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THE DETERMINANTS OF THE MONEY MULTIPLIER IN THE UNITED KINGDOM

Michael Beenstock

and

Kam-Fai Chan

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Centre for Economic Policy Research
6 Duke of York Street
London SW1Y 6LA

Tel: 01 930 2963

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ABSTRACT

We use annual data drawn from 1950-85 to estimate an econometric model of the money multiplier for the UK. We define the money multiplier as ratio of the money stock broadly defined (M3) and the monetary base (M0), and then decompose the multiplier into the currency ratio, the time deposit ratio and the reserve ratio. We find that the multiplier has been increased by institutional changes. These have arisen as banks have been deregulated and as they have competed for sight deposits by offering interest-bearing accounts. We find that the multiplier increases as interest rates rise because the demand for cash and the demand for bank reserves fall. The money multiplier also varies directly with the level of economic activity. An increase in the demand for money would therefore lead to an increase in the money supply, assuming that the monetary base (M0) is unchanged.

JEL classification: 311, 312

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Michael Beenstock and Kam-Fai Chan
The City University Business School
Frobisher Crescent
Barbican Centre
London EC2Y 8HB
(01) 920 0111

NON-TECHNICAL SUMMARY

The money multiplier defines the relationship between the money stock and the monetary base (M0). Although M0 itself may not be an instrument of economic policy, the determinants of monetary growth can nevertheless be analysed in terms of the components of the money multiplier and a theory of how the monetary base is determined. To our knowledge however there has been no previous empirical attempt to explain the determinants of the money multiplier in the UK.

For the hundred years starting in 1870, the money multiplier for M3, defined as the ratio of M3 to M0 has been relatively stable. It has fluctuated within fairly narrow limits until about 1970, but has more than doubled in magnitude since then. In the 1980s, £M3 has continued to outgrow M0 by a large margin.

The counterpart to this extraordinary behaviour is the surprising growth of bank lending. Conventional thinking about the determinants of money supply would suggest that interest rates must be raised to curtail this growth in demand for bank loans. However, our analysis leads to quite different conclusions.

During the last ten years the demand for cash by the public has fallen and the demand for bank deposits has increased. The private sector has made greater use of the banks because they have offered interest rates on sight deposits in order to attract business. As intermediaries, banks have expanded their assets. Bank lending has increased because of shifts on supply rather than in demand. At the same time, banks have been able to lower their cash reserves and expand their lending. Thus, for a given volume of base money (M0) broad monetary aggregates have grown disproportionately because the money multiplier has increased.

The multiplier approach to the determination of the money supply may be contrasted with the 'conventional approach' which explains the change in the money supply through the identity which links M3 to the public sector borrowing requirement and changes in bank lending to the private sector, changes in private sector holdings of public debt and external finance. The change in the money supply can also be defined in terms of changes in the money multiplier and the monetary base M0.

There can, of course, be no logical inconsistency between these approaches: they are both true by definition. However, the money multiplier approach provides an alternative point of departure for econometric purposes and in practice it may provide a better explanation of changes in the money supply than the 'conventional approach'. We do not attempt such comparisons in this paper, but instead explore money supply movements in terms of an analysis of the determinants of the money multiplier.

In this paper we focus on the determinants of the multiplier rather than the determinants of the monetary base. Our analysis therefore only provides an account of the determination of the money stock if it is assumed that M0 is exogenous and controlled by the authorities. The public sector accounting identities of course imply that the evolution of M0 depends upon fiscal policy, monetary policy and the exchange rate regime.

We define the multiplier in terms of three main components which might be regarded as key decision variables by the private sector.

1 ratio of cash held by the non-bank private sector to their sight deposits with banks

2 ratio of time deposits to sight deposits

3 ratio of banks' reserves to banks' liabilities

We refer to these as the currency ratio, the time deposit ratio and the reserve ratio respectively.

In sections 3, 4 and 5 we formulate behavioural hypotheses about the determinants of these ratios, which are then tested by means of regression analysis using annual data for the period 1950-85. We then simulate our estimated model of the money multiplier in order to examine the effect of disturbances. Our estimation results suggest that interest rates and the level of economic activity influence the ratio of cash to sight deposits, and the ratio of time deposits to sight deposits. Interest rates, the Bank of England's discount market policies and reserve requirements are found to be the main influences on the ratio of bank reserves to bank liabilities.

We use the estimated model to explore the effects of various disturbances on the supply of money for a given stock of M0. This information is summarised by the response of the multiplier to these disturbances. We begin by considering what would have happened to the multiplier had sight deposits continued to be non-interest bearing since the mid-1970s. The simulations suggest that the practice of paying interest on sight deposits has been responsible for about half of the growth in the multiplier over 1980-1985.

The supply of money in 1984 would have been about 20 percent lower than it was (ceteris paribus) had banks continued to refuse to pay interest on current account deposits.

In our second simulation we consider, for a given level of M0, the effects on the supply of money of an increase in the level of interest rates by one percentage point. According to conventional theory, the demand for money is likely to fall, but less attention has been paid to the effects of interest rates on the supply of money. We assume that interest rates are permanently raised from 1965. By 1984 the multiplier increased by about 9%, suggesting that the supply of money is quite elastic with respect to the rate of interest. The currency and reserve ratios both fall but the time deposit ratio rises. The net effect is for the multiplier to rise. Simulations of this type are to some extent artificial because interest rates have been assumed to be endogenous. Nevertheless, the results suggest that interest rate shocks have positive effect on the supply of money.

Finally, we simulate the effects on the supply of money of an increase in the level of GDP. Our estimation results suggest that this will lower the ratio of cash to sight deposits but raise the ratio of time to sight deposits. In the simulation GDP is raised by 1.0% from 1970. We find that this eventually raises the value of the multiplier by about 0.9%. This suggests that for a given value of M0 the supply of money rises slightly less than proportionately when GDP rises.

We wish to stress that our approach has nothing directly to do with the debate about monetary base control. Even if our estimates of the multiplier's components were reliable it does not automatically follow that to control the quantity of money the authorities should control M0. To demonstrate this would require much more investigation.

Our approach may be more relevant now than in the past because M0 is an intermediate target which forms part of the Medium Term Financial Strategy. Assuming this target is approximately attained (as has been the case to date) our model of the money multiplier provides a basis for conditional projections of the broad money supply which is an alternative in practice to the 'conventional approach'. More generally, however, a comprehensive theory of the supply of money must explain the joint determination of the money multiplier and the monetary base.

1. Introduction

To our knowledge there has been no previous empirical attempt to explain the determinants of the money multiplier in the UK. However, to explain the money multiplier seems a useful branch of empirical research because it defines the relationship between the money stock and the monetary base (M_0). Although, except until recently, M_0 might not have been an instrument of economic policy, the determinants of monetary growth may be analysed in terms of the components of the money multiplier along the lines described e.g. by Black (1975). A complete theory of the money stock requires an account of how the monetary base is determined as well as how the multiplier is determined.

This approach to the determination of the money supply may be contrasted with the 'conventional approach' of trying to explain the counterparts of the change in the money supply. The counterparts for £M_3 are referred to in equation (1).

$$\Delta M \equiv PSBR + \Delta A - \Delta G - \Delta NDL + EF \qquad (1)$$

where

- M = £M_3
- PSBR = Public Sector Borrowing Requirement
- A = bank lending in sterling to the non-bank private sector
- G = holdings of interest bearing public sector debt by the non-bank private sector
- EF = external finance
- NDL = non-deposit liabilities

In the 'conventional approach', e.g. Spencer and Mowl (1978) and Melitz and Sterdyniak (1979) the right hand side variables in equation (1) are determined in order to explain the change in the money supply.

Another definition of the change in the money supply is

$$\Delta M_t \equiv m_t \Delta M_{0t} + M_{0t-1} \Delta m_t \quad (2)$$

where

M_0 = monetary base

m = money multiplier

There can, of course, be no logical inconsistency between equations (1) and (2) since they are both definitionally true. However, equation (2) provides an alternative point of departure for econometric purposes and in practice it might be the case that it provides a better account of changes in the money supply than the 'conventional approach'. We do not attempt such comparisons here. Instead we explore equation (2) in terms of an analysis of the determinants of the money multiplier.

In this paper our preoccupation is with the determinants of the multiplier rather than the determinants of the monetary base. Our analysis therefore only provides an account of the determination of the money stock if it is assumed that M_0 is exogenous and controlled by the authorities. Through the public sector accounting identities it is necessarily true that

$$PSBR + \Delta RES \equiv \Delta M_0 + \Delta B$$

where

ΔRES = central bank purchases of gold and foreign exchange

B = interest bearing public sector debt.

This implies that the evolution of M_0 depends upon fiscal policy, monetary policy and the exchange rate regime.

2. The Multiplier and its Components

Here we define the multiplier in terms of three main components:

α = ratio of cash held by the non-bank private sector to their sight deposits with banks

β = ratio of time deposits to sight deposits

γ = ratio of banks' till money plus bankers' balances at the Bank of England to banks' sterling deposit liabilities.

We refer to these as the currency ratio, the time deposit ratio and the reserve ratio respectively. This choice is not exclusive but α, β and γ may be regarded as key decision variables by the public.

The money multiplier is defined in terms of these ratios as follows:

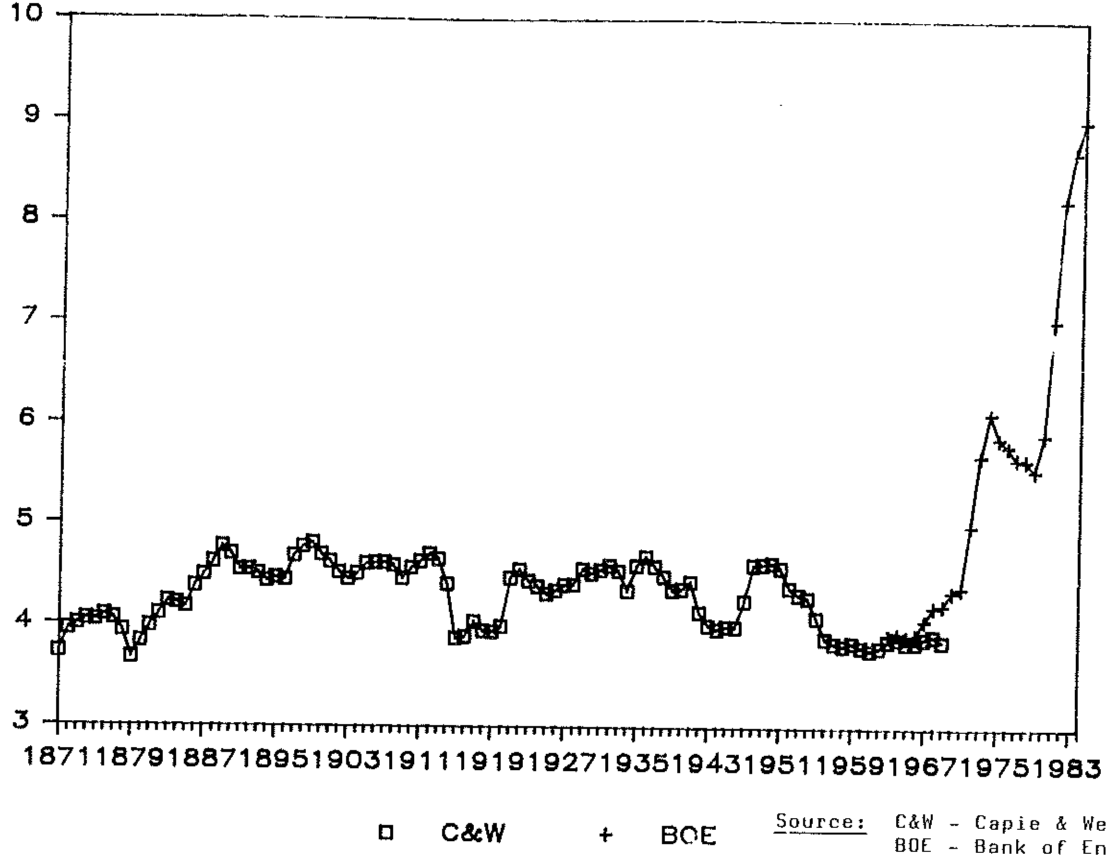
$$m \equiv \frac{1+\beta+\alpha}{\alpha+\gamma(1+\beta)} \qquad (3)$$

In sections 3, 4 and 5 we form behavioural hypotheses about the determinants of α, β and γ respectively, which are submitted to econometric scrutiny. In sections 5, 6 and 7 we discuss the implications of our econometric analysis of the money multiplier for the effects of various disturbances. In this section we introduce the data by looking at the behaviour of m, α, β and γ over the past.

To begin with we plot on chart 1 the behaviour of the money multiplier (M_3 definition) over the period 1870-1984. The chart reveals that until the 1970s the multiplier had been relatively stable for as long as data permit us to calculate it. Within the space of 10-15 years it

CHART 1

M3 MULTIPLIER



Source: C&W - Capie & Webber (1985)
BOE - Bank of England

CHART 2

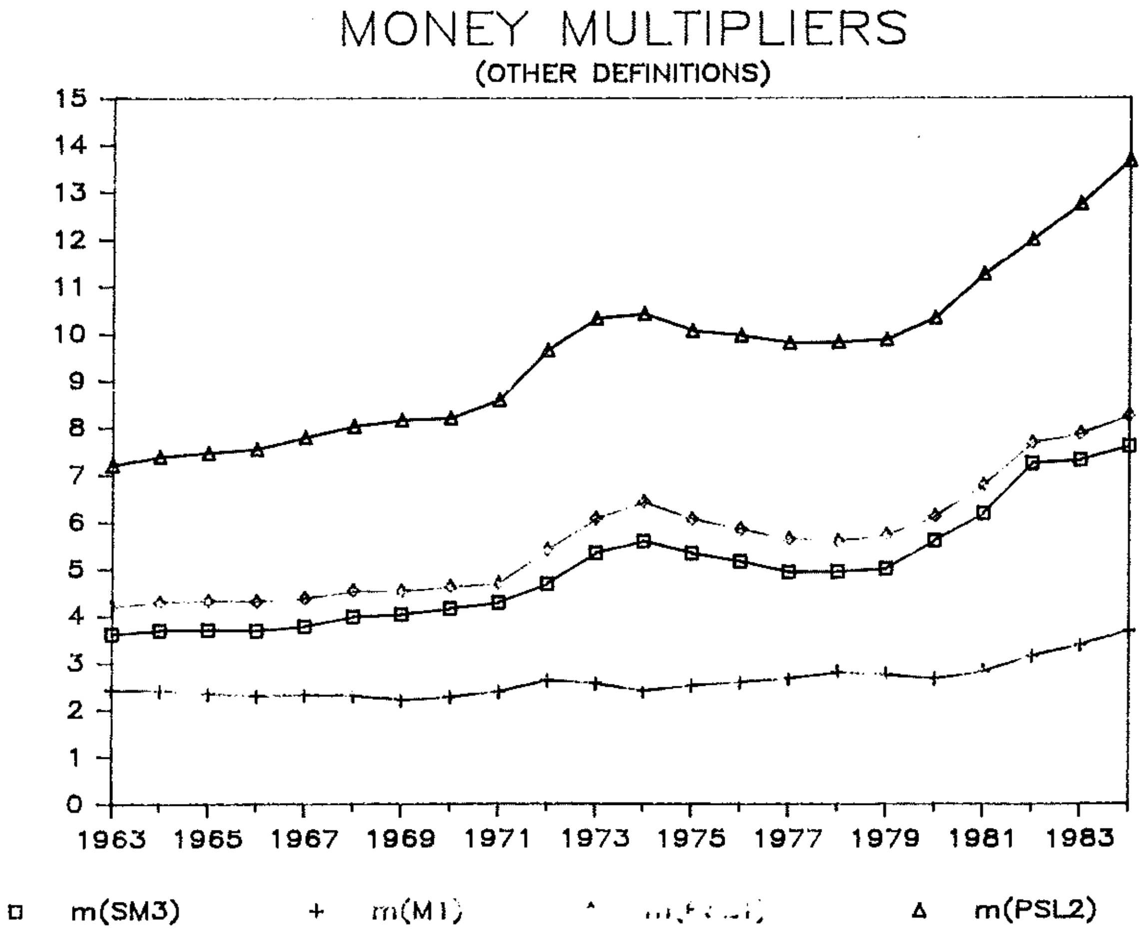

MONEY MULTIPLIERS
(OTHER DEFINITIONS)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
m(SM3)
m(M1)
m(PSL2)

CHART 3a

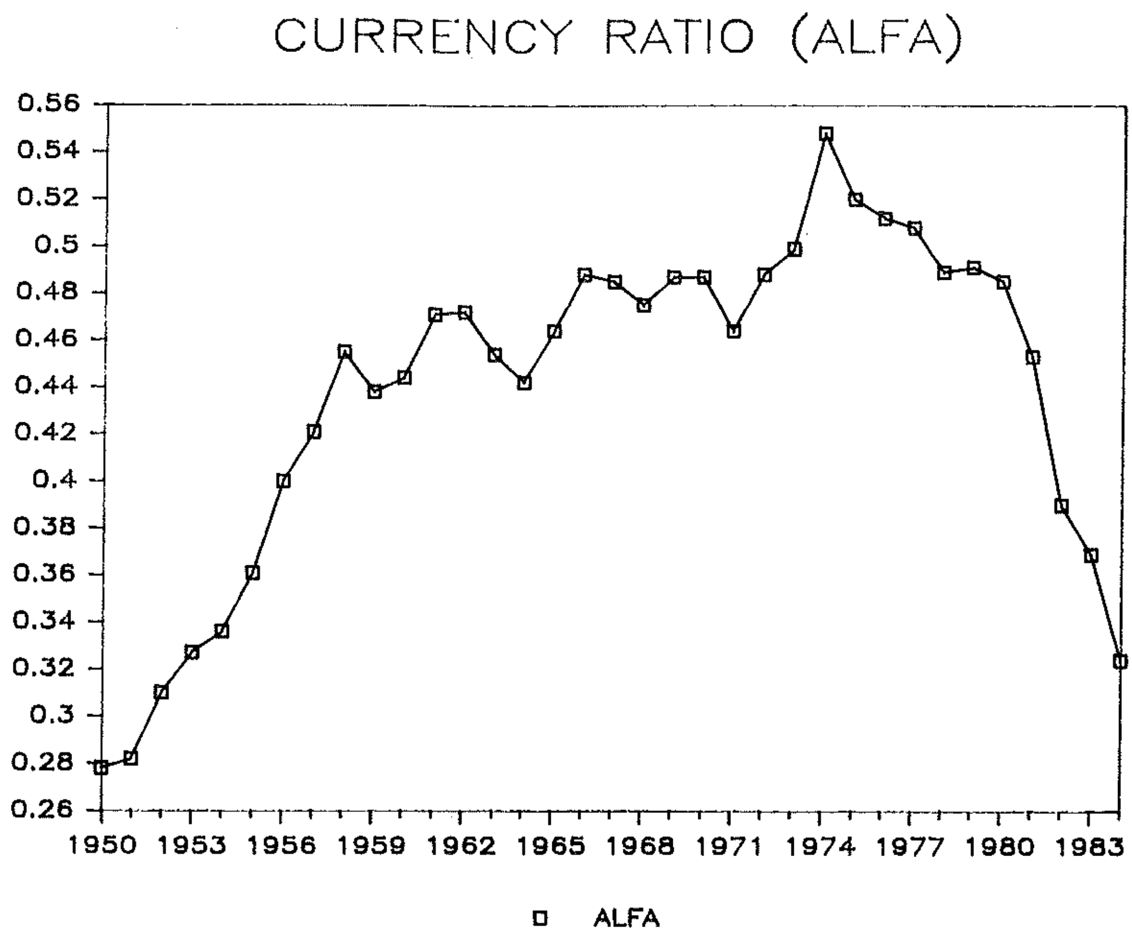

CURRENCY RATIO (ALFA)
0.56
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
ALFA

CHART 3b

TIME DEPOSIT RATIO (BETA)

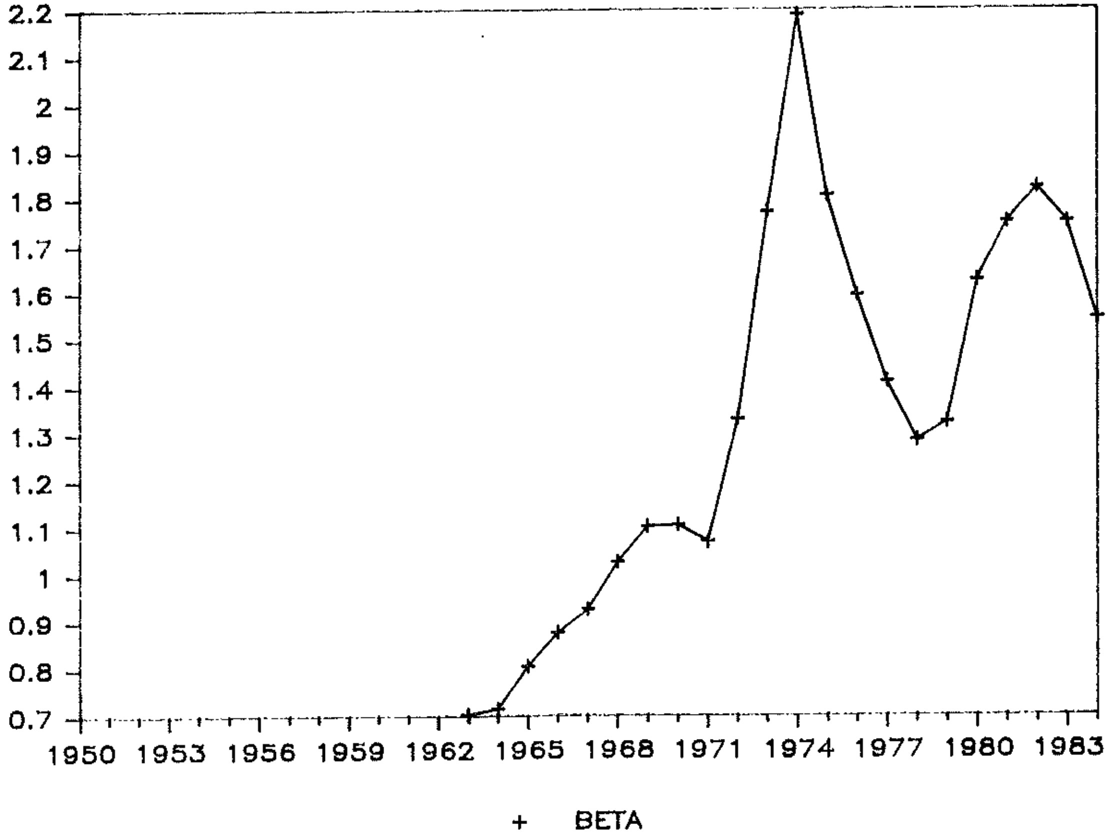
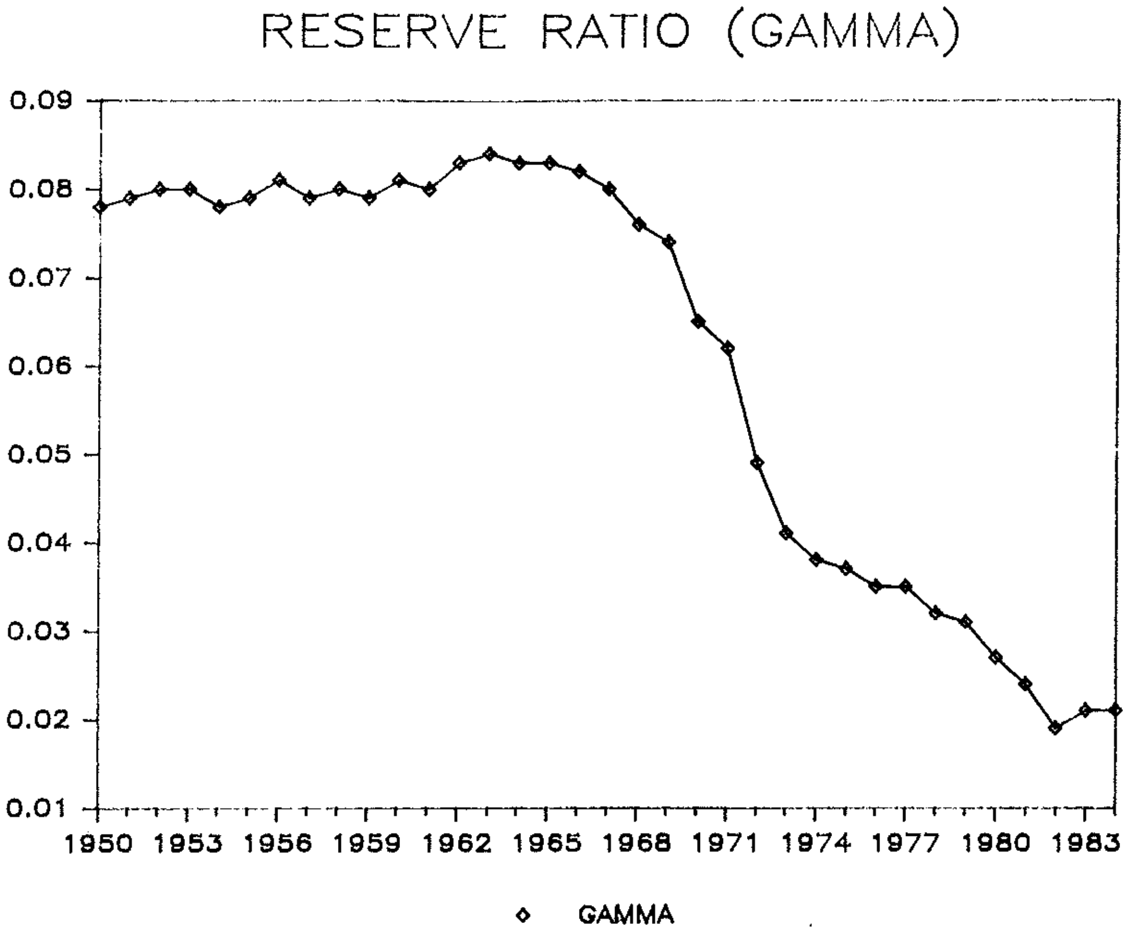


CHART 3c


RESERVE RATIO (GAMMA)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
1950 1953 1956 1959 1962 1965 1968 1971 1974 1977 1980 1983
GAMMA

has more than doubled. Chart 2 plots the behaviour of alternative definitions of the money multiplier over a shorter historical time span. It shows that irrespective of the choice of monetary aggregate the same pattern emerges; after being relatively stable in the 1950s and 1960s, the multiplier began to rise in the 1970s and rose even more sharply in the 1980s.

On charts 3 we plot the behaviour of α, β and γ. The currency ratio rose until the mid-1970s after which it fell dramatically. The time deposit ratio rose until the mid-1970s and has since stabilised. The reserve ratio has declined over the period as a whole. The discrete falls in γ reflect successive rounds of deregulation of banks as described in section 5.

Table 1 reports the contributions of the three ratios to changes in the multiplier for £M_3 over the last 20 years. Between 1965-70 the multiplier grew by 12.5 percent. However, the time deposit ratio rose by an amount which would have raised the multiplier by 8.9 percent. The fall in the reserve ratio would have raised the multiplier by 5.8 percent. Because the multiplier is non-linear in α, β and γ the fourth column in table 1 is not exactly equal to the sum of the first three columns. Nevertheless,

Table 1 Contributions to Changes in the Money Multiplier (%)

	Currency Ratio (α)	Time Deposit Ratio (β)	Reserve Ratio (γ)	$\Delta m/m$
1965-70	-2.4	8.9	5.8	12.5
1970-75	-3.6	18.5	10.1	27.7
1975-80	4.9	-4.3	3.4	3.5
1980-85	48.2	-5.4	5.9	53.1
1965-85	46.2	16.8	27.5	127.6

these columns indicate the contributions of the ratios to the change in the money multiplier.

Over the period as a whole, the time deposit ratio has not greatly affected the multiplier. In contrast the fall in the reserve ratio has steadily boosted the multiplier. The most striking feature of table 1 is that during the first half of the 1980s the unprecendented growth in the multiplier was almost exclusively determined by a massive reduction in the currency ratio. The counterpart to this massive expansion in the money multiplier has been a rapid increase in bank lending and monetary growth. On the face of it the reduction in the demand for cash has been responsible for a rapid build up of bank lending and monetary growth against a background in which M_0 has increasingly become an object of monetary policy.

3. The Currency Ratio

Our main purpose in this section is to estimate an econometric relationship for α, the currency ratio. Since the denominator in α is the volume of sight deposits, it seems likely that α will be influenced by the ratio of cash to cheque transactions in the economy. As this ratio rises so α is likely to increase, since in the UK the volume of notes and coin and the volume of sight deposits are demand determined.

Apart from transactions influences upon α, it has been suggested e.g. by Cagan (1965) that the currency ratio is likely to be influenced by increased financial sophistication. According to this hypothesis, as a richer array of liquid financial assets becomes available the demand for currency falls disproportionately. However, this hypothesis seems to be rejected by the UK data, since, at a time when financial innovation was quite rapid, the currency ratio rose rather than declined. Moreover, it turns out that not only did the demand for cash rise relative to the demand for sight deposits with banks, it also rose relative to deposits in National Savings accounts, Trustee Savings accounts and Building Societies.

Until the mid-1970s sight deposits did not bear interest in the UK. To a large extent this practice reflected the cartelized character of the banking industry until the aftermath of the policy of Competition and Credit Control that was instigated in September 1971. Since the mid-1970s banks have been increasingly competing for sight deposits by offering competitive interest rates on accounts so that by 1985 there were almost as many interest bearing sight deposits as there were non-interest bearing ones. Theory suggests that under such circumstances the currency ratio is likely to decline and it is no coincidence that α declined as banks made their sight business more attractive.

Another possible institutional change has been the increased use of banks and the reduced use of cash for the payment of wages and salaries (table 2). One interpretation of the data in table 2 is that the number of people holding bank accounts increased bacause their employers found it increasingly cheaper to pay salaries and wages via Bank Giro Credit than in cash. This forced people who might not otherwise have done so to open accounts. Institutional change of this type would have reduced the currency ratio. Certainly there has been a tendency for transactions to become less cash intensive. However, despite talk of a 'cashless society', 86 percent of all consumption in 1984 was transacted in cash.

Table 2 Bank Penetration

	1970	1976	1981	1984
% of population with bank accounts	40[a]	45	61	65
% of wages and salaries paid in cash	75[1969]	58	42	37
% of consumer transactions in cash		93	88	86

Source: Inter-bank Research Organisation, Research Brief, October 1985.

a Social Trends

Unfortunately, the data in table 2 is not useful for econometric analysis of the currency ratio because the observations are too few. In any case the causality assumptions contained in the previous paragraph might be invalid. The behaviour of the data in table 2 could be explained by an autonomous fourth variable, viz. an increase in the demand for current account deposits with banks. Nevertheless, the data in table 2 provide a rare glimpse into the structure of transactions even if we cannot integrate this satisfactorily into our econometric efforts.

A fourth hypothesis about the determination of the currency ratio has been suggested, inter alia, by Matthews (1982). He argues that the relative demand for currency varies directly with the spread of the 'black economy'. Transactions in the 'black economy' must be in the form of cash since bank records might lead to detection by the tax authorities. According to this view, the demand for cash will vary directly with the marginal rate of tax, since it is this that stimulates the 'black economy'.

Finally, the proportion of cash transactions might not be independent of the level of economic activity or its composition. If corporate spending is less cash intensive than consumer spending, the currency ratio is likely to vary inversely with the share of investment in GDP. Alternatively, the currency ratio might be temporarily disturbed by changes in the rate of economic growth. This will happen if the proportion of cash transactions is not independent of the rate of growth. Indeed, our results reported below suggest that in the short run increases in the rate of economic growth reduce the cash intensity of transactions.

Our eclectic theory for the currency ratio is summarised by equation (4):

$$\alpha = (\overset{-}{F}, \overset{-}{R}_s, \overset{-}{I/GDP}, \overset{?}{g}, \overset{+}{T}, \overset{?}{D}) \qquad (4)$$

where

F = index of financial sophistication

R_s = rate of interest on sight deposits

I = gross domestic fixed capital formation

g = economic growth

T = marginal tax rate

D = deposits

and where the signs of partial derivations are indicated over the variables to which they refer. We include a term on the level of deposits to test the hypothesis that the currency ratio is indeed independent of the demand for deposits. If it is not α will not be homogenous to degree zero in D.

More generally, the numerator and denominator terms of α as well as β might be modelled separately. This would be appropriate if, to a reasonable degree of approximation. people did not segment their demand for transactions balances and their demand for bank deposits from each other as well as other portfolio decisions. If this is true α and β would be influenced by other variables, e.g. the demand for gilts and equities. Although we have not rigorously tested such exclusion restrictions, we offer our results in the belief that α and β are plausible decision variables as a starting point for empirical work while testing for homogeneity as stated. Further discussion of portfolio nesting may be found in Matthews and Minford (1980).

After considerable experimentation over the period 1950-84 we arrived at the following empirical TSLS version of equation (4):

$$\Delta\alpha_t = \underset{(1.7)}{0.026} - \underset{(1.08)}{0.0386}\,\alpha_{t-2} - \underset{(4.43)}{0.425}\,\Delta g_t - \underset{(4.9)}{0.0192}\,R_{s_t} \quad (5)$$

$\sigma = 0.015$ DW = 1.9 ARI = -0.03 AR2 = 0.006

AR3 = 0.019 AR4 = 0.176

't' values are shown in parenthesis and AR_j is the j'th order autocorrelation coefficient of the residuals which has a standard deviation of approximately 0.17. Thus at the 95% level, none of the ARj's is significantly different from zero. Data definitions are provided in the appendix.

We were unable to detect any influence of alternative measures of financial sophistication on the evolution of α. Nor did α appear to be influenced by tax rates and investment as a proportion of GDP. An F ratio test suggested that it was inappropriate to add a term in deposits to equation (5) implying that α is homogenous to degree zero in D. This leaves the rate of interest on sight deposits and the change in the rate of economic growth as the main determinants of α. Indeed, the long run solution for α that is implied by equation (5) is

$$\alpha = -11.01\,\Delta g - 0.497\,R_s + \text{constant}$$

This suggests that accelerating growth lowers the demand for cash while an increase in the rate of interest on sight deposits (in 1985) by one annual percentage point eventually lowers the α ratio by about 50 percentage points. Thus the α ratio is quite elastic with respect to interest rates.

Equation (5) implies that the adjustment of α to its long run value is very protracted, but we could not safely reject the hypothesis that the coefficient on the second lag of α was non-zero. Alternatively α depends on a time trend, economic growth and the rate of interest on sight deposits.

4. The Time Deposit Ratio

Our main hypothesis was that β would vary directly with the rate of interest on time deposits (R_T) and inversely with the rate of interest on sight deposits (R_s). We also explored the hypothesis that the demand for different types of deposits depends on economic activity. Our results in fact suggest that as GDP rises, the demand for time deposits rises relative to the demand for sight deposits.

We report the following TSLS estimate for β drawn from observations over 1964-1984:

$$\Delta\beta_t = \underset{(2.06)}{-15.3} - \underset{(3.84)}{0.032}\,\beta_{t-2} + \underset{(3.02)}{0.0687}\,R_T - \underset{(2.6)}{0.167}\,R_s + \underset{(2.08)}{1.297}\,\ln GDP \qquad (6)$$

$\sigma = 0.118$ DW $= 2.05$ AR1 $= -0.04$

AR2 $= -0.069$ AR3 $= -0.417$ AR4 $= 0.111$

Equation (6) suggests that a rise in interest rates results in net substitution of sight deposits for time deposits while a rise in GDP results in substitution in the opposite direction. As in the case of equation (5) the data indicated the presence of an autoregressive adjustment at lag 2.

However, in this case the adjustment is much more rapid. The equation implies that the practice of paying interest on sight deposits helped to stabilise the time deposit ratio in the late 1970s after decades of secular decline.

5. The Reserve Ratio

In section 2, γ, the banks' reserve ratio, was defined in terms of vault cash plus bankers' balances at the Bank of England. Since 1971, there has not been a direct restriction on this ratio, although it surely has been indirectly affected by the cash ratio which refers to bankers' balances. As the cash ratio was lowered in 1971 and 1981, it is likely that this affected the γ ratio in the banking system as a whole irrespective of the elasticity of substitution between vault cash and bankers' balances.

For a given cash ratio the demand for reserves is hypothesisized to vary inversely with the rate of interest on bank assets, see e.g. Niehans (1978, cap 9). Because reserve assets do not earn interest their opportunity cost varies directly with interest rates. The demand for reserves is also likely to depend upon the frequency distribution of withdrawals; the greater the mean and variance of the withdrawal distribution the higher the demand for reserves is likely to be. Unfortunately, data are not available on these variables, although there was some evidence that the demand for reserves varied inversely with β. Because time deposits require notification in advance if they are to be withdrawn (unless a penalty is paid) the demand for reeserves is expected to vary inversely with β. Howard (1982) found some weak support for this hypothesis but in practice we found that this effect was statistically dominated by other variables as we explain below.

Howard also suggests that the Bank of England's money market policies are likely to affect the demand for reserves. If the Bank always assisted the market through its 'back window' there would be little or no penalty to low reserve positions. If it always assisted the market through its 'front window' the oppoosite would be true. Therefore, the demand for reserves will vary directly with the degree to which the Bank's assistance is penal. Howard defined this variable as

$$PEN = MLR \times \frac{\text{outstanding discount house borrowing from Bank}}{\text{cash reserves of banking system}}$$

but it was not significant. His definition is suspect (as he admits himself) because the Bank exercises the option whether or not to assist the market at penal rates. We try to overcome this problem by defining PEN as the ratio of penal assistance to total assistance (see appendix). Data are published for this variable up to 1973 and it is defined on a different basis from late 1982. Unfortunately, between these dates no data are published.

We summarise our eclectic hypothesis for the demand for reserves in equ (7)

$$Y = Y(\overset{+}{CR}, \overset{-}{\beta}, \overset{-}{R}_B, \overset{+}{PEN}, D) \qquad (7)$$

where

CR = cash ratio

R_B = rate of interest on bank assets

PEN = index of Bank penal assistance

We include a scale factor in D to test Howard's suggestion that the demand for reserves is influenced by economies of scale, i.e. $\delta\gamma/\delta D < 0$.

Over an observation period 1950-1984 we arrive after considerable experimentation at the following TSLS estimate of equ (7):

$$\gamma_t = \underset{(1.85)}{0.0091} + \underset{(9.35)}{0.683}\gamma_{t-1} + \underset{(4.52)}{0.0022}\, CR_t - \underset{(2.23)}{0.00058}\, R_{B_t}$$

$$+ \underset{(1.9)}{0.000102}\, PEN_{t-1} \qquad (8)$$

$\sigma = 0.00238$ DW = 1.69 AR1 = 0.126 AR2 = 0.433

AR3 = -0.054 AR4 = -0.1

There is some evidence of second order autocorrelation, but within a portmanteau context this is unlikely to be significant. After 1973, there are major data problems regarding PEN. However, when this variable is dropped, the rest of the model remains unchanged although the standard error of the regression rises by 5 percent. Therefore, we may use equ (8) in the simulation exercises that we report below.

The equation implies that in the long run a rise in interest rates of one percent lowers the reserve ratio by 0.18 percentage points while a switch from 100% 'front window' assistance to 'back window' assistance would lower the reserve ratio by 3.2 percentage points.

6. Multiplier Tracking Performance

How well do equations (5), (6) and (8) track the money multiplier via equation (3)? Static and dynamic solutions for the period 1965-1984 are plotted on chart 4. The former take data values for the lagged dependent variables while the latter represent these values in terms of their model solution values. It is clear that both the static and dynamic estimates of the money multiplier track the data quite well. Because equation (6) could not be estimated back to 1950 (due to data problems) we can only carry out the exercise from 1965.

It is surprising that the static solution errors appear to be autocorrelated (DW = 1.25) despite the fact that equations (5), (6) and (8) have random residuals. This suggests that nonlinear transformations of approximately white noise processes are not necessarily white noise themselves. Or it implies that the errors of equations (5), (6) and (8) are cross autocorrelated. The correlation between the estimated and actual value of the mulitplier is 0.968 and the standard of $\hat{m}$ is 0.31.

In contrast, the dynamic simulation errors are necessarily autocorrelated and the tracking is necessarily looser. The model under-estimates the fall in m in the early 1970s but it seems to capture the turning points as well as the overall scale of the movement in the multiplier. On the whole, we feel that these results suggest that the model describes the data generation process tolerably well.

CHART 4

SIMULATIONS OF m(SM3)

(BASE RUN)

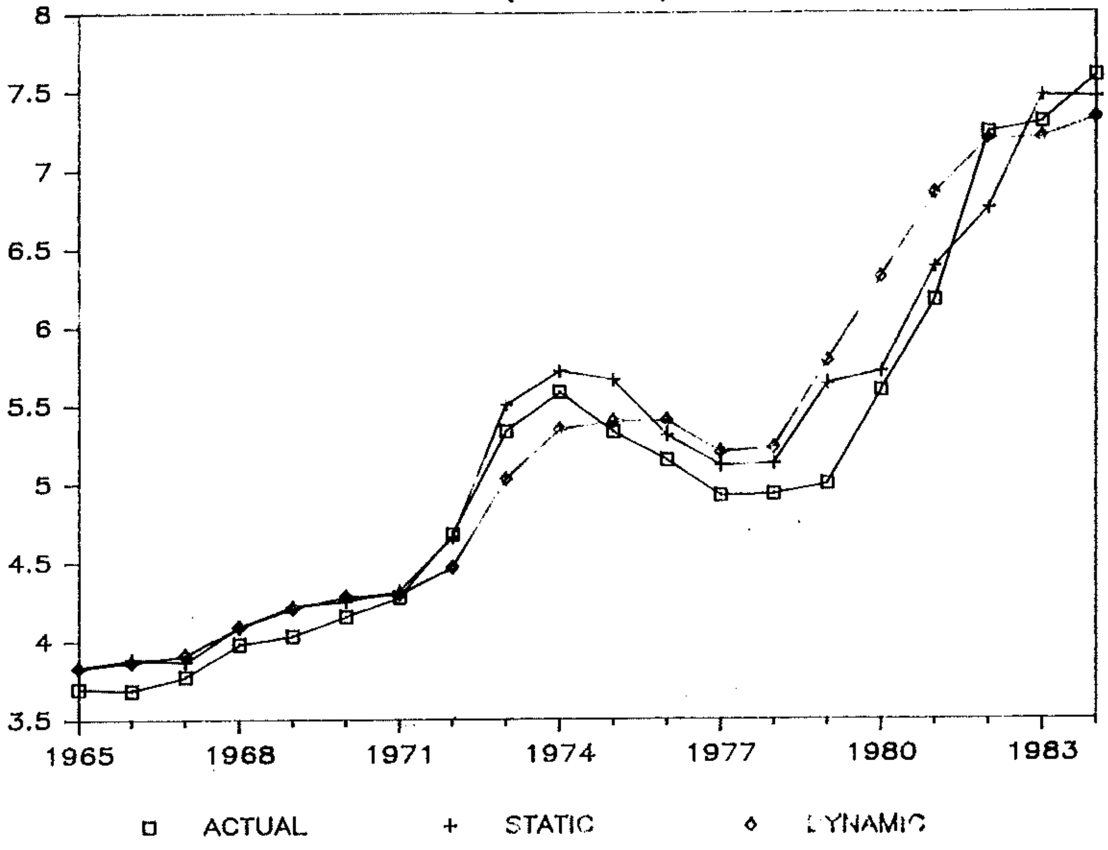
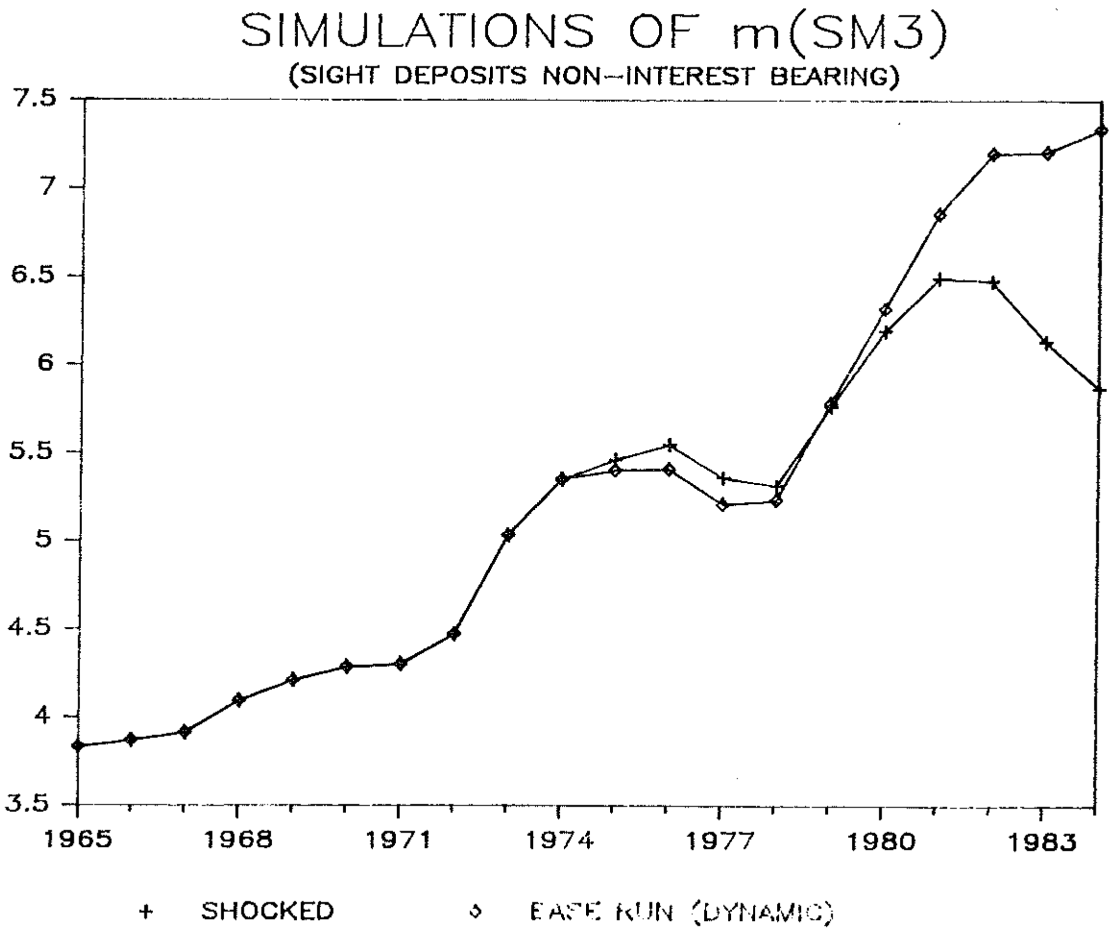


CHART 5



SIMULATIONS OF m(SM3)
(SIGHT DEPOSITS NON-INTEREST BEARING)
7.5
7
6.5
6
5.5
5
4.5
4
3.5
1965
1968
1971
1974
1977
1980
1983
+ SHOCKED
◇ BASE RUN (DYNAMIC)

CHART 6

SIMULATIONS OF m(SM3)

(INTEREST RATES INCREASED BY 1% POINT)

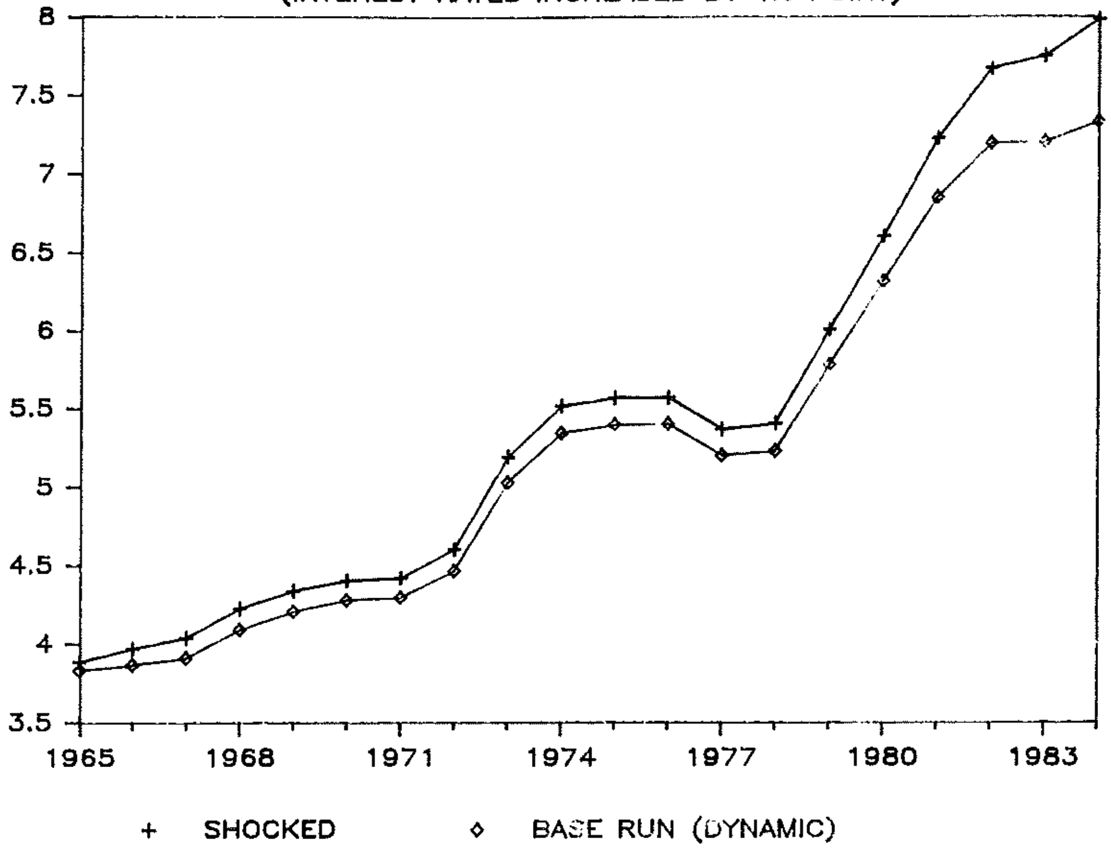
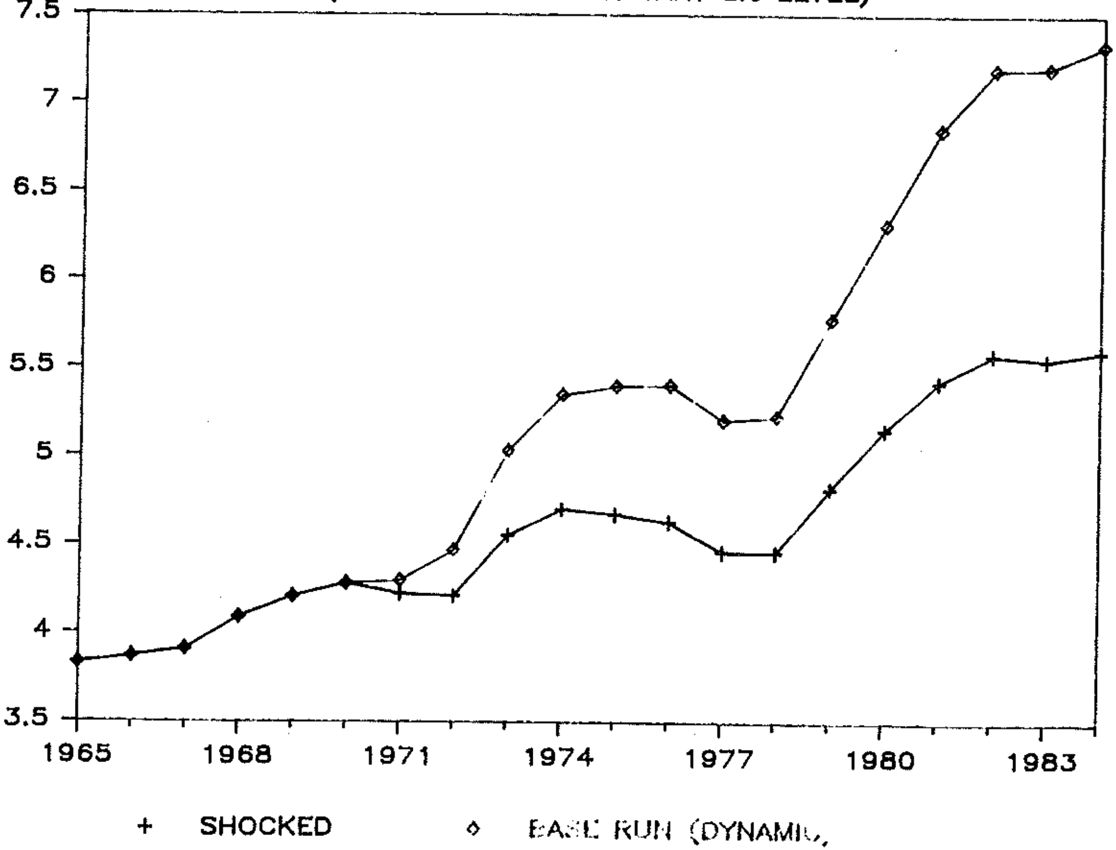


CHART 7

SIMULATIONS OF m(SM3)

(CASH RATIO AT CONSTANT 8% LEVEL)



7. Simulations

We use the model to explore the implications of various disturbances for the supply of money for a given stock of M_0. This information is summarised by the response of the multiplier to these disturbances. We begin by considering what would have happened to the multiplier had sight deposits continued to be non-interest bearing since the mid-1970s. The results of this exercise are plotted on chart 5, where it can be seen that the practice of paying interest on sight deposits has been responsible for much of the growth in m in the 1980s.

Alternatively, the supply of money in 1984 would have been about 20 percent lower than it was (ceteris paribus) had banks continued to refuse to pay interest on current account deposits. This suggests that about half of the growth in m (see table 1) over 1980-1985 can be attributed to this innovation. The simulation suggests (not shown) that the upward trend in α would have persisted, as would the upward trend in β. However, it should be recalled that m varies inversely with α and directly with β; therefore to some extent these effects counterbalance each other.

In our second simulation we consider the effects on the supply of money for a given volume of M_0 of an increase in the level of interest rates by one percentage point. According to Keynesian theory, the demand for money is likely to fall. Less frequent attention has been paid to the effects of interest rates on the supply of money.

On chart 6 we assume that interest rates are permanently raised from 1965. By 1984 m is raised by about 9 percent, suggesting that the supply of money is quite elastic with respect to the rate of interest. The currency and reserve ratios both fall but the time deposit ratio rises. The net effect is for the multiplier to rise as chart 6 indicates.

Simulations of this type are to some extent synthetic because interest rates have been assumed to be endogenous. Endogenous variables cannot be exogenised. Nevertheless, chart 6 at least gives a qualitative impression of the positive influence on the supply of money of interest rate shocks.

In our third simulation we ask - what would have happened to the multiplier had the cash ratio been kept at its 1970 level? The results of this exercise are plotted on chart 7. The reserve ratio would have remained at a relatively high level and the multiplier would have been reduced as indicated. Nevertheless, the upward trend in the multiplier would have occurred but at a much lower rate.

Finally, we investigate the effects on the supply of money of an increase in the level of GDP. On the one hand this lowers α in the short run via equation (5) and it raises β via equation (6). In the simulation GDP is raised by one percent from 1970. We find that this eventually raises the value of the multiplier by about 0.9%. This suggests that for a given value of M_0 the supply of money rises slightly less than proportionately when GDP rises.

8. Concluding Remarks

We wish to stress that our approach has nothing directly to do with the debate about monetary base control. Even if our estimates of α, β and γ were reliable it does not automatically follow that to control the quantity of money the authorities should control M_0. We cannot of course comment on this issue without undertaking much more research.

At the present time our approach may be more relevant than in the past because M_0 is an intermediate target which forms part of the Medium Term Financial Strategy. Assuming this target is approximately attained (as has been the case to date) our model of the money multiplier provides a basis for conditional projections of the money stock which is an alternative in practice, though not in principle, to the 'conventional approach'. More generally, a comprehensive theory of the supply of money requires the joint determination of the money multiplier and the monetary base.

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Data Definitions and Sources:

a) α : Currency Ratio and is defined as

$\alpha = C/Ds$

b) β : Time Deposit Ratio and is defined as

$\beta = DT/Ds$

c) γ : Reserve Ratio and is defined as

$\gamma = R/(Ds + DT)$

where

C is the amount of notes and coins in the hands of the public (average of four quarter-ends).

D_S is the total amount of non-bank private sector's sight depests with banks (average of 4 quarter-ends).

D_T is the total amount of non-bank private sector's time deposits with banks (average of 4 quarter-ends).

R is the annual average of bankers' till money and their balances with the Bank of England.

Source of data: 1) Capie and Webber (1985)

2) Bank of England Quarterly Bulletin

d) m(M1), M(M3), m(PSL1), m(PSL2) are respectively multipliers for the various definitions of money aggregates and are defined as

m(Money Aggregate) = Money Aggregate/M0

where

M0 is the money base

Source of data: 1) Capie and Webber (1985)

2) Bank of England Quarterly Bulletin

3) Financial Statistics

e) m(SM3) is the money multiplier for Sterling M3 and is defined in terms of the various ratios as shown in equation (3).

f) R_B : A proxy for rate of interest on bank assets and is assumed to be equal to the calculated

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gross redemption yield of short-dated British government securities (average of weekly or daily rate).

Source of data: 1) *Financial Statistics*

g) R_T : Net rate of interest on time deposits (annual average of end-week or daily rates and is calculated as

$$R_T = R(7 \text{ days}) * (1 - MTR)$$

where

R(7 days) is the 7 days' notice deposit account rate paid by selected retail banks.

MTR is the marginal income tax rate.

h) Rs : Calculated net rate of interest on sight deposits and is defined as

$$Rs = R_T * PIBSD$$

where

PIBSD is the proportion of sight deposits which is interest bearing. Due to data problem, the variable is assumed to be zero prior to 1975.

Source of data: 1) *Financial Statistics*

2) *Bank of England Quarterly Bulletin*

i) Δg : Change in economic growth and is defined as

$$\Delta g(t) = \Delta \ln TQ(t) - \Delta \ln TQ(t-1)$$

where

TQ is UK GDP at factor cost at constant (1980) prices.

j) CR : Cash ratio. Before 1971 it is equal to the 8% cash ratio banks would not normally be allowed to fall below. After the implementation of Competition and Credit Control (CCC) in 1971, it is reduced to 1.5%. It is further reduced to ½% after the new arrangement for monetary control which took effect in August 1981.

k) PEN : A proxy for the probability of banks borrowing at the penal rate from the Bank of England, and is calculated as the percentage BoE's assistance given to the money market at or above the Bank rate. For 1974 to 1984 it is assumed to be constant at its 1973 level.

Source of data: Bank of England Quarterly Bulletin

l) Other Instrumental Variables used in the Derivation 2SLS Estimates of Equations (5), (6) and (8):

WR : Weighted average of OECD countries' long-term government security yields.

Source of data: IMF International Financial Statistics Country Pages.

YW : World GDP

Source of data: OECD Economic Outlook and National Accounts

TPIW : World price index

Source of data: OECD Economic Outlook and National Accounts

POILD : Price of oil (Dollars/Tonne)

Source of data: IMF International Financial Statistics Commodity Prices Pages.

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../data definitions & sources

MTR : Marginal rate of UK income tax

MO : UK Money Base