automatically follow that limiting their growth will stabilise nominal demand and inflationary pressures. Moreover, even if controlling the aggregate does in fact stabilise inflation over the medium term, the time profile of real interest rates may differ depending on which aggregate is the focus of policy. Real interest rates higher than necessary to control inflation would have unnecessary costs in terms of economic activity. Real interest rate overkill may result.

(a) Dynamic stability and the own interest rate effect

Recent theoretical literature on market clearing economic models suggest that growth in monetary aggregates influences only inflation. According to this view of the world, the real economy evolves independently of money growth, apart from unexpected money surprises.[8] These results may not, however, be relevant to the policy making process if goods prices adjusted sluggishly and price expectations are relatively static (e.g. adaptive).

In this type of world it is helpful to distinguish the inflation component of nominal interest rates from their real levels. Higher inflation may push up the level of nominal interest rates. Monetary policy is then usefully thought of as affecting nominal interest rates relative to inflation. The level of real interest rates, in turn, impacts on economic activity, inflation (via the Phillips curve) and inflation expectations. Containing the growth of a monetary aggregate may not be sufficient to control inflation in such a world. Consider an upward shift in the expected rate of inflation. Nominal interest rates will rise and the rate of inflation will accelerate. Stabilising nominal money growth will be associated with a reduced rate of growth of the real money supply. However, it is possible that the *ex ante* demand for real money balances may decline to an even greater extent than the real money supply. This may happen if the interest sensitivity of money demand to the initial rise in nominal interest rates is particularly high. In these circumstances, constraining the growth of the nominal money supply could be associated with downward pressure on real interest rates. This would add to inflation pressures.[9]

These risks are greatly reduced if the interest sensitivity of money demand is small, or zero. They are also diminished if there is an own rate of interest effect. This can be shown to be equivalent to reducing the interest sensitivity of money demand.

When an own rate is present, the rise in inflation expectations causes both the competing interest rate and the own rate of interest to rise together. The downward pressure on money demand caused by an increased competing interest rate would to a large extent be offset by rising money demand associated with the own rate. Where own rate effects are present, containing the growth of a monetary aggregate in the face of inflation pressures would be more likely to be associated with rising real interest rates.

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8. See, for example, Lucas (1972) and Sargent (1976).

9. This dynamic stability problem was first recognised by Cagan (1956).

(b) An analytical illustration of the problem

These issues may be illustrated analytically by taking the simple form of the estimated money demand equation and adding some very basic interactions between interest rates, inflation and output:[10]

(3) $$m_t - p_t = -\beta\,(R_t + \pi_t - R_t^m) + \phi y_t$$

(4) $$\Delta p_t = \pi + \rho\,(y_t - \bar{y})$$

(5) $$\Delta\pi_t = \alpha(\Delta p_{t-1} - \pi_{t-1})$$

(6) $$y_t = \gamma\, y_t - \sigma\, R_t$$

(7) $$R_t^m = \psi\,(R_t + \pi_t)$$

The variables m and p are logarithms of the money supply and the price level. R and R^m are the domestic real interest rate and the nominal own rate on money. The variable π is the expected rate of inflation and y is the logarithm of output. Bars over variables indicate long-run equilibrium levels. All parameters are positive.

Equation 3 is the basic form of the money demand equation investigated in section 2. Equation 4 is the expectations-augmented Phillips curve, and adaptive price expectations are assumed in equation 5. The output - real interest rate interaction is captured in equation 6. Equation 7 is the own rate equation, capturing its dynamic dependence on rates throughout the economy.

Differencing equation 3, substituting from equations 4 to 7 and solving for the real interest rate, given a pre-determined rate of growth of the money supply, yields:

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10. This simplified model was proposed by a colleague at the OECD, Paul Masson, in an examination of nominal GNP targeting. The main differences here are the inclusion of the own rate effect and the difference equation formulation to cope with current and lagged interest rate effects found in empirical estimation. This cut down approach enables one to focus on the basic mechanisms at issue.

(8) $$R_t = \frac{1-\gamma}{\Lambda}(\pi_t - \Delta\bar{m}_t) + \frac{\sigma\phi+\beta(1-\psi)(\alpha\rho\sigma+1-\gamma)}{\Lambda} R_{t-1} - \frac{(1-\gamma)(\rho(1-\beta(1-\psi)\alpha))}{\Lambda}\bar{y}$$

Where $\Lambda = \sigma(\phi+\rho) + \beta(1-\psi)(1-\gamma)$ and $\Delta\bar{m}_t$ is the pre-determined rate of money growth. The expected rate of inflation is given by:

(9) $$\pi_t = \pi_{t-1} - \frac{\alpha\rho\sigma}{1-\gamma} R_{t-1} - \alpha\rho\bar{y}$$

Calculating the reduced form of the system of equations 8 and 9 ignoring exogenous variables, yields:

(10) $$\begin{bmatrix} R_t \\ \pi_t \end{bmatrix} = \begin{bmatrix} \frac{\sigma(\phi-\alpha\rho) + \beta(1-\psi)(\alpha\rho\sigma + 1-\gamma)}{\Lambda} & \frac{1-\gamma}{\Lambda} \\ -\frac{\alpha\rho\sigma}{1-\gamma} & 1 \end{bmatrix} \begin{bmatrix} R_{t-1} \\ \pi_{t-1} \end{bmatrix}$$

The characteristic equation of 10 is given by:

(11) $$\lambda^2 - \lambda\left(\frac{\sigma(\phi-\alpha\rho) + \beta(1-\psi)(\alpha\rho\sigma + 1-\gamma) + \Lambda}{\Lambda}\right) + \frac{\sigma\phi + \beta(1-\psi)(\alpha\rho\sigma + 1-\gamma)}{\Lambda} = 0$$

The condition for stability of this system is modulus of λ less than unity. This condition is satisfied if and only if:

(12) $$\frac{\sigma\phi + \beta(1-\psi)(\alpha\rho\sigma + 1-\gamma)}{\sigma(\phi+\rho) + \beta(1-\psi)(1-\gamma)} < 1$$

The stability of monetary targeting is crucially dependent on the interest rate sensitivity of money demand, and the extent to which the own interest rates reflects rates in the rest of the economy. In the extreme case where $\beta=0$ or $\psi=1$ the interest sensitivity of money demand is zero, and the stability condition reduces to $\sigma\phi/\sigma(\phi+\rho)<1$. Since all parameters are positive, this condition always holds. Restraining monetary growth in the face of a rise in inflation pressures will always lead to stabilising real interest rate responses. In the more general case where $\beta\neq0$ and $\psi\neq1$, inequality 12 implies that the higher the interest sensitivity of money demand and the smaller the own rate effect, the more likely the system is to be unstable.

In practice, the presence of an important own rate effect contributes greatly to dynamic stability. This is illustrated in Table 6, which compares the empirical results for M1 and M3. Hypothetical values for other parameters are used to complete the calculation. The parameters estimated for the M1 equation imply that the aggregate is likely to be associated with policy instability. Even though the parameter ß is higher for M3 than for M1, the presence of the own rate effect ensures dynamic stability.

Table 6: Illustration of the Stability Condition for M1 and M3

Parameters	M1	M3
ϕ	0.89	1.37
β	5.96	10.47
ψ	0.00	0.76
Stability Condition $\dfrac{\sigma\phi+\beta(1-\psi)(\alpha\rho\sigma + 1-\gamma)}{\sigma(\phi+\rho)+\beta(1-\psi)(1-\gamma)}$	1.0024	0.9889

Note: A value in the bottom row greater than unity indicates instability. Hypothetical values for other parameters are $\alpha=0.2$; $\sigma=0.25$; $\rho=0.1$; and $\gamma=0.7$. The value of $\psi=0.76$ is the coefficient of the regression of the M3 own rate against the BM own rate. It has an R^2 of .99.

For broad money it will be recalled that there was no contemporaneous interest rate sensitivity of money demand. Only the lagged competing rate/own rate differential was accepted by the data. In the analytical illustration the money demand equation 3 is replaced by:

$$(3a) \qquad m_t - p_t = -\beta\,(R_{t-1} + \pi_{t-1} - R^m_{t-1}) + \phi y_t$$

Solving for the interest rate in a manner analogous to equation 8 yields:

$$(8a) \qquad R_t = \frac{1-\gamma}{\sigma(\phi+\rho)}\,(\pi_t - \Delta\bar{m}) + \frac{\sigma\phi-\beta(1-\psi)(1-\gamma-\alpha\rho\sigma)}{\sigma(\phi+\rho)}\,R_{t-1} + \frac{\beta(1-\psi)(1-\gamma)}{\sigma(\phi+\rho)}\,R_{t-2} - \frac{(1-\gamma)\rho(1-\beta(1-\psi)\alpha)}{\sigma(\phi+\rho)}$$

This gives rise to a third order system, the characteristic equation of which can be shown to be:

$$\text{(11a)} \quad \lambda^3 + \lambda^2 \left(\frac{\beta(1-\psi)(1-\gamma-\alpha\rho\sigma)-2\sigma\phi-\sigma\rho(1-\alpha)}{\sigma(\phi+\rho)}\right) +$$

$$\lambda \left(\frac{\sigma\phi-\beta(1-\psi)(2(1-\gamma)-\alpha\rho\sigma)}{\sigma(\phi+\rho)}\right) + \frac{\beta(1-\psi)(1-\gamma)}{\sigma(\phi+\rho)} = 0$$

The stability conditions are considerably more complex.[11] Nevertheless, it can be shown that stability is again critically dependent on the interest sensitivity of money demand ß, and the size of the own rate effect ψ. Higher values of ß and lower values of ψ are more likely to be associated with instability.

Using the estimated values from section 2 (ϕ=1.52, ß=2.48), the value ψ=0.72 (obtained from a simple regression), and the hypothetical parameters given at the bottom of Table 6, the stability properties for BM can be verified. This exercise indicates that BM targeting is not likely to be associated with instability.

(c) <u>Own rates and the problem of real interest rate overkill</u>

When monetary aggregates are targeted, dynamic stability, in the sense discussed in sections 3(a) and 3(b), ensures that rising inflation leads to higher (as opposed to lower) real interest rates. However, interactions are such that real interest rate overkill is an inherent possibility in monetary targeting. The extent of this danger is also closely linked to the parameters of money demand and the presence or absence of an own rate effect.

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11. Writing the equation as:

$$\lambda^3 + a_1\lambda^2 + a_2\lambda + a_3 = 0$$

Stability requires that four conditions be satisfied:

$$1 + a_1 + a_2 + a_3 > 0$$
$$1 - a_1 + a_2 - a_3 > 0$$
$$1 - a_2 + a_1a_3 - a_3^2 > 0$$
$$a_2 < 3$$

The ultimate level to which real interest rates would rise depends on interactions between inflation and real money demand. As real interest rates were being pushed upwards through deliberate attempts to control inflation, real money demand would fall in line with declining real money balances. However, as inflation eventually began to decline in response to these actions, so too would inflation expectations. This would reduce nominal interest rates and increase money demand. In these circumstances, continuing efforts to restrain growth of the aggregate would require resistence to lower nominal interest rates. As inflation expectations would be falling, real interest rates would tend to rise even though this would not be necessary to control inflation. Real interest rate overkill would result.

The extent of this overkill again depends on the interest sensitivity of money demand, and whether or not an own rate effect is present. The more sensitive money demand is to reduced pressure on interest rates and the smaller the own rate effect, the more sharply *ex ante* money demand would increase, and the more likely would be unnecessarily high real interest rates.

This point may be verified analytically. Real interest rates defined by equation 8 would continue to rise to the point where $\Delta R_t=0$, which occurs when:

$$(13) \qquad R = \frac{1-\gamma}{\sigma\rho(1-\beta(1-\psi)\alpha)}(\pi_t - \Delta\bar{m}_t) - \frac{1-\gamma}{\sigma}\bar{y}$$

Clearly, the higher is β and the lower is ψ the greater will be the increase in real interest rates associated with a rise in inflation pressures. For an aggregate such as M1, with a high β and $\psi=0$, real interest rate overkill would be more problematic than for M3 or BM.

The presence of an own rate effect is instrumental in reducing this danger. As increased real interest rates were effective in reducing inflation in the economy, the resulting downward pressure on nominal interest rates would also be reflected in the own interest rate on money. The tendency for money demand to rise with the fall in the competing rate would be offset by the decline in money demand associated with the falling own rate. This interaction would offset the tendency for real money demand to rise at the wrong time in the business cycle.

4. Concluding Remarks

In a period of deregulation great uncertainty attaches to the role that monetary aggregates should play in the formulation of monetary policy. A primary requirement for a major role is that the demand for money should be stable - that money should have a predictable relationship with income, interest rates and prices. A careful analysis of demand functions for M1, M3 and BM, has shown that M3 exhibited important evidence of instability in the early and mid 1980s, but this was less so for M1 and, particularly, for BM. This evidence provides some support for the decision taken in January 1985 to suspend the M3 projection.

Estimates of the demand for M1, M3 and BM also shed light on the issue of real interest rate dynamics and the effectiveness of aggregates as intermediate targets. The estimated parameters suggest that M1 would be more likely to be subject to the problem of dynamic instability because of its high interest sensitivity and the absence of an own rate effect. This problem is one whereby an acceleration of inflation expectations pushes up nominal competing interest rates, reducing ex-ante money demand by more than the decline in real money balances. To avoid a sharp downturn in money growth, real interest rate cuts would be needed. But this would add to inflation pressures.

These difficulties are unlikely to be associated with either M3 or BM because of the presence of own interest rate effects. As competing nominal interest rates rise, tending to reduce money demand, the own rate also rises offsetting this effect.

Similarly, the presence of an own rate effect reduces the extent of real interest rate overkill associated with monetary aggregates as intermediate objectives. As rising real interest rates are eventually successful in reducing inflation and inflation expectations, there would be an incipient decline in nominal interest rates. This could lead to increased money demand at a time when the economy was turning down and real interest rates were increasing. The tendency for the own rate of interest to decline sympathetically with the competing rate would reduce this danger.

Taken together, the above findings might constitute an argument in favour of targeting broad money. This conclusion, however, has some limitations. In the first place, the estimates of the broad money equation are new and are still based on a relatively small sample size. Deregulation is still very much in progress, and firmer conclusions will have to await a few more years of data. Secondly, the lag structure with respect to interest rates is particularly complex and no contemporaneous effect is apparent. BM behaviour is dominated by the past pattern of economic activity. In practice, targeting BM would amount to little more than directly targeting nominal income. Finally, it is by no means clear that monetary targets are the optimal way of conducting monetary policy. Even if the demand function is stable in an econometric sense, there are risks of real interest rate overkill, even for broad money, which could destabilise other aspects of economic performance.

In a period of deregulation it would seem wise to take account of a number of indicators in addition to monetary aggregates. The evidence from this paper suggests only that BM may be a better candidate for a monetary aggregate indicator.

APPENDIX A: STATISTICAL TESTS

This appendix sets out in detail the stability tests applied to the preferred equations for M1, M3 and Broad Money recorded in Tables 1, 2 and 3. The tests are largely derived from Brown, Durbin and Evans (1975) who presented a group of formal significance tests for the constancy of estimated coefficients (β) and sample variance ($\hat{\sigma}^2$). Even though the tests are presented as formal significance tests, the authors recommend that they be regarded as "yardsticks" rather than conclusive decision rules.

The CUSUM and CUSUMSQ plots use the recursive residuals of the regression to test the hypothesis of constant β and σ^2 over time.

The CUSUM of recursive residuals is defined as:

$$W_t = \hat{\sigma}^{-1} \sum_{j=k+1}^{t} v_j \qquad t = k+1, \ldots t$$

where k is the number of estimated parameters;
v_t is the recursive residual in period t, i.e.

$$v_t = y_t - X_t' b_{t-1}$$

where b_{t-1} is the OLS estimator based on the first t-1 observations, i.e.

$$b_{t-1} = (X_{t-1}' \; X_{t-1})^{-1} X_{t-1}' \; Y^*_{t-1}$$

and

$$\hat{\sigma}^2 = \Sigma \, (v_t - \bar{v})^2/(T-k-1)$$

where $\bar{v}$ is the arithmetic mean of the residuals.

The CUSUMSQ is

$$WW_t = \sum_{t=k+1}^{t} v_t^2 / \sum_{t=k+1}^{T} v_t^2$$

Under the null hypothesis of stability, the recursive residuals are uncorrelated, with zero mean and constant variance. This property is useful in interpreting plots of the CUSUM and CUSUMSQ: since the distributions of the statistics are known, boundary lines can be constructed around the mean value lines such that the probability of crossing the boundaries is equal to the chosen significance level of the tests.

The plots thus serve the double purpose of providing a formal hypothesis test for stability and giving a graphical representation of the residuals from which breaks in the data can sometimes be identified.

The CUSUM test is sensitive to a disproportionate number of residuals of the same sign, which moves the plot away from the mean value line. It is also useful for detecting structural breaks in the data, which appear as a secular increase or decrease in the plot.

The CUSUMSQ is more sensitive to haphazard changes in the residuals, and is also useful for detecting structural breaks and/or gradual increases in variances over time.

Quandt's log-likelihood ratio and the Chow test for structural break were used in tandem to detect potential breaks in the data. Quandt's log-likelihood ratio guides the choice of break point for the Chow test. The ratio is calculated for each t=r from r=k+1 to r=T-k-1:

$$\lambda_r = \log_{10} \left(\frac{\text{max. likelihood given } H_0}{\text{max. likelihood given } H_1}\right)$$

where H_1 is the hypothesis that the samples before and after r come from different populations.

The most likely point for structural break is at the point r where λ_r is minimised.

F tests and Chow tests were conducted at the minimum of λ_r for each of the preferred equations. The F statistic is calculated:

$$F = \frac{[\hat{U}'\hat{U} - (\hat{U}_1'\hat{U}_1 + \hat{U}_2'\hat{U}_2)]/k}{(\hat{U}_1'\hat{U}_1 + \hat{U}_2'\hat{U}_2)/(n_1 + n_2 - 2k)} \sim F\ (k, n_1 + n_2 - 2k)$$

where n_1 is the sample from 1, ..., r;

n_2 is the sample from r+1, ..., T;

$\hat{U}'\hat{U}$ is the sum of squares of the least squares residuals over the entire sample. Subscripts 1 and 2 indicate the same statistic for each of the two sub-samples.

Where one sub-sample is too small to estimate a regression, the alternative Chow statistic is:

$$F = \frac{(\hat{U}'\hat{U} - \hat{U}_1'\hat{U}_1)/n_2}{(\hat{U}_1'\hat{U}_1)/(n_1-k)} \sim F\,(n_2,\ n_1 - k)$$

where n_1 is the largest of the two sub-samples.

The last of the stability tests used is Brown, Durbin and Evans' Homogeneity Statistic, which also tests for changes in estimated coefficients and sample variance. The Homogeneity statistic is calculated from the residual sums of squares of moving regressions of sample size n. The null hypothesis of constant ß and $\hat{\sigma}^2$ is tested by the statistic:

$$\frac{T - kp}{kp - k} \cdot \frac{S(1,T) - [S(1,n) + S(n+1,\ 2n) + \ldots + S(pn-n+1,T)]}{[S(1,n) + S(n+1,2n) + \ldots + S(pn-n+1,T)]}$$

where n is the length of the moving regression;

S(r,s) is the residual sum of squares of the regression calculated for observations r to s inclusive;

p is the integral part of T/n; and

k is the number of parameters.

Under the null hypothesis of stability the statistic is distributed as F(kp-k,T-kp).

Notice that all of the stability tests described above rely on an assumption of homoskedastic errors: they are joint tests of constant coefficients and sample variance. Tests tend towards rejection of the null of stability when heteroskedasticity is present. The results of the Breusch-Pagan test (reported in Appendix B) suggest the possibilty of heteroskedasticity for M3 and BM, although this test may be unreliable in such small samples.

APPENDIX B: TEST RESULTS

CHOW TEST FOR STRUCTURAL BREAK

Equation	Break Point	Degrees of Freedom	Statistic
M1	(a) 1976Q1	(7,35)	3.35**
	1985Q1	(5,37)	2.78*
M3	(a) 1983Q1	(7,24)	4.25**
	1985Q1	(5,26)	4.89**
BM	(a) 1979Q1	(7,25)	1.81
	1985Q1	(5,26)	2.93*

Note (a) Break at observation indicated by plot of Quandt's log-likelihood ratio
** Indicates rejection of the null at the 1% level
* Indicates rejection of the null at the 5% level

BREUSCH-PAGAN TEST FOR HETEROSKEDASTICITY

$\sim X^2 k-1$

Equation	Degrees of Freedom	Statistic
M1	6	9.64
M3	6	15.37*
BM	6	14.14*

BROWN DURBIN AND EVANS' HOMOGENEITY TEST

Equation	Sample Size (n)	Degrees of Freedom	Statistic
M1	15	(14,28)	0.44
	16	(14,28)	0.23
	17	(7,35)	2.28
	18	(7,35)	2.21
	19	(7,35)	1.99
	20	(7,35)	1.71
	21	(7,35)	1.53
	22	(7,35)	1.09
	23	(7,35)	0.98
	24	(7,35)	0.65
M3	10	(19,17)	0.74
	11	(14,17)	0.68
	12	(14,17)	0.50
	13	(7,24)	2.75*
	14	(7,24)	2.42
	15	(7,24)	2.26
	16	(7,24)	1.73
	17	(7,24)	1.65
	18	(7,24)	1.31
	19	(7,24)	1.02

BM	10	(14,17)	0.68
	11	(14,17)	0.47
	12	(14,17)	0.28
	13	(7,24)	2.51*
	14	(7,24)	2.58*
	15	(7,24)	2.29*
	16	(7,24)	1.68
	17	(7,24)	1.48
	18	(7,24)	1.06
	19	(7,24)	0.58

APPENDIX C:
DATA SOURCES

M1 = currency plus current deposits with all trading banks; unadjusted, 3 month average over quarter.

Source: Reserve Bank of Australia Bulletin Database as at August 1986 (see Table A1 of Reserve Bank of Australia (RBA) Bulletin).

M3 = currency plus bank deposits of the private non-bank sector; unadjusted, 3 month average over quarter.

Source: RBA Bulletin Database as at November 1986 (see Table A1 of RBA Bulletin).

Broad Money = M3 plus borrowings from private sector by Non-Bank Financial Institutions less the latter's holdings of currency and bank deposits; unadjusted, 3 month average over quarter.

Source: RBA Bulletin Database as at November 1986 (see Table A1 of RBA Bulletin).

R = Two year Treasury Bond yield, 3 month average over quarter.

Source: Bulletin Database as at August 1986 (see Table J2 o RBA Bulletin).

R_{BM} = Broad Money own rate: quarterly average of monthly weighted average of interest rates on broad money assets.

R_{M3} = M3 own rate: quarterly monthly weighted average of interest rates on M3 assets. Notes on calculation of R_{BM} and R_{M3} in Appendix D. (All interest rates normalised by dividing b 100.)

Y = Gross Domestic Product, current price, unadjusted series.

Source: Australian Bureau of Statistics (ABS) Quarterly Estimates, June 1986.

P = Gross National Expenditure deflator.

APPENDIX D: CALCULATION OF THE OWN RATE ON M3 AND BM

An assumption frequently made in studies of the demand for money is that the pecuniary (and/or non-pecuniary) return to holding money assets is either zero or constant. The motivation for calculating own rates for M3 and BM is that this assumption has become less and less tenable for the broader money aggregates, especially during the relaxation of monetary controls in Australia over the last decade.

Complete details of the calculation procedures for R_{M3} and R_{BM} are given in notes by J. Lynne Evans (1986) "A Series for the Own Rate of Money: M3", and S. Thorp (1986) "The Own Rate of Return on M3 and Broad Money".

The own rates on M3 and BM used in estimations reported in this paper are simply weighted averages of pecuniary returns to the asset components of M3 and BM. Data on interest rates and detail on different deposit types needed for the calculations were not complete, so simplifying assumptions were made. The final products are thus best regarded as "representative" of the true own rates.

Both R_{M3} and R_{BM} were constructed as monthly rates using data taken mostly from the Reserve Bank Statistical Bulletins. Table D.1 shows the components of M3 and the Statistical Bulletin tables from which data are drawn for the calculation of R_{M3}. The pattern of calculation is identical to the method of Evans (1986).

(a) Zero interest components

Zero interest rates were attributed to all trading bank current deposits, all cheque accounts with savings banks, "other" accounts with savings banks and fixed deposits with savings banks, in the absence of more complete information. This assumption probably leads to some systematic underprediction of the M3 own rate in recent years.

(b) Certificates of deposit

A weighted average of interest rates on certificates of deposit is available from Table J3 of the RBA Bulletin. The rate is weighted by the share of certificates of deposit in total M3.

(c) Trading bank fixed deposits

A breakdown of fixed deposits into categories greater than and less than \$50,000 was supplied by internal RBA sources. The midpoint of the range of interest rates available for "small" fixed deposits was used as a representative rate for those categories. The weighted average rate for deposits over \$50,000 (Table J3) was multiplied by the appropriate share and employed in calculation.

(d) Savings bank deposits

On the basis of two annual observations, Evans split total savings bank Passbook accounts into those "less than" and those "greater than" \$4,000 in the ratio of 45:55. The interest rates on large and small Passbook deposits (J3) were weighted in line with that ratio.

The necessary breakdown of savings bank deposits into the categories listed i Table D.1 was supplied by internal sources. "Statement" and "investment" account interest rates were thus weighted by their share in total M3. As noted above, the fixed deposits, interest bearing and non-interest bearing cheque accounts and "other" categories are assumed to earn zero interest.

Having weighted each interest rate by the share of each deposit type in tota M3, the rates were summed to form the R_{M3} series. The monthly series from January 1974 to June 1986 is set out in full in Thorp (1986).

The M3 own rate was employed as the representative rate for the M3 component of Broad Money. An own rate similar to R_{M3} was also constructed for the non-bank financial institution (NBFI) component of BM, then each own rate (R_{M3} and R_{NBFI}) was weighted according to the shares of M3 and NBFI's in Broad Money. The sum of the weighted R_{M3} and R_{NBFI} then gave the BM own rate.

The problem of data availability was compounded for the construction of R_{NBFI}. The NBFI component of Broad Money includes borrowings of permanent building societies, credit co-operatives, finance companies, authorised mone market dealers, pastoral finance companies, money market corporations, genera financiers and cash management trusts. Of these categories, interest rates were available only for building societies, finance companies, money market corporations and cash management trusts. Institutions for which rates were not available were given zero weight in R_{NBFI} - implicitly assuming that the final weighted average rate is representative of the true return to holding assets of the excluded institutions as well as the included ones. Despite the exclusions, about 85 per cent of the total NBFI borrowings in Broad Money were given positive weighting in R_{NBFI}.

Volumes of borrowings by NBFI's were netted of cash, bank deposits and balances with other NBFI's (strictly, Financial Corporations Act corporations) to avoid double-counting. The details of these calculations are set out in Thorp (1986). Details on the selection of interest rates for each institution are set out below.

(e) Money market corporations - interest rates

A complete range of 24-hour call rates was supplied by internal sources and used in calculations. The 11.00 a.m. call rate was initially preferred as a representative rate, but was not available as far back as August 1976, where the broad money series begins. (Note that this series is different from the 24-hour call rate reported in the RBA Bulletin.)

(f) Finance companies

The mid point of the two year and three year debenture rates (from RBA Bulletin table J4) was selected as representative of finance company borrowing rates. The Bulletin series was unavailable prior to April 1980, so rates were collected from the Stock Exchange Fixed Interest Offerings for the period August 1976 - April 1980. (See Thorp (1986) for details.)

(g) Building Societies

Since no breakdown of Building Society deposits into call and term components is at present available, the midpoint of the range of rates on call deposits and 12-month fixed-term shares was selected as the single representative rate on Building Society borrowings. In this case, rates from the RBA Bulletin were supplemented with rates supplied in December 1983 Economic Digest of the Permanent Building Societies Association (NSW).

(h) Cash Management Trusts

The weighted average net yield to unitholders of cash management trusts (Bulletin Table J4) was selected for calculation.

Once interest rate and borrowings data had been collected the process of calculating the interest rate was simply a matter of weighting the interest rates and summing them to produce a single series.

As noted above, all components of broad money for which interest rate series were unavailable were given a zero weighting, so the weighting for the building society rate, for example was:

$$WBS = \frac{BS}{BS + FC + MMC + CMT}$$

where

BS is net borrowings of building societies
FC is net borrowings of finance companies
MMC is net borrowings of money market corporations
CMT is net borrowings of cash management trusts
WBS is weight given to the building society interest rate in R_{NBFI}

Similar weights were constructed for the other components, multiplied with the appropriate interest rate, and the weighted rates were summed to a single R_{NBFI}. R_{M3} and R_{NBFI} were then weighted and summed to form R_{BM}.

The monthly BM series is presented in full in Thorp (1986).

TABLE D.1: SOURCES FOR M3 OWN RATE DATA

Components of M3	Bulletin Table Volume	Bulletin Table Interest Rate
Currency	A1	-
TRADING BANKS		
Current deposits I.B.	C1	-
N.I.B.	C1	-
Certificates of deposit	C1	J3(b)
Fixed deposits:		
less than $50,000 (30 day	C1(a)	J3
(3 month		J3
(6 month		J3
(12 month		J3
(24 month		J3
(48 month		J3
greater than $50,000		J3(b)
SAVINGS BANKS		
less than $4,000 Passbook A/c)	A1(a)	J3
greater than $4,000 Passbook A/c)		J3
Statement A/c)		J3
Investment A/c)		J3
Fixed Deposit)		-
I.B. Cheque A/c)		-
N.I.B. Cheque A/c)		-
Other)		-

(a) Breakdown of volumes supplied by internal RBA sources.

(b) Weighted average figure quoted in Bulletin Table.

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