The demand for M0 revisited[1]

● *The velocity of circulation of M0—as measured by the ratio of total consumer spending to narrow money—has been on a steady upward trend over the post-war period.*

● *Empirical studies have explained this trend in terms of financial innovation by the banking system, notably the introduction of alternative means of payment, interest-bearing current accounts, liquid savings accounts and Automated Teller Machines (ATMs).*

● *But changes in the composition of consumer expenditure and employment, related to rising incomes, have also contributed to this upward trend in velocity.*

● *Within total consumer spending, there has been a decline in the share of smaller value purchases, such as foodstuffs, and a rise in the share of larger value purchases, such as many services, cars, and household goods. Although all categories of expenditure are financed to some extent by cash, larger value purchases are more likely to be paid for by other means, thus reducing the stock of M0 in relation to total spending.*

● *Over the economic cycle, expenditure patterns vary. Spending on essentials grows more steadily than spending on luxuries. Because essentials are more likely to be purchased with cash, the growth of M0 fluctuates less than that of income. Although the evidence here is less strong, this phenomenon may have induced short-run movements in the velocity of M0.*

Introduction

Over the post-war period the ratio of nominal expenditure to M0 (defined as notes and coin in circulation outside the Bank of England and operational bankers' balances at the Bank) has been on a steady upward trend, suggesting that there has been a reasonably stable relationship between M0 and nominal expenditure. As a result, and because M0 data are particularly timely, M0 has been regarded as a useful indicator of monetary conditions.

The velocity of M0 over the long run

As Chart 1 demonstrates, the velocity of M0—the value of consumer spending[2] in relation to the outstanding stock of M0—has been on a steady upward trend since at least 1955. Consequently, the levels of M0 and personal spending have gradually diverged.

Usually, this trend is explained by the introduction of financial innovations and heightened competition in financial services, including:

(i) the introduction and more widespread use of alternative means of payment—in chronological order: cheque books, credit cards and debit cards;

Chart 1
The relationship between M0 and the value of consumer spending
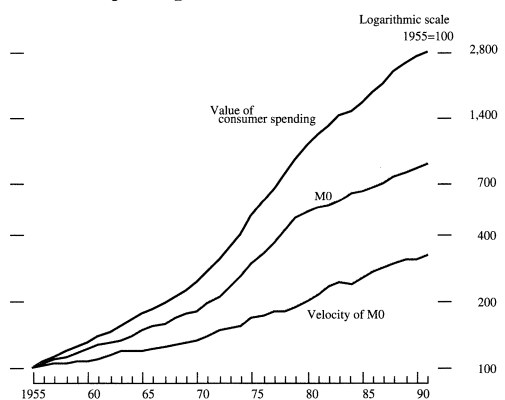
(ii) the increasing opportunity cost of holding cash, reflected in the introduction of interest-bearing current accounts and more price competitive liquid deposit accounts, which provide an incentive for individuals to economise on cash holdings for a given level of cash transactions; and

(1) Prepared by Glenn Hoggarth and Huw Pill of the Bank's Economics Division.
(2) At the end of 1990, some 99% of the stock of M0 was notes and coin, the majority of which was held by the personal sector (around 66%); 8% was held by companies; 19% was till money held by the banks and building societies and the remaining 7% was held by the overseas and the public sectors. Given that M0 holdings are dominated by the personal sector, it is appropriate to relate it to a measure of *personal* sector transactions such as consumer spending.

(iii) increasing efficiency in the holding of cash facilitated by the introduction of ATMs.[1]

Early studies of the demand for M0 included explicit measures of financial innovation,[2] encompassing examples of all of the above. More recent empirical models have developed this approach by introducing factors which explain, rather than only describe, the innovation process. In attempting to explain why financial innovation has encouraged individuals to economise on cash holdings,[3] these models have concentrated on the introduction of interest-bearing accounts and ATMs ((ii) and (iii) above). However, ATMs and interest-bearing current accounts have become significant only since the late 1970s (see Chart 2), whereas M0 velocity has been on an upward trend since at least 1955.[4] This would suggest that the increase in the use of alternative means of payment offers a more plausible reason for the upward trend in velocity over the whole post-war period.

Chart 2
Financial innovation
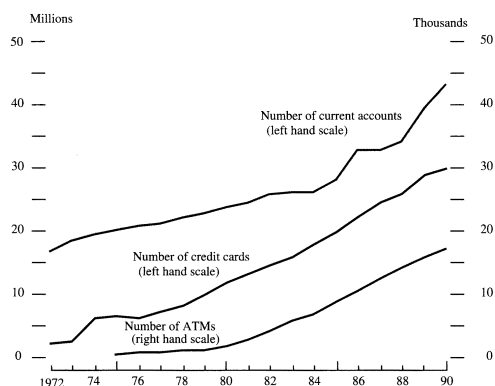
Source: Association of Payment Clearing Services (APACS); British Banking Association (BBA).

Although data for the value of transactions conducted with alternative payments media are available only since the early 1970s, it is probable that the number of current accounts and, more importantly, the total value of transactions carried out with current accounts,[5] have increased throughout the post-war period. As shown in Chart 3, the proportion of adults with a current account has increased steadily since at least 1976. Although not common before the early 1970s, both the number and use of credit and charge cards have also increased steadily (as illustrated in Table A).

The development of alternative means of payment, spurred by the increase in financial technology and consumer sophistication, affected cash holdings in two distinct ways.

Chart 3
Percentage of adults holding current accounts
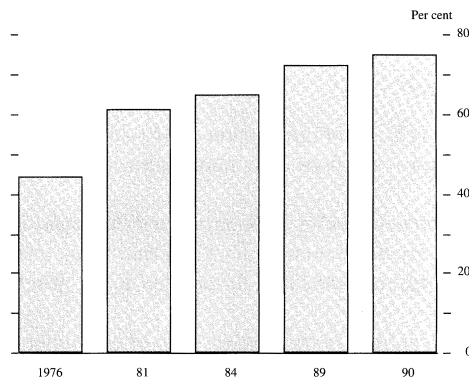
Source: APACS.

First, the proliferation of alternative means of payment meant that *all* payments—both receipts of income and expenditures—became less likely to be made with cash. Second, changes in the pattern of both employment and expenditure accentuated this trend.

Table A
Methods of payment (number of transactions)

Percentage of total

Method of payment	1976	1984	1990
Cash	93	86	78
Non-cash	7	14	22

Percentage of non-cash

Cheque	68	64	52
Standing order/ direct debit	22	22	23
Plastic payment card	6	12	20
Other	4	2	5

Source: APACS.

On the income side, as current accounts became more widespread, wages and salaries were increasingly paid directly into bank accounts rather than in cash. Firms took advantage of cost-saving technological innovations which made payments through the banking system safer, cheaper and simpler than using cash. The abolition of the Truck Acts (which had given employees the right to demand to be paid in cash) in 1986 merely accommodated what had already become normal practice. This trend was encouraged by the rising share of the workforce employed in the services sector and the corresponding fall in the share (and level) of manufacturing employment. As a result, in 1960, 75% of employees were paid in cash and only 15% directly into bank accounts, whereas the corresponding figures for 1990 were 22% and 61% respectively.

(1) While notes held by banks and building societies in ATMs remain within M0, the lower average holdings by individuals facilitated by the introduction of ATMs will also have allowed banks and building societies to economise on their holdings of cash, implying a reduction of M0 relative to spending.
(2) For example, Johnston (1984) uses a whole array of measures of financial innovation such as the number of current accounts, credit cards and ATMs. For a critique of this approach, see Hoggarth (1984).
(3) Hall, Henry and Wilcox (1989) and Brookes *et al* (1992) introduced a cumulative interest rate term to capture the incentives for individuals to exploit the financial innovations offered to them by the banking system. Walton and Westaway (1992) argue that this term captures the banks' incentive to offer innovations.
(4) Empirical models of the demand for M0 which include the cumulative interest rate term (such as Hall, Henry and Wilcox (1989) and Walton and Westaway (1992)) have only considered the period since 1969 when these effects may have been more important. However, as shown in the appendix, our preliminary results suggest that even over this period the cumulative interest rate effect may be only one of a number of important factors.
(5) The Walton and Westaway (1992) justification of the cumulative interest rate term from the supply side would imply greater numbers of current accounts, but not necessarily more intensive use of existing current accounts.

On the spending side, although through time financial innovation has reduced the use of cash for all types of payment, M0 is still used by individuals for a wide range of transactions. Thus it is appropriate to measure the velocity of M0 against a broad measure of personal spending, such as consumer expenditure. However, since the use of cash varies quite markedly across spending categories, changes in the pattern of expenditure will probably have affected the velocity of M0—the broader the measure of expenditure, the more important the changes in the pattern of expenditure become.

The rise in real income per head over the post-war period has resulted in expenditure on luxury goods comprising a growing proportion of total personal spending, with spending on essentials constituting a declining proportion. This is likely to have resulted in an increase in the average real value of individual purchases. The availability of alternative means of payment may have facilitated the increased desire for a more secure and convenient means of payment in response to these changes in expenditure patterns. Consequently, this has led to a trend reduction in the desired use of cash relative to total expenditure.

Cash has a number of characteristics which broadly distinguish it from close substitutes as a means of payment. The anonymity of cash as compared with cheques or credit cards makes it an attractive way of financing illegal or other dubious activity.[1] Because cash is a bearer instrument, ownership does not have to be transferred in a time-consuming manner (for example, by writing a cheque or signing a credit card receipt). On the other hand, cash is less convenient for large transactions. It has to be counted in a way which is unnecessary for other media (such as cheques and credit cards) where the amount can be specified exactly; and in many cases it will be more cumbersome to carry. Moreover, as a bearer instrument it is an insecure way of holding a large amount of wealth. In some cases, a fixed transaction fee is imposed (on either the payer or recipient) for non-cash transactions which would deter its use for small value purchases.

As shown in Chart 4, the use of cash for spontaneous transactions[2] declines as the value of the transaction increases. This suggests that the non-cash payment media, such as cheques, credit cards and direct debit, have attributes which make them particularly attractive as a means of payment for higher value transactions. The data in the chart suggest that, although cash is used to some extent for payments of all sizes, of the total value of spontaneous cash expenditures of over £1, approximately one third are for transactions less than £10, over one half are for less than £25 and three quarters are for less than £50.

The value of a transaction is likely to vary according to the type of expenditure. Although time-series data of consumer spending by value of transaction are not available, the

Chart 4
**Proportion of spontaneous payments within differant value bands, 1991**(a)
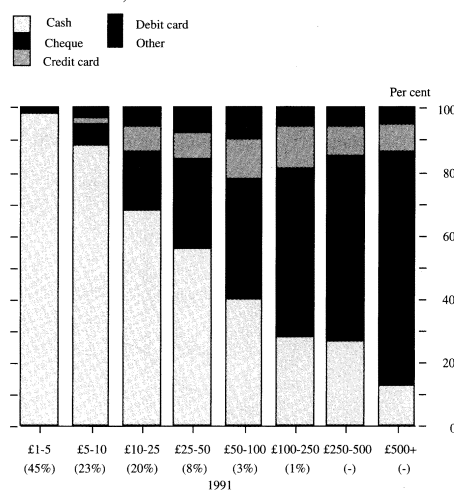
Source: APACS.

(a) The percentage in brackets is the proportion of spontaneous payments made within the particular value band. A dash indicates a percentage under 0.5%.

average value of an individual foodstuff purchase would, for example, be expected to be smaller than the purchase of a durable, such as a washing machine or motor car. Moreover, the smaller the purchase, the more likely it is to be paid for with cash. This is supported by the available survey data (see Chart 5). According to the APACS Consumer Payments Survey (1990) the share of the value of spontaneous expenditures paid for with cash is, by retailer, highest for non-supermarket food stores (88%), newsagents (86%) and off-licences (84%) and lowest for travel agents (16%), furniture stores (24%) and electrical stores (35%).

Chart 5
**The share of spontaneous payments by value made in cash**
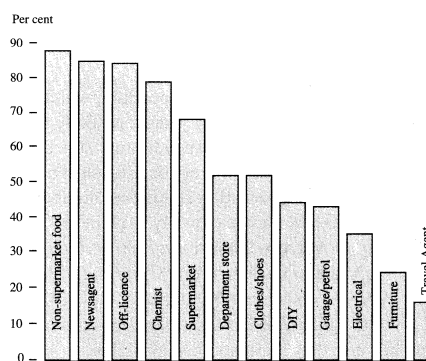
Source: APACS Consumer Payments Survey (1990).

(1) The anonymity of cash results in its use as a savings as well as a transactions medium. The level of personal holdings of M0 implies that individuals hold approximately £225 in cash per head. This is implausibly large as a transactions balance for 'normal' spending. Thus a large part of M0 must be held for savings purposes or for certain transactions where anonymity is important eg related to the black economy (tax evasion, money laundering, drug transactions).
(2) This measure of transactions excludes precommitted regular payments, such as taxes and gas and electricity bills. The data are collected by survey.

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Chart 6, which shows the growth of different categories of expenditure relative to that of total M0, is consistent with this view. M0 has grown more slowly than all categories; food expenditure, however, has been the slowest growing category, and has risen less in relation to M0 than have other categories.

Chart 6
Ratio of different measures of consumption to total M0
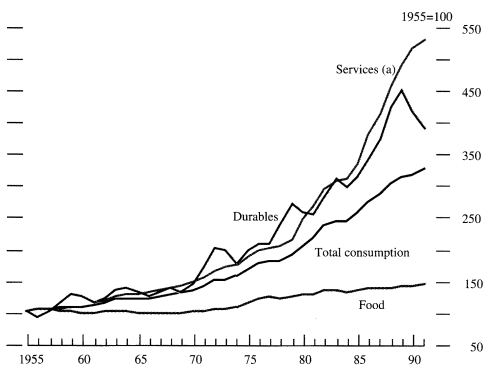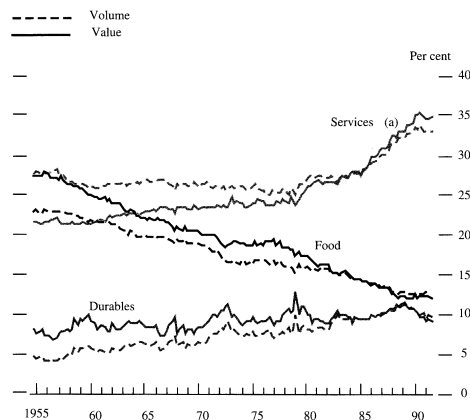

(a) Other than rents, rates and water charges.

The rise in food spending relative to M0 reflects both changes in cash-financed expenditure on non-food items and, within the food component itself, a trend towards larger value payments. The proliferation of supermarkets encourages larger purchases. As people have become wealthier, they have bought more expensive foods and the real value of a typical food payment has risen. There have also been financial innovation effects, unrelated to changes in the pattern of spending.

Within total consumer expenditure, the decline in the share of spending on food is evident since at least 1955 (see Chart 7). The categories whose shares have risen most quickly were initially (in the 1955–70 period) rents, rates and water charges and, since 1980, primarily other types of services. Durables, which include cars, have also been on a gradual upward trend throughout.

These changes in the pattern of personal spending, which have occurred throughout the last forty years, are likely to have reduced the proportion of total expenditure that is cash financed. In contrast, ATMs and interest-bearing current accounts have only been introduced in significant numbers since the late 1970s. While they may partly explain the increase in velocity growth observed since 1980 (velocity growth against the value of consumption averaged 2.5% per annum during 1955–79, rising to 4.5% during 1980–90), they cannot provide a plausible explanation of the earlier period simply because they were not then available. Consequently, an explanation of M0 velocity growth which takes account of both the availability of alternative means of

Chart 7
Volume and value of sectors in total consumption

(a) Other than rents, rates and water charges.

payment and the impact of changes in expenditure patterns appears consistent with the trend in M0 velocity since the mid-1950s.[1]

The velocity of M0 over the short run

Although M0 velocity has been on a steady upward trend over a long period, shorter-run movements have been subject to greater variability, implying that in some instances M0 could give damped contemporaneous signals of the value of expenditure. M0 and personal spending may not always move closely together over the very short run, such as on a monthly basis, because of the high volatility of these series (particularly the monthly retail sales data) and the difficulty in measuring accurately the underlying seasonal elements in the data. Nevertheless, over the short run there is some evidence of a cyclical element within velocity growth which may also be related to changes in expenditure patterns.

Real income growth per capita varies over the business cycle. The conjecture about the responsiveness of different types of expenditure to real income—described above in the context of the trend increase in M0 velocity—would suggest that the composition of total spending will vary cyclically. In particular, during downturns non-essential expenditures—typically larger value purchases—tend to be reduced the most, whereas necessary—and typically smaller value—purchases are maintained.

In the most recent and the previous recession, the share of food expenditure within the total value of consumers' expenditure remained constant in volume terms (in contrast to its general downward trend; see Chart 8) while, at least in the present recession, the shares of durables (including cars and household goods) and services have fallen.[2]

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(1) This is shown more formally in the appendix. However, it is difficult on statistical grounds to distinguish clearly this effect from other *additional* explanations, for example, the pattern of employment and measures of financial innovation.
(2) The changes in the value share were more pronounced than volume share, suggesting perhaps that price cutting is more prevalent during recessions for less essential goods.

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Chart 8
Volume growth in total consumer spending and the share of total spending on food
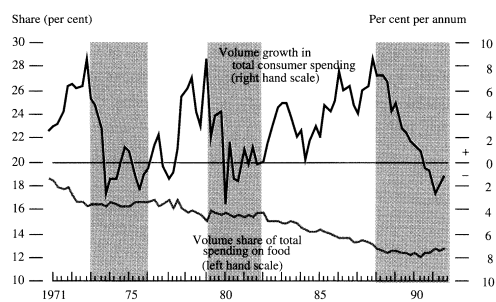
The general downward trend in the share of total expenditure accounted for by food tends to change in the early stages of downturns in the growth of personal spending, as highlighted by the shaded areas in Chart 8. This may reflect the impact of changes in consumer confidence which precipitate the reduction in the growth of expenditure on luxuries and durables, and therefore in consumer spending as a whole.

Since cash is held mostly for small value transactions, cash holdings will rise relative to total spending when a greater proportion of that spending takes place in the form of such transactions. Hence, in recessions, M0 velocity growth should be below trend, as essential small transaction purchases form a larger proportion of total expenditure. In part, this is borne out by the most recent data (see Table B).

Table B
Growth rates (Q4 on Q4) of consumer spending, M0 and velocity

Percentage

| | Consumer spending | | | | |
	Value	Volume	Price deflator	M0	Velocity
1988	12.5	6.7	5.4	7.7	4.4
1989	8.9	2.4	6.3	6.0	2.7
1990	4.9	-0.6	5.5	2.9	2.0
1991	6.4	-1.3	7.8	2.8	3.5 (a)
Mean for:					
1955–91	9.8	2.6	7.2	6.0	3.8
1980–91	9.2	3.0	6.2	4.6	4.6

(a) Distorted upwards by the increase of VAT in April.

In particular, annual velocity growth declined in 1989 as the volume growth of personal spending fell rapidly from its cyclical peak following the tightening in monetary policy. This coincided with a fall in the share of household durables in total consumer spending and a halt to the decline of the share of food expenditure. Thus, in the early stages, the slowdown in spending was probably concentrated mainly in expenditure on items for which cash is relatively little used.

From the end of 1989 until spring 1991, annual velocity growth (measured against consumer spending) was low by historical standards, although reasonably stable.[1] As the economy recovers and real incomes begin to grow more strongly, it is likely that spending on luxury, large value items (for example, cars and white goods) will recover more strongly than expenditure on essential items. Thus it is possible that M0 velocity growth will recover.[2]

However, the impact of cyclical changes in spending patterns on M0 velocity may be swamped, in some instances, by other factors. For example, at the beginning of the previous recession the tendency to cut back on large value purchases as real income fell appears to have been broadly offset by the impact of the doubling in VAT (in the 1979 Budget). Although cash-financed expenditure was maintained by the increase in the share of food in retail sales this may have been countered in part by the impact of higher VAT increasing the value of expenditures on large value items, such as many services. It may explain why the slowdown in velocity growth was more pronounced in the early stages of the most recent recession than in the previous one.

Nevertheless, taking the last twenty years as a whole, there is some evidence of a cyclical component in velocity growth. Twenty-two per cent of the quarterly movement in M0 velocity growth can be explained by the contemporaneous quarterly growth in the volume of consumer spending alone between the first quarter of 1970 and the second quarter of 1991. In contrast, the level of, or change in, present and up to six months' lags on interest rates—the opportunity cost of holding cash—have little explanatory power on their own, accounting for no more than 4% of the quarterly growth in velocity, over the same twenty-year period (see the appendix).

Thus there is some evidence that short-run fluctuations in M0 velocity are related to the economic cycle. A plausible explanation of this is the changing pattern of personal spending over the cycle. Some evidence supporting this hypothesis is presented in the appendix to this article.

Conclusion

The velocity of circulation of M0, measured against broad measures of personal spending, has exhibited a trend increase since at least 1955. Previous explanations related this trend to financial innovation by the banking system alone—notably the introduction of alternative means of payment, interest bearing liquid accounts and ATMs.

These explanations largely ignore the additional impact on M0 velocity of changes in the pattern of consumer spending and employment. This article has focused on the former since it has not been highlighted in previous work. Over the

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(1) The fact that velocity growth remained positive (although well below trend) despite expenditure shares reversing their long-run patterns may reflect the impact of financial innovation, generating continuing economies of cash holdings for a given expenditure pattern.
(2) The recovery in the twelve-month growth rate of velocity from spring 1991 onwards is probably related, in the main part, to a special factor—the changes in VAT introduced in the 1991 Budget. This increased the price (and thus the value) of the non-food components of retail sales and brought forward the purchase of larger items (durables and other household goods), which are less likely to be bought with cash.

post-war period, as per capita incomes have increased, a declining proportion of personal expenditure has been devoted to smaller value, essential items, such as food, and an increasing proportion to larger value purchases, such as cars, household goods, and many services. While all categories of expenditure are financed to some extent by cash, large value purchases are more likely to be paid for by other means, thus reducing the stock of M0 in relation to spending.

Over the economic cycle, as the growth in real income differs from its long-run trend so does the change in expenditure patterns. This may have affected short-run movements in the velocity of M0. In particular, it may partly explain why M0 growth has been higher during this recession, in relation to the growth in total personal expenditure, than its long-run trend. Thus observations on the composition of spending may be used to improve the information content of M0.

Appendix

Modern theories of the transactions demand for money originate with the work of Baumol (1952) and Tobin (1956), who adopted an inventory theoretic approach. They concentrated on the relationship between money and personal spending, rather than income—an approach followed here.[1] They also implicitly assumed that all transactions were conducted through the medium of cash—a simple form of the 'cash-in-advance' model (see Clower (1967)).

The approach described in the main text highlights the importance of the composition of spending. Not all purchases are financed with cash—models of M0 ought therefore to focus more closely on 'cash-financed' expenditure. This will depend on both real income (reflecting the changes in spending patterns between goods with different income elasticities) and time (modelling some forms of financial innovation). Applying a generalised version of the Baumol/Tobin inventory theoretic model to this transactions measure implies a demand for M0 equation of the form:

$$M0 = p\, \alpha(r,t)\, C(y,t)$$

where: r = interest rate
t = time
C = cash-financed expenditure
y = real income
p = price level

By differentiation, M0 growth is then given by:

$$\frac{\delta M0}{\delta t} = p\, C(y,t)\, \frac{\delta \alpha}{\delta r} \cdot \frac{\delta r}{\delta t} + \frac{\delta \alpha}{\delta t} \qquad (i)$$

$$+ \quad p\, \alpha(r,t)\, \frac{\delta C}{\delta t} \qquad\qquad (ii)$$

$$+ \quad p\, \alpha(r,t)\, \frac{\delta C}{\delta y} \cdot \frac{\delta y}{\delta t} \qquad (iii)$$

Thus, M0 growth—and, by implication, M0 velocity growth—can be decomposed into three factors:

(i) a process of 'genuine' velocity growth, as technological advances (notably ATMs) have allowed economies in cash holdings *for a given level of cash-financed expenditure.* This is modelled as being time dependent;[2]

(ii) a process of 'financial innovation' resulting in *all goods becoming less likely to be purchased with cash* as alternative means of payment become available; and

(iii) changes in the *composition of spending*, which in turn depend on real income growth. This is modelled as changes in the composition of cash-financed expenditure C as income increases through time.

Recent published work has concentrated on (i),[3] which has become the conventional approach. As suggested in the main text, this does not provide a complete explanation of the trend in M0 velocity over the post-war period as a whole. The main article advances the hypothesis that there may be important *additional* effects from the composition of personal spending on M0 velocity, although this does *not* exclude the possibility that other *additional* factors may also have been relevant. Thus the empirical work presented below tests the hypothesis for the relevance of expenditure patterns but does not attempt to find the best equation for forecasting purposes based on the statistical 'goodness-of-fit'.

The procedure used is the Johansen VAR maximum likelihood co-integration approach (Johansen (1988)). This is preferable to alternative approaches because it allows for more than one long-run relationship. Furthermore, compared to the Engle-Granger two-step procedure (Engle and Granger (1987)), the Johansen procedure has the advantage of conditioning estimation of the long-run relationship between the variables (presented here) on the short-run dynamic movements. The latter are likely to be important, possibly for the reasons expounded in the main text. Other estimation techniques which exclude the dynamics are likely to produce biased results.

Three equations for the long-run behaviour of M0 are reported below:

Johansen Maximum Likelihood Co-integration Procedure
Sample period : 1972 Q1—1991 Q4
Trend in variables and in Data Generating Process
The long-run is conditional on two lags in the dynamics.[4]

$$\ln \mathbf{M0} = \alpha + 1.06 \ln \mathbf{C\pounds} - 0.24\, \mathbf{CR} \qquad (1)$$
$$CT = 19.90\ (29.68)$$

$$\ln \mathbf{M0} = \alpha' + 0.72 \ln \mathbf{C\pounds} + 4.99\, \mathbf{RATIO} + 0.08\, \mathbf{CR} \quad (2)$$
$$CT = 52.67\ (47.21)$$

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(1) This does not allow for the role of cash as a means of paying wages and salaries. As discussed in the main text, this is likely to have been part of the explanation of M0 velocity movements over the post-war period.
(2) The interest rate effects on the demand for cash ($\partial\alpha/\partial r$) are likely to be small. Cash is held for transactions purposes, not as wealth. The Keynesian 'speculative' demand for money—which would give a powerful role to the level of interest rates—is based on money being capital certain in the face of interest rate changes, unlike bonds. This is not relevant since cash is dominated by interest bearing, yet capital certain, assets such as bank deposits. In this simple analytical approach, we therefore assume that cash is held solely for transactions purposes. Furthermore, the level of interest rates does not exhibit trend growth (at least over reasonably long data samples). As such, it cannot explain trend changes in other variables—most importantly, it cannot explain the trend increase in M0 velocity.
(3) Hall, Henry and Wilcox (1989), Brookes *et al* (1992) and Walton and Westway (1992).
(4) The results are reasonably robust to changes in the number of lags.

$$\ln \mathbf{M0} = \alpha'' + 0.67 \ln \mathbf{C\pounds} + 3.46 \, \mathbf{RATIO} \qquad (3)$$
$$CT = 38.67 \, (29.68)$$

where:
M0	=	the stock of nominal M0
C£	=	nominal consumer expenditure
CR	=	cumulative interest rate term
RATIO	=	food spending share of total expenditure
ln	=	natural logarithm
CT	=	co-integration likelihood ratio (LR) test based on trace of the stochastic matrix (number of co-integrating vectors > 0). (95% critical vale in parentheses)

Equation (1) follows the 'conventional' approach to the demand for M0, attributing the movement of long-run velocity to financial innovation as proxied by a cumulative interest rate term. The equation fails to co-integrate; that is, there is no long-run steady relationship between the variables included in the equation.

Equation (2) includes an additional term—the ratio of spending on food to the total value of consumer expenditure—which proxies, albeit imperfectly, the impact of spending patterns on the proportion of total expenditure which is cash rather than non-cash financed. This passes the standard co-integration test.[1] Although the cumulative interest rate term enters the equation with a wrongly signed coefficient, the coefficient is not statistically different from zero, and thus equation (3) drops this term.

Equation (3) co-integrates, suggesting that a statistical explanation of the demand for M0 can be found which includes the pattern of spending. These results do not imply that changes in the pattern of spending are the *only* reason for the upward trend in M0 velocity over the last twenty years. The coefficient on nominal spending is not constrained to unity; indeed, the data reject such a restriction. The less than unit coefficient on total spending encompasses implicitly, and in a statistical sense, the influences on M0 velocity, other than the pattern of spending (described in the main text). Using the long-run equation (3), this velocity growth can be decomposed into that resulting from changes in spending patterns and other factors. The equation suggests that changes in the composition of expenditure account for approximately one quarter of the trend increase in velocity since 1972. This may overstate, to some extent, the contribution of spending patterns because RATIO may be capturing other influences which have also been on a trend over the sample period.[2]

The lagged residual from equation (3) can be interpreted as an error correction term in a demand for money equation—it enters (a variety of) dynamic short-run equations for M0 growth with a negatively signed and statistically significant coefficient. The dynamic equation, using the residual from equation (3) as the long-run term, is tested down from a general form, including two lags of all the variables in the

long-run, in order to find a parsimonious equation. The reported equation includes a contemporaneous effect from changes in the pattern of spending. This is consistent with the conjecture that as real income varies through the economic cycle, cash-financed expenditure forms a varying proportion of total expenditure and M0 velocity varies pro-cyclically. There is a degree of subjectivity in the testing down procedure; this is one of many possible representations of the dynamics. However, it does suggest that there is some evidence supporting the hypothesis that spending patterns are both statistically and economically significant in the short-run as well as the long-run demand for M0.

Instrumental Variables estimation [3] (instruments: lagged Δ**RATIO**, Δln**C£**)
Sample 1973 Q2–1991 Q4

$$\Delta \ln \mathbf{M0} = \underset{(2.8)}{0.12} + \underset{(3.5)}{0.44 \, \Delta \ln \mathbf{M}} + \underset{(2.1)}{1.55 \, \Delta \mathbf{RATIO}}$$
$$- \underset{(2.6)}{0.07} \, (\ln \mathbf{M0}_{-1} - 0.67 \ln \mathbf{C\pounds}_{-1} - 3.46 \, \mathbf{RATIO}_{-1})$$

$R^2 = 0.46$	LM(4)	$X^2(4) = 1.9522**$
SE = 0.0084	RAMSEY	$X^2(1) = 3.7223**$
	NORMALITY	$X^2(2) = 5.9207**$
	HETEROSKEDASTICITY	$X^2(1) = 2.6155$

t-statistics in parentheses below parameter estimates
** statistically significant at 95% confidence level

As discussed in the main text, the evidence from simple OLS regressions that M0 velocity growth (Δln**VEL**) is pro-cyclical is quite strong—the quarterly growth of the volume of consumer spending (Δln**C£**) explains 22% of the quarterly movements in M0 velocity. When the exercise is repeated using instead changes in the pattern of spending (Δ**RATIO**) explicitly, this variable is statistically significant and correctly signed. It also explains more of the movement in velocity growth than either the level or change in contemporaneous and lagged interest rates.

Regression of Δln**VEL** on:

		coefficient	t-statistic	R-squared
(1)	Δln**C£**	0.459	4.684	0.223
(2)	Δ**RATIO**	-1.240	2.305	0.065
(3)	r	0.549	1.654	0.034
(4)	r	-0.288	0.335	
	r(-1)	1.251	0.952	
	r(-2)	-0.461	0.557	0.039
(5)	Δr	-0.415	0.553	0.004
(6)	Δr	-0.653	0.011	
	Δr(-1)	0.706	0.072	
	Δr(-2)	0.417	0.025	0.023

(1) There is a unique co-integrating vector for both equations (2) and (3).
(2) The statistical methods available cannot clearly distinguish the separate effect of variables which follow similar trends.
(3) In principle, this should prevent bias estimates of the coefficients arising from the possibility of contemporaneous feedback effects from M0 on the pattern of spending.

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