The personal saving ratio

A research paper, prepared in the Bank's Economic Section, largely by J. C. Townend.

The first section of this article traces the course of the personal saving ratio since 1973.[1] The exceptionally high rate of personal saving in this period can be only partly explained by the equations normally used to determine and predict consumers' expenditure. The second section examines and assesses some of the alternative explanations of this unusual behaviour. Evidence was found to support the view that the value of liquid assets held by the personal sector, when adjusted for the effects of inflation, has had a significant effect on the volume of spending throughout the period, and was responsible for a large part of the unforeseen rise in saving since 1973. Somewhat weaker evidence was also found to support the view that, during a period of rapid inflation, expectations of price changes might lag behind actual changes, and that consumer resistance might then result in less expenditure and higher saving. Other possible theories were tested, but did not appear to be helpful. These included the uncertainty of employment prospects and future standards of living, and reductions in the value of illiquid wealth associated with the general weakness of financial and property markets in 1974 and the early part of 1975.

Several of the explanations offered involve monetary phenomena, and have been developed further in order to re-examine the links between the real and financial sectors of the economy – an area around which much of the Bank's longer-term research is centred.

There are also two technical appendices. The first describes the equations relating to consumers' expenditure, which have hitherto figured in the macro-economic model used in the Bank;[2] the second discusses the formulation of the equations and the empirical results obtained.

The context

In most industrialised countries, the ratio of saving to personal disposable income has risen significantly since the mid-1950s or early 1960s. In the United Kingdom, this trend has not been particularly evident[3] but the saving ratio over the last three years has been much higher than in the past. From an average of 8.1% during the 1960s, the proportion of income saved has been consistently above 11% since the latter part of 1973,[4] reaching a peak of 14.1% at the beginning of 1975 (see Chart A). After falling by about one percentage point to 13.0% in the second quarter, the ratio rose again in the third despite a small decline in real disposable income. But in the fourth quarter, when real personal disposable income probably fell quite sharply while consumers' expenditure was little changed, the saving ratio is likely to have fallen again.

The above estimates relate to the personal sector as defined in the national income accounts, and so include saving by unincorporated businesses as well as by households. But after deducting depreciation and stock appreciation from both income and saving, and excluding from saving both net capital transfers and the physical increase in stocks, the resulting estimate of 'household' saving has been as far above trend in recent quarters as has the broader, more conventional, definition of the saving ratio.

[1] The personal saving ratio measures the proportion of total personal disposable income which is not spent by the consumer.

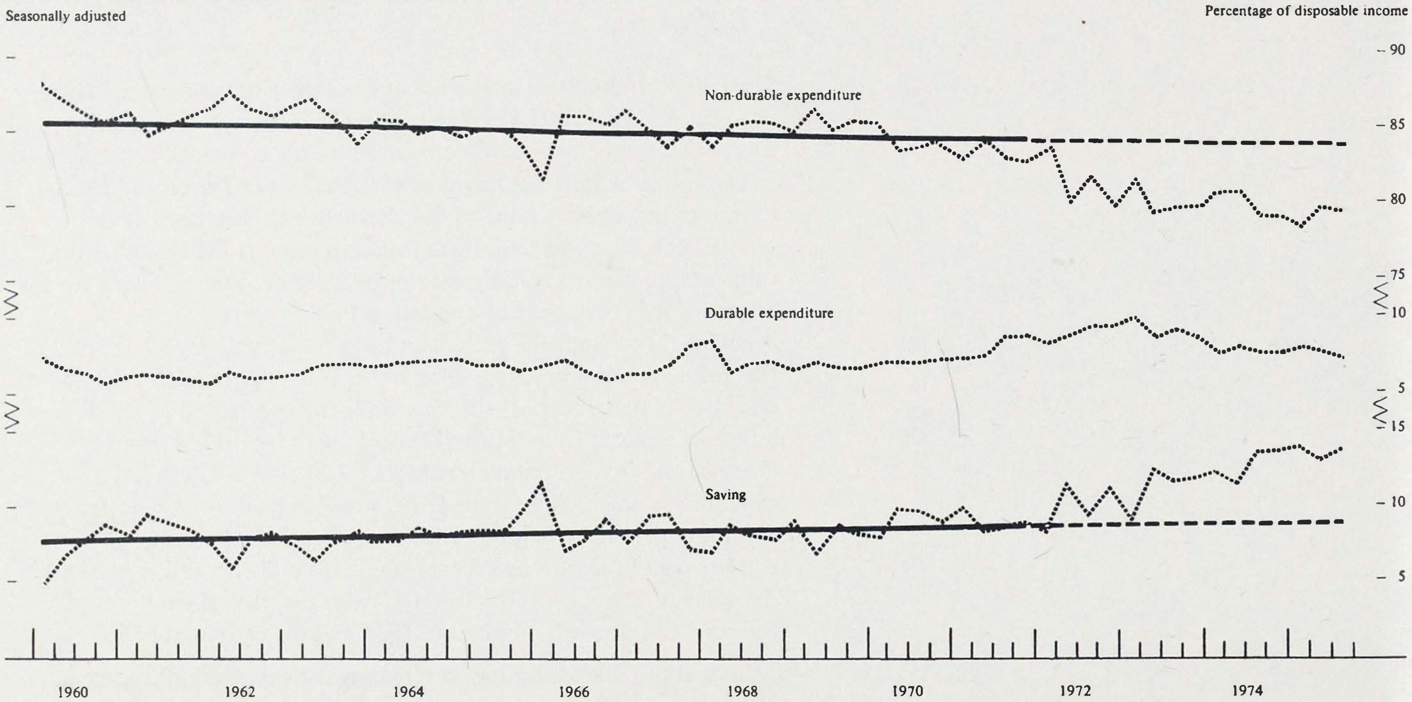
[2] The equations originally formed part of the London Business School model which, together with the associated computer programs, was provided to the Bank in 1972. Considerable revisions have since been made, using programs provided by Dr D. Hendry (London School of Economics).

[3] The coefficient on the trend of the saving ratio in Chart A had a t statistic of 1.8, and was therefore barely significant.

[4] The precise quarter when the saving ratio exceeded its upward trend depends partly on the period over which the trend is estimated and partly on distortions caused by the miners' strike in 1972.

Chart A

Trends in personal consumers' expenditure and saving[a]



[a] The trend lines were estimated from the first quarter of 1960 to the fourth quarter of 1971 in order to eliminate the more extreme observations. No discernible trend was apparent for durable spending.

Together with the proportion of disposable income saved, the chart also shows the proportions of income spent on non-durable goods (such as food, clothing and services) and on durables, including cars and electrical goods.[1] The slightly rising trend in saving is mirrored by a similar decline in that part of income spent on non-durables; and over the last three years, when the saving ratio has been unusually high, expenditure on non-durables has been well below trend. The proportion of income spent on durable goods shows a weak cyclical pattern and no significant trend, but it has declined fairly steadily since early 1973, when almost 10% of income was spent on goods of this type.

Explanations of such changes in consumers' expenditure lie at the centre of all Keynesian macro-economic models. Typically, empirical results show that consumption patterns change relatively slowly in response to movements in income, an observation which is consistent with a number of theories. One such theory by Friedman **[7]**, termed the permanent income hypothesis, suggests that people tend to adjust their consumption patterns only to those variations in current income which they expect to persist. Another names inertia or lack of awareness as mainly responsible for the long delays before spending adjusts to current income. A third stresses force of habit or persistence, with expenditure determined as much by the amount bought in the recent past as by current earnings. In most instances those three theories would predict similar saving behaviour, and equations derived from them produced satisfactory results during the 1960s and early 1970s. More recently, however, they have typically overpredicted spending and understated the rise in the saving ratio.

Table A shows the forecasting errors which would have resulted from typical equations to explain and predict expenditure on durables and non-durables from the end of 1973 onwards. (The equations underlying these results are identical in structure to those shown in Appendix 1, but were estimated only up to the fourth quarter of 1973.)

[1] In order to reduce the effect of relative price movements, the estimates of expenditure on durables and non-durables (at 1970 prices) were multiplied by the average consumer price deflator rather than by the component price deflators, but the use of the separate deflators would have made little difference to the series.

Table A

£ millions: *seasonally adjusted*; 1970 prices

		Expenditure on non-durables					Expenditure on durables		
		Actual[a]	Static prediction	Error	Dynamic prediction	Error	Actual	Static/ dynamic prediction	Error
1974 1st qtr		6,836	6,877	− 41	6,877	− 41	769	758	11
2nd „		6,778	6,873	− 95	6,872	− 94	794	773	21
3rd „		6,824	6,877	− 53	6,900	− 76	794	802	− 8
4th „		6,850	6,881	− 31	6,933	− 83	796	794	2
1975 1st qtr		6,922	6,932	− 10	6,994	− 72	822	808	14
2nd „		6,748	6,913	−165	6,967	−219	773	798	−25
3rd „	(provisional)	6,604	6,775	−171	6,939	−335	726	794	−68

[a] Excluding estimated spending out of current grants from public authorities, as explained in Appendix 1.

The figures in the second column for both non-durables and durables are predictions in a static sense, i.e. they assume perfect forecasts of all the variables which influence consumption in the equations, including the level of consumption in the previous period. The differences between these forecasts and the outturns are shown in the next column. For non-durables these forecasting errors are consistently negative, but those for durables have no regular pattern. Dynamic predictions, which allow forecasting errors in one period to affect subsequent forecasts by incorporating the error in the estimated value of lagged consumption in the equation, (but which still assume perfect knowledge on income and of the other variables in the equation[1]), are also shown for non-durables.[2] The forecasting errors are shown to accumulate and the equation would therefore have led to a significant overprediction of spending on non-durables throughout this period.[3]

Some alternative hypotheses

The simplest, but at the same time most barren, explanation is that the delays between changes in income and changes in consumption have been longer or more variable over the last two years than allowed for by the equations. One possible reason for this is that the rise in nominal incomes, particularly from mid-1974, was so rapid that consumers were unusually slow to adjust their spending. However, this hypothesis cannot be tested econometrically because of the relatively short period involved; and if it were accepted, there would be no way of measuring how far the saving ratio may have been underpredicted. A second explanation, advanced by Juster and Wachtel [9], is that when nominal incomes change rapidly, expectations of price changes – and hence of the standard of living in real terms – become more uncertain. A reasonable response to this uncertainty might be to increase the proportion of income held as a precautionary reserve. Although this is a plausible explanation of the high saving ratio, it is extremely difficult to test rigorously because uncertainty cannot easily be measured directly. Tests were made using two proxy variables, one relating to expected unemployment and the other to the expected rate of inflation (see Appendix 2), but neither provided any statistical support for the precautionary saving hypothesis.

Both of these inconclusive arguments assume that the relationship between income and consumption has been rather different from 1973 onwards than in earlier periods. However, other hypotheses seek to offer a better explanation of consumers' behaviour both before and after 1973. The first is that the amount of the personal sector's liquid assets has an important influence on saving patterns, either because of their absolute size (a 'wealth effect') or because of their relative size (a 'portfolio balance effect'). Individuals may regard their holdings of liquid assets as the most important part of their available resources when planning their expenditure. Alternatively or in addition,

[1] The effect of the error process is also different in the static and dynamic forecasts.

[2] Because the form of the equation is rather different, with no lagged dependent variable, a static/dynamic distinction is not relevant for durables.

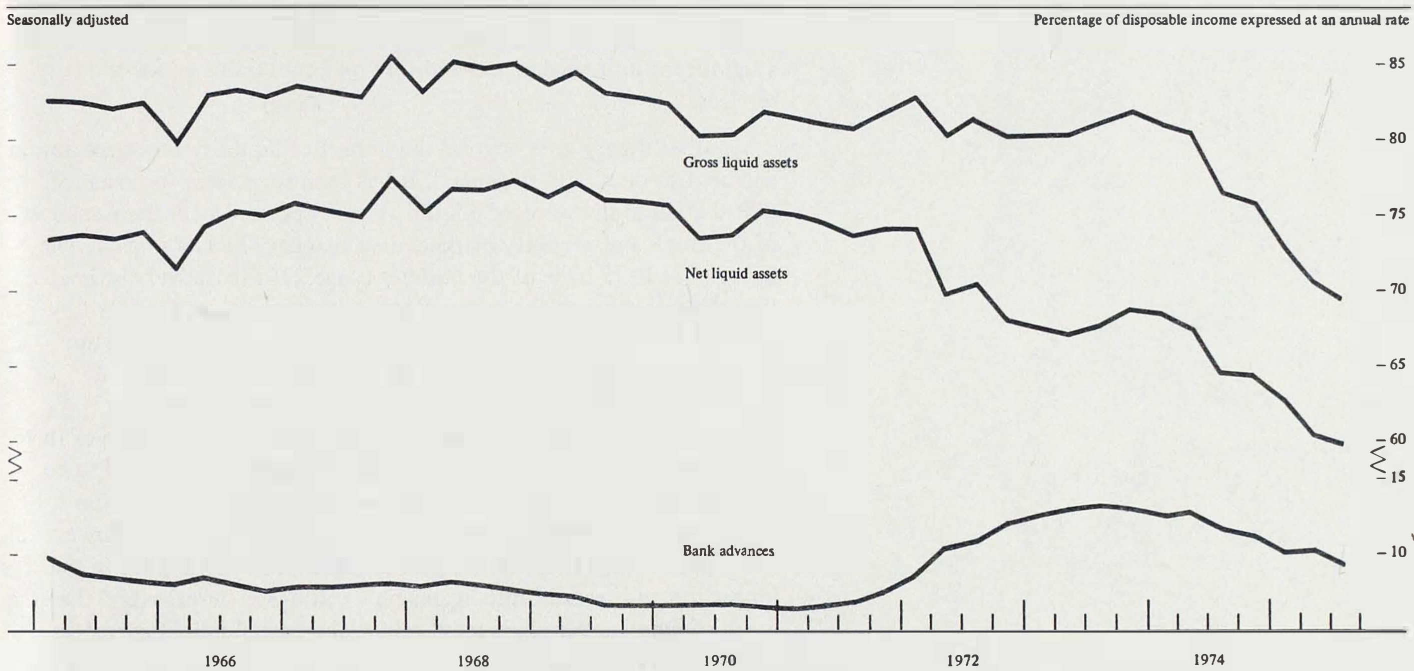
[3] A $\chi^2(6)$ test for post-sample parameter stability (excluding the provisional data for the third quarter of 1975) took the value 40.4 for the non-durable expenditure equation, suggesting instability (because, at the 5% level of significance, the critical value of $\chi^2(6)$ is 12.6). The $\chi^2(6)$ value for the durables equation was only 2.7.

consumers may have a preferred amount of liquid balances to satisfy both precautionary and transactions motives, and any reduction below this amount may cause expenditure to be restrained. For example, Forsyth **[10]** recently suggested that if holdings of liquid assets fall in relation to disposable income, an attempt is made to restore some of the shortfall by saving a higher proportion of current income. Demand for liquid assets to finance transactions is easily comprehended, particularly in the case of those non-durable goods and services where the pattern of expenditure tends to be uneven. For durable goods, an initial period is required in which to accumulate savings for down payments: to the extent that inflation meanwhile erodes the real value of such savings, prospective purchasers need to save correspondingly more. On the other hand, the precautionary motive depends on the degree of uncertainty about the future: any increase in uncertainty would probably lead to a higher proportion of wealth being held in liquid form and a tendency to borrow less either from banks or in the form of hire-purchase debt. If liquid assets exceed the amount necessary to satisfy these requirements, then consumption and the accumulation of illiquid assets will be unconstrained. If not, and if the immediate encashment of illiquid assets would involve losses, consumption would fall in relation to income. The impact of changes in the amount of liquid assets held might on these grounds be expected to be asymmetrical, depending on whether the constraint was, or was not, binding. But partly because of the problems associated with aggregating the behaviour of individuals, and partly because it is not possible to determine the desired volume of liquidity (and, therefore, deviations from it), a direct estimation of this approach is not easy. In practice, therefore, the theory that holdings of liquid assets are important in their own right, as an indication of the true resources available for an individual's consumption over a long period, cannot be distinguished from one in which insufficient liquidity causes the individual to restrain his consumption. Both theories may therefore be represented by introducing the stock of liquid assets into the normal consumption equations.

These hypotheses have led to a number of empirical studies in US literature, for example those by Suits **[13]**, Zellner, Huang and Chau, **[15]**, and Cheng **[4]**, although the models estimated are rather different in each case. In his summary of these and other studies, Ferber **[6]** concluded that the weight of evidence favoured the inclusion of a liquid assets variable in the consumption function. However, in one of the few studies for the United Kingdom which took account of liquid assets, Hilton and Crossfield **[8]** found that whereas changes in bank advances significantly affected expenditure on durable goods, they could find no significant role in either equation for the stock of liquid assets in spite of experimenting with a variety of different specifications. They were unable to offer any convincing explanation for the difference between the UK and US results.

Chart B shows the amount of bank advances outstanding to persons at the end of each quarter from 1965 (expressed as a percentage of disposable income in the subsequent quarter); the stock of gross liquid assets (similarly expressed); and the ratio of the stock of net liquid assets to income (i.e. the difference between the first two series). Although there appears to have been a slight downward trend in the ratio of gross liquidity to income from 1965 onwards, it was not very marked until the second quarter of 1974, when nominal income began to rise very rapidly. Bank advances also declined slightly in relation to income during the 1960s but then almost doubled between 1971 (when tax relief was allowed on interest on all bank borrowing) and 1973; thereafter they declined. So the net liquidity ratio was roughly constant until 1971 but then declined, initially because of the growth in bank borrowing, and more recently in response to the rapid rise in money incomes. Although comparison with the earlier chart

Chart B
The stock of personal sector liquid assets in relation to income



suggests a simple negative correlation between the saving ratio and the net liquidity ratio, no direct causation can be inferred without careful analysis of the data.

A number of equations which attempt to identify the relationship between expenditure and holdings of liquid assets are shown in Appendix 2, with the detailed results set out in section 1 b. The introduction of liquid assets into the non-durable equation increases the overall goodness of fit of the equation. Moreover, the coefficients on gross liquid assets and on bank advances are not significantly different, thus suggesting that consumers regard liquid assets and bank borrowing as substitutable. But the results permit no discrimination between the two competing theories of consumer behaviour described earlier, i.e. about whether spending takes time to adjust to current income, or whether expenditure is determined essentially by permanent income. Although liquid assets play a statistically significant role in the estimated equations, their influence on the consumption of non-durables has been relatively small: a fall of 1% in the real value of liquid assets held (equivalent to an average over the estimation period of about £270 million) leads to an immediate reduction in real spending of about £5 million per quarter, and perhaps three times as much in the long run.[1] However, the significant effect of holdings of liquid assets on consumption is shown to apply not merely to the latest observations but also from the beginning of the estimation period in the mid-1960s.

Table B shows predictions of the saving ratio which would have emerged from an equation including liquid assets estimated up to the end of 1973.[2] The forecasts are directly comparable with those shown in Table A and the improvement is immediately apparent:[3] in particular, the errors are no longer consistently negative.

The inclusion of a liquid assets variable in the equation to explain consumer durables gave much less encouraging results, partly because of the significant effect already identified in the equation for changes in bank advances (see Appendix 1). This effect tended to dominate any

Table B

£ millions: *seasonally adjusted*; 1970 prices

		Expenditure on non-durables			
	Actual	Static prediction	Error	Dynamic prediction	Error
1974 1st qtr	6,836	6,837	– 1	6,837	– 1
2nd ,,	6,778	6,827	– 49	6,816	– 38
3rd ,,	6,824	6,834	– 10	6,826	– 2
4th ,,	6,850	6,835	15	6,853	– 3
1975 1st qtr	6,922	6,884	38	6,886	36
2nd ,,	6,748	6,843	– 95	6,821	– 73
3rd ,, (provisional)	6,604	6,707	–103	6,752	–148

[1] Although this is true in a single equation context, feedback effects make the long-run impact very uncertain because, in time, the higher rate of saving should reverse the fall in holdings of liquid assets.

[2] The predictions were based on an equation with the same structure as equation (1) in Table 1 of Appendix 2.

[3] A $\chi^2(6)$ test for post-sample parameter stability (excluding the provisional data for the third quarter of 1975) took the value 3.7 for the four quarters in 1974, and 17.8 when the first half of 1975 was included, indicating a substantial improvement over the equation excluding liquid assets.

other liquidity variable, and no equation which excluded bank advances produced comparable results. So it can only be concluded that changes in bank advances are the predominant financial influence on expenditure on durable goods, even though the stock of liquidity exerts a significant influence on expenditure on non-durable goods and services.

Another theory goes beyond the impact of liquidity on consumption and centres on wealth in general. It has been suggested, for instance, that the fall in the value of illiquid assets associated with the weakness of the stock and property markets may also have had an impact. The September 1975 issue of the *Bulletin* (page 216) tentatively estimated that the real value of the personal sector's net assets was reduced by roughly £40 billion, or 20%, in 1974 as a result of general inflation combined with the decline in the relative price of houses and of securities. An attempt was therefore made to discover whether consumers were adding to their current savings to restore some of this loss of real wealth.[1] None of the additional variables proved to be statistically significant, perhaps because the available information is inadequate. (The detailed results are shown in Appendix 2.) However, if consumers expect short-term losses on equities to be reversed in the longer run and regard capital gains on dwellings as unrealisable, then the stock of liquid assets alone may well be the crucial monetary factor affecting consumption.

The above hypotheses were tested in a form in which consumers' *real* expenditure was determined by disposable income and other factors in *real* terms. In other words, prices were assumed to be important for spending decisions only through their indirect impact, for example, on real wealth or by increasing uncertainty. In contrast, Deaton [5] does not make this assumption: his argument is that the increase in the proportion of income saved is related directly to inflation. Deaton disputes the classical assumption that real expenditure is independent of prices. In traditional economic theory, the concept of 'money illusion' meant that individuals were more conscious of changes in nominal income than of changes in prices, and that identical changes in incomes and prices might therefore lead to rather higher consumption and lower savings than would otherwise occur. Deaton, however, argues that the reverse is more likely to be true. Because a consumer purchases goods sequentially, he will have accurate information only on the prices of those goods actually bought, and thus be unable to distinguish between relative and absolute changes in prices. So if prices are thought to have risen by 2% over a given period, but have actually risen by 5%, the individual may consider, wrongly, that the prices of those items which he intends to purchase are relatively expensive, and will therefore buy less than he first intended. With different consumers buying different commodities at any given moment, similar mistakes can be expected over the whole range of consumer goods. As the errors are discovered, attempts will be made to rectify them; but while inflation continues to accelerate and expectations do not immediately and fully adjust, the saving ratio will remain abnormally high. Expectations of inflation are thus crucial to this hypothesis, but the difficulty of measuring them makes robust econometric results extremely hard to obtain.

To try to overcome these difficulties, two rather different approaches were adopted in the estimation of this theory (and are fully reported in Appendix 2, section 2). The first was to take a direct estimate of inflationary expectations as constructed by Carlson and Parkin [3] from Gallup poll data for expected changes in retail prices. However, the calculated expectations of inflation in the more recent periods were thought to be unrealistic, presumably because the method of deriving quantitative estimates from such surveys is harder to apply

[1] In the absence of any comprehensive official data, an aggregate wealth series was constructed, using data based on Revell and Roe's work [12].

when a large percentage of respondents expect changes in the same direction. So an alternative series of wholesale price expectations was also taken, drawing on CBI surveys of business opinion. In fact, the results derived from using either of the expectations series were surprisingly similar, and in both cases the deviation of prices from their expected path was significant with the *a priori,* negative, sign, suggesting that when prices are higher than expected, expenditure will be less than otherwise predicted. In view of the inevitable uncertainty of these data, the model was also estimated on the assumption that expectations about future prices were determined by the behaviour of prices in the recent past. The evidence from this test is necessarily less conclusive, partly because of collinearity problems and partly because the coefficients on current and past prices capture both the determination of expectations and the extent to which money illusion exists. But the results do offer tentative evidence that the immediate impact of inflation may be to reduce consumption below its normal relationship with income. Although no further improvement in predictive ability was achieved by the inclusion of the additional price variables in either approach, the influence of liquid assets was consistently significant in these equations.

Conclusions

A number of rather different theories have been examined empirically to test whether any acceptable explanation can be found for the recent high saving ratio. The hypotheses tested ranged from the desire of consumers to restore some part of any reduction in the value of liquid assets relative to their incomes, to increased uncertainty about prospective real incomes, and to the effects of inflation itself. Because of the difficulties in determining expectations, it is not, perhaps, surprising that the necessarily crude attempts to capture the effect of uncertainty were all unsuccessful. Unless a better measure can be found, the precautionary saving hypothesis must, therefore, remain unproven. Evidence was, however, found to support the view that, among the various forms of wealth, liquid assets had an important influence on expenditure. But it is difficult to say whether this is because, as part of wealth, liquid assets are available to be taken directly into account in consumption plans or whether it is because a reduction in liquid assets below a desired amount tends to reduce expenditure in the short-run in relation to income. The inclusion of the stock of liquid assets led to a substantial improvement in the statistical properties of the equation, both in terms of overall goodness of fit and of predictive performance. Finally, although the problems associated with the measurement of expectations prevented conclusive quantification of the money illusion hypothesis, some evidence was found that, in the short run, consumers act so as to reduce their real expenditure when prices rise faster than expected.

For short-term forecasting, the results suggest that as the rate of inflation moderates, the saving ratio should decline – and the fall might be accelerated if liquid assets were restored to a more normal relationship with income. However, it requires a reliable forecast of disposable income, inflation, and holdings of liquid assets by the personal sector for the results of the single equations discussed in the article to provide a more precise indication of the extent of any such decline.

Appendix 1

This appendix describes the form of the consumption functions previously in use in the Bank, and shows the empirical estimates.

Consumers' expenditure is disaggregated into spending on non-durables and durables, and both functions are expressed in real terms (i.e. at 1970 prices). The main influence in the equations is real personal disposable income and this is subdivided into income from current grants and other income, including both wages and salaries and income from rent, interest and dividends.[1] The reason for this disaggregation is that it seemed reasonable to expect income from current grants from public authorities (i.e. national insurance benefits, family allowances, assistance grants, war pensions and service grants, etc.) to be consumed more rapidly than income from other sources. The coefficients on current grants were therefore imposed before estimation, subject to the constraint that the long-run propensity was unity, i.e. that all income from current grants was spent on non-durables in the long run. Although this constraint may seem excessively restrictive, other constraints both on the timing and overall impact of grants were tried, and the results, in terms of the aggregate propensity to spend out of all income, were not significantly different.

The equations are shown in the table. (Throughout the tables, figures in brackets are standard errors.)

Expenditure on non-durables

$$CND_t = \underset{(123.1)}{580.7} + \underset{(0.03)}{0.15345}(INC - CG)_t + 0.6^*CG_t + 0.3^*CG_{t-1} + 0.1^*CG_{t-2}$$
$$+ \underset{(0.06)}{0.72031}(CND_{t-1} - 0.6^*CG_{t-1} - 0.3^*CG_{t-2} - 0.1^*CG_{t-3})$$
$$+ \sum_{i=0}^{2} a_i \, DVA_i + U_t$$

$$U_t = -\underset{(0.15)}{0.32637}U_{t-1} + \epsilon_t$$

$$se = 37.3 \quad \bar{R}^2 = 0.991$$

Expenditure on durables

$$CD_t = -\underset{(51.3)}{41.1} + \underset{(0.01)}{0.09703}(1-\beta^*)\sum_{i=0}^{\infty} \beta^{*i}(INC - CG)_{t-i} - \underset{(0.86)}{2.74}\, HP_t$$
$$- \underset{(5.39)}{16.71}(1-\gamma^*)\sum_{i=0}^{\infty}\gamma^{*i}HP_{t-i} + \underset{(0.04)}{0.08048}\, \Delta BA_t + \underset{(0.04)}{0.11446}\, \Delta BA_{t-1}$$
$$+ \sum_{i=0}^{1} \delta_i \, DVB_i + U_t$$

$$se = 24.5 \quad DW = 2.00$$

*imposed coefficients.

where

CND	is real expenditure on non-durable goods.
INC	is real personal disposable income.
CG	is real current grants from public authorities.
DVA_i	are 0, 1 dummy variables to allow for distortions to the pattern of spending before and after the 1968 Budget, and in the first quarter of 1973 before the introduction of VAT.
CD	is real expenditure on durable goods.
HP	is a variable to reflect changes in hire-purchase regulations.
β	is 0.3.
γ	is 0.2.
ΔBA	is real changes in bank advances to the personal sector.
DVB_i	are 1, −½, −½ dummy in the first, second and third quarters of 1968 and 0 elsewhere to allow for pre- and post-Budget distortions, and a 0, 1 dummy for the miners' strike in the first quarter of 1972.

The equation for non-durable goods was estimated from quarterly observations from the third quarter of 1963 to the first quarter of 1975 using an autoregressive least squares program.[2] The equation for durable goods was estimated over a shorter period (the third quarter of 1963 to the end of 1973), using an instrumental variable estimation program[2] to allow for the simultaneous

[1] An attempt was made to split earned and unearned income, because the marginal propensity to consume out of unearned income might be expected to be lower than that for earned income. But multi-collinearity between the variables prevented any meaningful results from being obtained.

[2] The two estimation programs used throughout were written by Dr D. Hendry (London School of Economics). They provide consistent and efficient maximum likelihood estimates of the parameters, including those on the lagged dependent variable and the error structure.

determination of spending on durables and changes in bank advances. (In fact, the estimates were little different from those which took no account of simultaneity, probably because the authorities had imposed ceilings on credit for much of the estimation period, and advances may have been determined largely independently of consumption.) The short and long-run marginal propensities to consume all income for the combined equations were about 0.3 and 0.8 at the mean of the estimation period.

Appendix 2

This appendix presents the mathematical formulation of the equations designed to test the theories referred to in the main text, together with some of the empirical estimates. Two separate formulations were used. The first was an extended version of the linear expenditure equations referred to in Appendix 1. Liquid assets (net and gross of bank advances) were entered as additional variables, together with other more complete wealth terms and other variables to capture the influence of capital gains and losses on wealth. This model was also used to test the precautionary saving hypothesis. Secondly, a rather different, log-linear, formulation was estimated to test whether any direct link could be found between the rise in the saving ratio and inflation.

1 a The linear model

In the traditional consumption functions of economic theory, of which the non-durable equation in Appendix 1 is typical, expenditure is related, among other terms, to the level of real disposable income in the current period and spending in the previous period. Many different hypotheses can underlie this kind of reduced form equation, and it is difficult in practice to decide whether the lagged dependent variable represents habit or persistence in spending decisions (as suggested first by Brown[2]), a partial response to current income, or the adjustment of current to permanent income[1] (see, for example,[14]). These alternative hypotheses do, however, have implications for the way in which additional variables enter the equations. If, for example, the equilibrium level of expenditure depends on current income but only partial adjustment to this level occurs in any period, then the introduction of the real stock of liquid assets will lead to an equation of the form:[2],[3]

$$CONS^*_t = a_0 + a_1 INC_t + a_2 LIQ_{t-\frac{1}{2}} + \mu_t$$

$$CONS_t - CONS_{t-1} = (1-b)(CONS^*_t - CONS_{t-1})$$

$$CONS_t = a_0(1-b) + a_1(1-b)INC_t + a_2(1-b)LIQ_{t-\frac{1}{2}} + bCONS_{t-1} + (1-b)\mu_t. \qquad (1)$$

This equation is referred to as model (1). Alternatively, if consumption depends on permanent or smoothed income, liquid assets appear rather differently in the estimating equation:

$$CONS_t = a_0 + a_1 INC^*_t + a_2 LIQ_{t-\frac{1}{2}} + \mu_t$$

$$INC^*_t = (1-b)\sum_{i=0}^{\infty} b^i INC_{t-i}$$

$$CONS_t = a_0(1-b) + a_1(1-b)INC_t + a_2 LIQ_{t-\frac{1}{2}} - a_2 bLIQ_{t-1\frac{1}{2}} + bCONS_{t-1} + \mu_t - b\mu_{t-1}. \qquad (2)$$

This equation is called model (2). It differs from model (1) in that it includes current and lagged terms in liquid assets, and the error term is serially correlated.[4] Also, whereas model (1) can be estimated by using an ordinary least squares (or autoregressive least squares) regression program, model (2) requires a non-linear estimation program because of the constraint that the estimated parameter on the lagged liquid assets variable be equal, and opposite in sign, to the product of the coefficients on the current value of liquid assets and the lagged dependent variable.

It is also hard to separate the different hypotheses relating to the stock of liquid assets. The theory that capital losses on liquid assets arising from inflation are considered part of a wider concept of income than that defined in the national income accounts can, of course, be distinguished from those theories in which the stock of liquid assets plays a significant role, but it does not prove possible to

[1] The difficulty of interpreting the lagged dependent variable relates more to expenditure on non-durables than on durables because spending on durables is unlikely to be much influenced by the amount spent on such goods in the previous period (except negatively). This is reflected in the equations shown in Appendix 1, where the income term in the durables equation is specifically formulated to approximate permanent income.

[2] If consumption depends on expenditure in the previous period because of inertia in consumption plans, an equation similar to (1) results.

[3] The stock of liquid assets relates to the end of the previous period.

[4] The implied serial correlation of the error structure in model (2), and its absence in model (1), is one possible way of discriminating between the two models. But one difficulty is that the serial correlation in model (2) is first order moving average while in the estimation this was approximated by a first order autoregressive process. Also, if the structural equation is misspecified, for example by the omission of important variables, μ_t itself might be autocorrelated. In fact, the CND results shown in Appendix 1 are ambiguous: although the first order autoregressive error parameter is negative, it is only just significantly different from 0 and is less than half as large as the lagged dependent variable coefficient. However, after the inclusion of liquid assets, the results reported below do offer some evidence in favour of the permanent income model.

discriminate between different stock theories.[1] If, for example, the structure underlying model (1) is estimated but expenditure plans are in fact influenced by permanent, and not current income as supposed, then to the extent that the value of liquid assets is related to permanent income, this influence will be captured indirectly by the liquidity variable. Even in model (2), in which allowance is made for permanent income by a geometric distribution of current and past levels of income, the significance of a liquid assets term may result from the imperfect nature of the income variable as a reflection of the true resources available to the consumer over his lifetime. Liquid assets may, however, enter into the model in exactly the same way if individuals are thought to have a preferred amount of liquid assets in relation to income and other factors – when holdings fall below the desired amount, consumers' expenditure will be restrained below its normal relationship with income until the preferred amount of liquid assets is restored. Although this might suggest an asymmetrical response to liquidity, the constraint will not be identical for all individuals but will be binding at any time on at least part of the personal sector. Aggregation across individual functions leads to a macro-consumption function in which the constraint holds at all times, to a greater or lesser extent.[2] Alternatively, if liquid assets are thought to vary more generally in response to changes in transitory incomes, and if expenditures adjust to both positive and negative imbalances in liquid assets, then, following Zellner, Huang and Chau [**15**], a structural model may be estimated in which deviations of liquid assets from the desired amount influence equilibrium consumption. This produces a reduced form similar to model (2).

$$CONS_t = a_0 + a_1\, INC^*_t + a_2\,(LIQ_{t-\frac{1}{2}} - LIQ^*_t) + \mu_t$$

$$INC^*_t = (1-b)\sum_{i=0}^{\infty} b^i INC_{t-i}$$

$$\text{(a)} \quad LIQ^*_t = cINC^*_t$$

$$\text{(b)} \quad LIQ^*_t = dINC^*_t + e(RS - \dot{P}^e) + f(RL - \dot{P}^e)$$

$$CONS_t = a_0(1-b) + (a_1 - a_2\, c)(1-b)INC_t + a_2\, LIQ_{t-\frac{1}{2}} - a_2 b LIQ_{t-1\frac{1}{2}} + bCONS_{t-1} + \mu_t - b\mu_{t-1} \qquad \text{(3 a)}$$

$$CONS_t = a_0(1-b) + (a_1 - a_2 d)(1-b)INC_t + a_2\, LIQ_{t-\frac{1}{2}} - a_2 b LIQ_{t-1\frac{1}{2}} + e(RS-\dot{P}^e)_t - eb(RS-\dot{P}^e)_{t-1} + f(RL-\dot{P}^e)_t - fb(RL-\dot{P}^e)_{t-1} + bCONS_{t-1} + \mu_t - b\mu_{t-1} \qquad \text{(3 b)}$$

If, in the absence of any *a priori* information, the desired amount of liquidity is assumed to be proportional to permanent income [i.e. equation (a)], it is then not possible to identify the structural coefficients a_1 and c from the estimated parameter on income in equation (3 a) [nor a_1 and d in equation (3 b)]. There is therefore no material difference between equation (3 a) and model (2), and the empirical estimates provide no information which would help to distinguish between the different theories underlying them. However, if the interest-rate parameters were significant in equation (3 b), this would offer some evidence in favour of the more complicated formulation, although other structures may, of course, be consistent with this reduced form equation (e.g. interest rates may influence consumption directly rather than indirectly through liquid assets). In fact, the results from equation (3 b) were disappointing because neither interest-rate term approached significance in the constrained or unconstrained form, and the results are not reported in the next section.[3]

[1] Formally, if capital losses (produced by inflation) on the stock of liquid assets are defined as:

$$\pi LIQ_t = \frac{LIQ_{t-\frac{1}{2}}}{PCND_t}\left(\frac{PCND_t - PCND_{t-1}}{PCND_{t-1}}\right) = LIQ_{t-\frac{1}{2}}\left(\frac{1}{PCND_{t-1}} - \frac{1}{PCND_t}\right)$$

then if individuals treat these losses as an exact offset to income as conventionally defined, the equation might be:

$$CONS_t = a_0 + a_1(INC - \phi\pi LIQ)_t + a_2\, LIQ_{t-\frac{1}{2}} \qquad \text{with } \phi = 1.$$

Even with $\phi \neq 1$, the parameters can still be identified.

[2] Theoretically, a non-linear relationship results from this hypothesis but it is perhaps plausible to assume linearity within the relevant region.

[3] The short-term rate of interest, RS, was taken to be the three-month local authority rate, and the long-term rate, RL, to be the yield on 2½% Consols. Price expectations, $\dot{P}^e$, were assumed to be determined by lagged prices.

1 b Liquid asset results

Table A shows the results of introducing the stock of liquid assets at the beginning of the quarter into the non-durable expenditure equation.[1]

Table A

$$CNDT_t = \underset{(105.5)}{687.5} + \underset{(0.02)}{0.18878}(INC-CG)_t + \underset{(0.05)}{0.58051}\, CNDT_{t-1} + \underset{(0.004)}{0.01979}\, NLA_{t-½} + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \quad (1)$$

$$U_t = \underset{(0.14)}{-0.63893}\, U_{t-1} + \epsilon_t$$

$$se = 25.9 \qquad \bar{R}^2 = 0.995$$

$$CNDT_t = \underset{(117.9)}{632.5} + \underset{(0.02)}{0.18977}(INC-CG)_t + \underset{(0.06)}{0.60883}\, CNDT_{t-1} + \underset{(0.006)}{0.01561}\, GLA_{t-½} \underset{(0.006)}{-0.02345}\, BA_{t-½} + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \quad (2)$$

$$U_t = \underset{(0.14)}{-0.65718}\, U_{t-1} + \epsilon_t$$

$$se = 26.0 \qquad \bar{R}^2 = 0.995$$

where

CNDT	is $(CND_t - 0.6^*CG_t - 0.3^*CG_{t-1} - 0.1^*CG_{t-2})$.
NLA	is the real stock of net liquid assets held by the personal sector.[2]
GLA	is the real stock of gross liquid assets held by the personal sector.
BA	is the real stock of bank advances held by the personal sector.

In equation (1), the stock of net liquidity is significant with the *a priori*, positive, sign, and the overall goodness of fit of the equation is superior to the non-durable equation shown in Appendix 1. Although liquid assets are significant, the variable makes only a small contribution towards explaining movements in consumption – not surprisingly in view of the dominant relationship between consumption and income already identified. At the mean of the estimation period in this single-equation context,[3] a decline of 1% in holdings of real liquid assets (equivalent to about £270 million) would, *ceteris paribus*, have reduced real spending on non-durables by little more than £5 million immediately, and by less than £15 million in the long run. The real value of liquid assets fell by some 9% between the end of 1973 and the first half of 1975 and consumption of non-durables may have been reduced on this account by some £35 million per quarter by the end of this period, although the potentially offsetting influences of lags and feedbacks make this figure particularly uncertain.

Holdings of gross liquid assets and bank advances are each subject to different influences, so these are shown separately in equation (2). Although the parameter on bank advances is seen to be rather larger than that on gross liquid assets, it is not significantly greater,[4] and the larger size of the asset variable implies that its contribution to changes in expenditure has been rather greater. Between the end of 1973 and mid-1975, gross real assets fell by some £3,600 million (11%) and bank advances by some £1,300 million (25%), and the equation would have 'explained' a rather smaller net fall in expenditure than equation (1) (about £25 million as an impact effect by mid-1975, as against £35 million).

It is important to assess how much the significance of these results depends on the most recent data. If the liquid assets variable was only significant after, say, 1973, rather less confidence could be placed in the parameter estimates than if a stable

[1] As a more direct test of the hypothesis advanced by Forsyth, that the liquidity: income ratio influences the saving: income or consumption: income ratio, an equation was estimated in the same form as equation (1) but replacing real net liquid assets by the ratio of net liquidity to disposable income. The coefficients were as follows:

$$CNDT_t = \underset{(196.3)}{-176.7} + \underset{(0.05)}{0.67411}\, CNDT_{t-1} + \underset{(0.03)}{0.21008}(INC-CG)_t + \underset{(47.2)}{207.6}\, \frac{NLA_{t-½}}{INC_t} + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t$$

$$U_t = -0.68774\, U_{t-1} + \epsilon_t$$

$$se = 28.5 \qquad \bar{R}^2 = 0.994$$

The results in terms of goodness of fit are rather worse than equation (1), and because it is difficult to derive this form of equation from standard utility theory, it was not pursued further.

[2] The data on liquid assets were taken from *Financial Statistics*, Table 88. Gross liquid assets include deposits with the banking sector, building societies and finance houses; national savings; tax reserve certificates; and local authority temporary debt.

[3] In a full model in which holdings of liquid assets are also explained, the impact may be expected to be less than this in the long run because of feedback effects.

[4] As shown by an F test on the increase in the residual sum of squares between equations (1) and (2) (F = 0.98).

equation could be shown to exist over the whole sample period from 1965. As a partial test, the equation was re-run without the post-1973 data: the parameter estimates were almost identical and certainly not significantly different. As a more severe test, the equation was re-run and divided into two equal periods. A Chow test was made and an F statistic of 1.92 was obtained, suggesting no evidence of instability. However, because of the dominance of the income term and the relatively insignificant contribution of the liquidity variable, it was thought that this did not necessarily imply stability of the liquid assets parameter. As an additional test, the equation was re-estimated with the liquid asset variable entered twice into the equation, first using the entire sample period and secondly multiplied by a 0, 1 dummy variable dividing the sample into two. The result for equation (1) is shown below:

$$\underset{}{CNDT_t} = \underset{(139.7)}{721.7} + \underset{(0.03)}{0.19824}(INC-CG)_t + \underset{(0.06)}{0.54070}\,CNDT_{t-1} + \underset{(0.005)}{0.02528}\,NLA_{t-\frac{1}{2}}$$

$$-\underset{(0.001)}{0.00001}\,NLA_{t-\frac{1}{2}}\,DVC + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2}\beta_i Q_i + U_t$$

$$U_t = \underset{(0.16)}{-0.6555}\,U_{t-1} + \epsilon_t$$

$$se = 29.6 \qquad \bar{R}^2 = 0.993$$

where

DVC is 0 from the first quarter of 1965 to the second quarter of 1970 and 1 from the third quarter of 1970 to the second quarter of 1975.

The t statistic on the second liquid asset variable is very low (0.02) and no evidence of instability is shown. The same result was true of equation (2). Liquid assets thus appear to have had a significant and stable influence on expenditure on non-durable goods over the whole sample period from 1965.

The addition to equation (1) of the variable to capture the specific influence of losses on liquid assets caused by inflation did not improve the goodness of fit. The parameter estimates suggested that such losses were regarded as only a minor offset to income as conventionally defined, and the effect of the stock of liquid assets remained overwhelming.

The results reported so far have been for model (1) in which only the current value of liquid assets has an influence. Table B shows the estimates for model (2) both with and without imposing the constraint that the coefficient on lagged liquid assets be equal, and opposite in sign, to the product of the parameters on current liquid assets and the lagged dependent variable.[1]

Table B

Unconstrained

$$CNDT_t = \underset{(144.1)}{611.2} + \underset{(0.03)}{0.17927}(INC-CG)_t + \underset{(0.06)}{0.59541}\,CNDT_{t-1} + \underset{(0.02)}{0.04877}\,NLA_{t-\frac{1}{2}}$$

$$-\underset{(0.02)}{0.02707}\,NLA_{t-1\frac{1}{2}} + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2}\beta_i Q_i + U_t \qquad (1)$$

$$U_t = \underset{(0.16)}{-0.68628}\,U_{t-1} + \epsilon_t$$

$$se = 29.5 \qquad \bar{R}^2 = 0.993$$

Constrained

$$CNDT_t = 995.7 + \underset{(0.03)}{0.18019}(INC-CG)_t + \underset{(0.06)}{0.5957}\,CNDT_{t-1} + \underset{(0.01)}{0.05437}\,NLA_{t-\frac{1}{2}}$$

$$-0.05437(0.5957)NLA_{t-1\frac{1}{2}} + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2}\beta_i Q_i + U_t \qquad (2)$$

$$U_t = \underset{(0.2)}{-0.68337}\,U_{t-1} + \epsilon_t$$

$$se = 28.8 \qquad \bar{R}^2 = 0.993$$

Unconstrained

$$CNDT_t = \underset{(173.8)}{677.6} + \underset{(0.03)}{0.20026}(INC-CG)_t + \underset{(0.09)}{0.53181}\,CNDT_{t-1} + \underset{(0.02)}{0.05731}\,GLA_{t-\frac{1}{2}}$$

$$-\underset{(0.02)}{0.02942}\,GLA_{t-1\frac{1}{2}} - \underset{(0.04)}{0.08613}\,BA_{t-\frac{1}{2}} + \underset{(0.04)}{0.06227}\,BA_{t-1\frac{1}{2}} + \sum_{i=0}^{2} a_i DV_i$$

$$+\sum_{i=0}^{2}\beta_i Q_i + U_t \qquad (3)$$

$$U_t = \underset{(0.17)}{-0.69413}\,U_{t-1} + \epsilon_t$$

$$se = 29.9 \qquad \bar{R}^2 = 0.993$$

[1] In model (2) the parameter on the moving average error process, b, should be equal, and opposite in sign, to the coefficient on the lagged dependent variable. However, because the error structure was approximated by an autoregressive process the constraint could not be imposed.

Constrained

$$CNDT_t = \underset{(0.03)}{965.5+0.18123}(INC-CG)_t + \underset{(0.06)}{0.59992}\,CNDT_{t-1} + \underset{(0.01)}{0.0543}\,GLA_{t-½}$$
$$-0.0543(0.59992)GLA_{t-1½} - \underset{(0.02)}{0.06011}\,BA_{t-½}$$
$$+0.06011(0.59992)BA_{t-1½} + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \qquad (4)$$

$$U_t = -\underset{(0.16)}{0.69312}\,U_{t-1} + \epsilon_t$$

$$se = 29.3 \qquad \bar{R}^2 = 0.993$$

In both the equation using net liquid assets and the one which separates gross assets and bank advances, the non-linear constraint imposed by the model is satisfied by the data. (F tests on the increase in the residual sum of squares caused by the constraint relative to the unconstrained residual sum of squares took the values 0.8 and 0.9 for the net and gross models respectively.) Also, the coefficients on gross liquid assets and bank advances are not significantly different from each other in equation (4).

These results confirm the small but significant role for the stock of liquid assets in the equation explaining expenditure on non-durables. They suggest that net liquidity is the appropriate variable, but although the data satisfy the non-linear constraint imposed, the addition of lagged liquid assets does not significantly improve the fit of the equation, and model (2) could not be regarded as preferable to model (1).

The results of adding liquid asset variables into the equation for consumer durables were less encouraging – not surprisingly in view of the relatively well determined equation previously estimated (shown in Appendix 1) – and they are not reported here in detail. No equation in which net or gross liquidity was substituted for current and lagged changes in bank advances produced a goodness of fit equal to that for the equation including the latter variables, and when the stock of gross liquid assets was introduced as an additional variable it was quite insignificant. Experiments with the stock of real hire-purchase debt also produced insignificant results, and no further work was undertaken on the consumer durables equation.

1 c More general wealth effects

Because the liquid asset results did not indicate that model (2) was superior to model (1) in terms of goodness of fit, model (1) was used as a test for the presence of wider wealth effects. Table C shows some of these results.

Table C

$$CNDT_t = \underset{(94.8)}{420.2}+\underset{(0.02)}{0.178}(INC-CG)_t + \underset{(0.04)}{0.628}\,CNDT_{t-1} + \underset{(0.004)}{0.02679}\,NLA_{t-½}$$
$$-\underset{(0.0005)}{0.00134}\,NIA_{t-½} + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \qquad (1)$$

$$U_t = -\underset{(0.14)}{0.666}\,U_{t-1} + \epsilon_t$$

$$se = 24.0 \qquad \bar{R}^2 = 0.996$$

$$CNDT_t = \underset{(292.0)}{574.1}+\underset{(0.02)}{0.177}(INC-CG)_t + \underset{(0.07)}{0.607}\,CNDT_{t-1} + \underset{(0.02)}{0.0236}\,GLA_{t-½}$$
$$-\underset{(0.01)}{0.0193}\,BA_{t-½} - \underset{(0.001)}{0.0015}\,GIA_{t-½} + \underset{(0.007)}{0.0054}\,GIL_{t-½} + \sum_{i=0}^{2} a_i DV_i$$
$$+\sum_{i=0}^{2} \beta_i Q_i + U_t \qquad (2)$$

$$U_t = -\underset{(0.14)}{0.697}\,U_{t-1} + \epsilon_t$$

$$se = 24.8 \qquad \bar{R}^2 = 0.996$$

$$CNDT_t = \underset{(154.5)}{651.9}+\underset{(0.03)}{0.1513}(INC-CG)_t + \underset{(0.07)}{0.697}\,CNDT_{t-1} + \underset{(0.001)}{0.0008}\,W_{t-½}$$
$$+\sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \qquad (3)$$

$$U_t = -\underset{(0.17)}{0.41}\,U_{t-1} + \epsilon_t$$

$$se = 34.8 \qquad \bar{R}^2 = 0.991$$

where

NIA	is the real stock of net illiquid assets held by the personal sector.
GIA	is the real stock of gross illiquid assets held by the personal sector.
GIL	is the real stock of gross illiquid liabilities of the personal sector.
W	is the stock of the personal sector's real net worth.

The net illiquid asset variable in equation (1) was constructed largely from Revell and Roe's work on personal sector balance sheets but, although significant, it had the incorrect sign (probably caused by collinearity between the liquid and illiquid asset terms). The second equation shows similar poor results for separate gross illiquid asset and liability variables, and the final equation in which the liquid and illiquid assets and liabilities are combined in a composite wealth variable is equally disappointing.

In addition to these tests, a number of variables, including changes in share prices and in new house prices, were introduced to capture the effect of capital gains and losses on illiquid assets, but with no significant results. Overall, the estimates suggest that holdings of liquid assets are the most important form of wealth as far as consumers' expenditure is concerned, and that there is no wider category of assets which can be identified as equally influential.

1 d Precautionary saving

Two tests were made for precautionary saving, each using the same model. The first introduced the level of unemployment six months ahead, on the assumption that expectations might be accurately fulfilled. In the second, Gallup poll data on price expectations were used on the grounds that prospects for real income are likely to be more uncertain when rapid inflation is expected. These results are shown below:

Table D

$$\begin{aligned} CNDT_t = {} & \underset{(132.5)}{584.7} + \underset{(0.02)}{0.177}(INC-CG)_t + \underset{(0.05)}{0.611}\, CNDT_{t-1} + \underset{(0.01)}{0.018}(NLA)_{t-½} \\ & + \underset{(0.05)}{0.082}[LU_{t+2}\,(D664)] + \underset{(0.03)}{0.061}[LU_{t+2}\,(1-D664)] \\ & + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \end{aligned} \qquad (1)$$

$$U_t = \underset{(0.15)}{-0.643}\, U_{t-1} + \epsilon_t$$

$$se = 25.5 \qquad \bar{R}^2 = 0.995$$

$$\begin{aligned} CNDT_t = {} & \underset{(130.9)}{637.9} + \underset{(0.03)}{0.178}(INC-CG)_t + \underset{(0.05)}{0.597}\, CNDT_{t-1} + \underset{(0.005)}{0.021}(NLA)_{t-½} \\ & \underset{(2.71)}{-0.97}\, PE_t + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \end{aligned} \qquad (2)$$

$$U_t = \underset{(0.14)}{-0.632}\, U_{t-1} + \epsilon_t$$

$$se = 26.5 \qquad \bar{R}^2 = 0.994$$

where

LU	is registered wholly unemployed (excluding school-leavers and adult students) in Great Britain.
*D*664	is 0, 1 dummy; 0 up to the fourth quarter of 1966, 1 thereafter.
PE	is price expectations derived from Gallup poll data (see below, page 68).

The unemployment series was divided at the fourth quarter of 1966 to allow for the widely reported structural change in the series around that time, associated with the introduction of earnings-related benefits. In fact, the coefficients are quite similar, but both have the *a priori* incorrect signs as proxies for precautionary saving.[1] In the second equation the data for price expectations had the correct sign but were insignificantly different from zero. To the extent that greater uncertainty might be expected to change the functional form of the equation, these results are perhaps hardly surprising; it may well be difficult to offer any convincing econometric results as evidence for precautionary saving.

[1] Unemployment may of course also affect consumption without a lag, because the unemployed have a lower average propensity to save than the employed. When this was tested, unemployment in the current time period took a negative sign.

2 A log-linear model

This section reports the results of a rather different model designed to test another view propounded by Deaton, that the rise in the saving ratio could be explained by the rate of inflation itself. The model underlying the equations reported in the first section assumed that the pattern of consumers' expenditure was not affected by changes in nominal income and wealth when these were entirely offset by changes in prices, leaving income and wealth unchanged in real terms. In terms of the earlier function:

$$CONS = f\left(\frac{NOM\,INC}{PRICE^{a}}, \frac{NOM\,LIQ}{PRICE^{a}}\right) \tag{4}$$

where *NOM INC* and *NOM LIQ* are income and liquidity expressed in current prices and *PRICE* is the price level, it was implicitly assumed that a was identically equal to 1. However, to the extent that money illusion exists and that prices are higher or lower than consumers expect, a would be different from 1. In the traditional sense in which the term is used, a would be expected to be less than 1, but for Deaton's theory to be validated a should be greater than 1 and consumption therefore less in relation to income than the absence of money illusion would suggest. Because of the non-linearities involved in estimating such a model, a log-linear model, similar to that suggested by Branson and Klevorick[1] relating consumption to income[1] and prices is estimated.

$$\ln CND = \beta_0 + \beta_1 \ln INC_t^P + \beta_2 \ln NLA_{t-\frac{1}{2}} + \beta_3 \ln PCND_t \tag{5}$$

where

INC^P is permanent or smoothed income.

In this log-linear model the implications of a value of a greater or less than 1 in the linear model translate directly into positive or negative values of β_3, because $\beta_3 = (1-a)$. This may be regarded as a long-run model which takes no account of the determination or effect of expectations. If β_3 is significantly different from zero, real expenditure is no longer independent of prices and there is money illusion in a long-run sense. However, Deaton's hypothesis is essentially a short-run phenomenon, which is only influential while expectations of inflation are lagging behind the true rate. This is captured by allowing deviations of prices from their expected path to influence consumption as follows: [2]

$$\ln CND = \gamma_0 + \gamma_1 \ln INC_t^P + \gamma_2 \ln NLA_{t-\frac{1}{2}} + \gamma_3 \ln (PCND/PCND^e)_t \tag{6}$$

where

$PCND^e$ = the price level expected to prevail in period t.

The difficulty with this model lies in the estimation of expectations, and two alternatives were tried. First, the externally generated Carlson and Parkin [3] data on price expectations were used and, secondly, a traditional distributed lag model was estimated in which expected prices are assumed to depend on past prices.

A *Carlson and Parkin method*

The basic Carlson-Parkin approach yields a quantitative series of expectations of inflation derived from replies to surveys which simply take the form of 'up', 'down' or 'no change'. The method was applied by Parkin, Sumner and Ward[11] to CBI questionnaires on wholesale and export prices and to Gallup poll data on retail price expectations.[3] Unfortunately, the figures derived from Gallup poll data (which should be the best guide to consumers' expectations about prices directly affecting them) give implausibly low estimates in the latest period (e.g. about 9% at an annual rate at the end of 1974), probably because the method suggested may not be as suitable when most respondents expect changes in the same direction. Table E shows the results of using this information up to the fourth quarter of 1974 and then without the last eight observations, ending in the fourth quarter of 1972 when the method was probably rather more reliable.[4] Third degree Almon polynomials were used throughout so as not to impose monotonic lag distributions on the coefficients, and a zero end-point constraint was imposed.

[1] In the light of the earlier results, and because it was desired to allow for different lag structures on income and prices, the log-linear model was assumed to be a permanent income model, and the smoothing of the income terms was achieved by the use of Almon variables.

[2] The derivation of the reduced form equation is rather different from that suggested by Deaton although the form in which the equation is estimated is entirely consistent with his model.

[3] The Bank are grateful to Robert Ward of Manchester University who supplied the data used in Parkin, Sumner and Ward [11], and updated the figures to include 1974.

[4] The data are for expectations about the annual rate of change of prices, $\dot{P}^e$. Because the desired variable is the deviation of expected prices from actual prices, the data were transformed as follows:

$$P_t^e = P_{t-1}\,4\sqrt{(1+\dot{P}^e)} \;\therefore\; \ln\left(\frac{PCND}{PCND^e}\right)_t = \ln PCND_t - \ln PCND_{t-1} - 0.25 \ln (1+\dot{P}^e).$$

Table E

$$\ln CND_t = \underset{(0.2)}{0.06} + \sum_{i=0}^{7} b_i \ln INC_{t-i} + \underset{(0.04)}{0.24609} \ln NLA_{t-\frac{1}{2}} - \underset{(0.2)}{0.46494} \ln (PCND/PCND^e)_t$$

$$+ \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \qquad (1)$$

$$se = 0.00496 \quad \bar{R}^2 = 0.995 \quad DW = 1.7 \quad \chi^2(\rho_1) = 1.8$$

Estimated from the second quarter of 1965 to the fourth quarter of 1974.

where

$$b_i, i = 0 \ldots 7 = \underset{(0.025)}{0.198}, \underset{(0.013)}{0.157}, \underset{(0.005)}{0.121}, \underset{(0.007)}{0.09}, \underset{(0.011)}{0.063}, \underset{(0.012)}{0.04}, \underset{(0.011)}{0.022}, \underset{(0.007)}{0.009} \quad \sum_{i=0}^{7} b_i = \underset{(0.03)}{0.700}$$

$$\ln CND_t = \underset{(0.3)}{0.03} + \sum_{i=0}^{7} b_i \ln INC_{t-i} + \underset{(0.08)}{0.25683} \ln NLA_{t-\frac{1}{2}} - \underset{(0.3)}{0.25724} \ln (PCND/PCND^e)_t$$

$$+ \sum_{i=0}^{1} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \qquad (2)$$

$$se = 0.00505 \quad \bar{R}^2 = 0.988 \quad DW = 1.7 \quad \chi^2(\rho_1) = 1.8$$

Estimated from the second quarter of 1965 to the fourth quarter of 1972.

where

$$b_i, i = 0 \ldots 7 = \underset{(0.036)}{0.198}, \underset{(0.017)}{0.156}, \underset{(0.013)}{0.120}, \underset{(0.020)}{0.088}, \underset{(0.026)}{0.061}, \underset{(0.027)}{0.038}, \underset{(0.023)}{0.021}, \underset{(0.014)}{0.008} \quad \sum_{i=0}^{7} b_i = \underset{(0.096)}{0.691}$$

The $\chi^2(\rho_1)$ figure is a χ^2 test on the significance of the first order autocorrelation coefficient and is shown where the serial correlation parameter is insignificant.

Although the deviation of prices from their expected path is shown to be significant in equation (1) with the negative sign suggested by Deaton, equation (2) shows that the significance of the variable is entirely due to the observations in the last two years when, according to the data, the gap between expected and actual inflation was so large. Although inflationary expectations are likely to be less accurate when prices are rising rapidly, it is doubtful whether expectations diverged as far from reality in the recent past as the data suggest. In view of the uncertainty surrounding the data, wholesale price expectations (derived by Parkin, Sumner and Ward from CBI returns) were used as an alternative proxy: this series seems much more realistic with expectations rising to about 25% by the end of 1974. The estimates are shown below:

$$\ln CND_t = \underset{(0.3)}{0.65} + \sum_{i=0}^{7} b_i \ln INC_{t-i} + \underset{(0.03)}{0.25289} \ln NLA_{t-\frac{1}{2}} - \underset{(0.2)}{0.45871} \ln (PCND/PCND^e)_t$$

$$+ \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t$$

$$se = 0.0046 \quad \bar{R}^2 = 0.996 \quad DW = 1.9 \quad \chi^2(\rho_1) = 1.1$$

Estimated from the second quarter of 1965 to the fourth quarter of 1974.

where

$$b_i, i = 0 \ldots 7 = \underset{(0.025)}{0.174}, \underset{(0.013)}{0.139}, \underset{(0.004)}{0.108}, \underset{(0.005)}{0.081}, \underset{(0.009)}{0.057}, \underset{(0.011)}{0.037}, \underset{(0.010)}{0.021}, \underset{(0.006)}{0.009} \quad \sum_{i=0}^{7} b_i = \underset{(0.019)}{0.627}$$

This result gives rather more confidence in the underlying hypotheses, because the expectations series was nearer to the actual rate of inflation and the deviation of expected from actual prices was still significant.[1]

B *Distributed lag model*

In this formulation expected prices, rather than being externally generated, are estimated within the model as a function of lagged prices.

In equation (6), log $PCND^e$ is determined as:

$$\ln PCND^e = \delta(L) \ln PCND \qquad (7)$$

where

L is the lag operator.

Permanent income is again approximated by a lagged distribution on past income, and the equation to be estimated becomes:

$$\ln CND = a + b(L) \ln INC + c \ln NLA + d(L) \ln PCND \qquad (8)$$

[1] This equation was also run up to the fourth quarter of 1972, and the parameter estimates were very close to those shown for the period to the fourth quarter of 1974. In particular, the parameter on the price variable was $\underset{(0.17)}{-0.42166}$.

The lagged parameters on prices potentially capture two effects: the influence of money illusion and the determination of price expectations. Interpretation is rather difficult because from equations (6), (7) and (8):

$$d(L)\ln PCND = \gamma_3[1-\delta(L)]\ \ln PCND$$

The *a priori* expected values of the δ coefficients which determine expectations are positive, and that part of the lagged price distribution $d(L)$ which is dominated by the expectations-generating mechanism is therefore likely to be positive. Expectations are unlikely to adjust immediately and the first coefficient on the price distribution is thus likely to represent a pure money illusion effect; if it is negative it would support Deaton's hypothesis. The coefficients may therefore change sign over the distribution. If any long-term money illusion exists, the sum of the $d(L)$ coefficients would be different from zero.[1] The results are shown below.

Table F

$$\ln CND_t = \underset{(0.7)}{3.9} + \sum_{i=0}^{7} b_i \ln INC_{t-i} + \sum_{i=0}^{7} d_i \ln PCND_{t-i} + \sum_{i=0}^{2} a_i DV_i + U_t \quad (1)$$

$$U_t = \underset{(0.1)}{0.271}\, U_{t-1} + \epsilon_t$$

$$se = 0.0046 \qquad \bar{R}^2 = 0.997$$

where

$b_i, i = 0 \ldots 7 =$ 0.181, 0.099, 0.056, 0.040, 0.042, 0.050, 0.052, 0.039 $\sum_{i=0}^{7} b_i = 0.560$
(0.048)(0.018)(0.027)(0.026)(0.018)(0.018)(0.025)(0.022) (0.083)

$d_i, i = 0 \ldots 7 =$ −0.336, −0.101, 0.050, 0.132, 0.158, 0.143, 0.102, 0.050 $\sum_{i=0}^{7} d_i = 0.198$
(0.089) (0.031)(0.068)(0.064)(0.034)(0.022)(0.046)(0.047) (0.041)

$$\ln CND_t = \underset{(0.6)}{0.8} + \sum_{i=0}^{7} b_i \ln INC_{t-i} + \sum_{i=0}^{6} d_i\, \Delta \ln PCND_{t-i} + \sum_{i=0}^{2} a_i DV_i + U_t \quad (2)$$

$$U_t = \underset{(0.09)}{0.7402}\, U_{t-1} + \epsilon_t$$

$$se = 0.0050 \qquad \bar{R}^2 = 0.996$$

where

$b_i, i = 0 \ldots 7 =$ 0.223, 0.147, 0.107, 0.092, 0.091, 0.093, 0.085, 0.058 $\sum_{i=0}^{7} b_i = 0.896$
(0.052)(0.031)(0.035)(0.030)(0.024)(0.032)(0.040)(0.033) (0.063)

$d_i, i = 0 \ldots 6 =$ −0.350, −0.298, −0.225, −0.144, −0.069, −0.011, 0.016
(0.123) (0.118) (0.131) (0.132) (0.139) (0.141)(0.107)

$d^*_i, i = 0 \ldots 7 =$ −0.350, 0.052, 0.073, 0.082, 0.075, 0.058, 0.027, −0.016 $\sum_{i=0}^{7} d^*_i = 0$

$$\ln CND_t = \underset{(0.9)}{0.2} + \sum_{i=0}^{7} b_i \ln INC_{t-i} + \underset{(0.05)}{0.258} \ln NLA_{t-\frac{1}{2}} + \sum_{i=0}^{7} d_i \ln PCND_{t-i}$$
$$+ \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \quad (3)$$

$$se = 0.0047 \qquad \bar{R}^2 = 0.996 \qquad DW = 2.0$$

where

$b_i, i = 0 \ldots 7 =$ 0.271, 0.136, 0.062, 0.032, 0.032, 0.044, 0.053, 0.044 $\sum_{i=0}^{7} b_i = 0.674$
(0.049)(0.017)(0.024)(0.024)(0.017)(0.017)(0.023)(0.02) (0.071)

$d_i, i = 0 \ldots 7 =$ −0.061, 0.015, 0.045, 0.043, 0.021, −0.007, −0.028, −0.03, $\sum_{i=0}^{7} d_i = -0.003$
(0.104)(0.034)(0.063)(0.063)(0.042) (0.034) (0.049) (0.046) (0.051)

[1] This long-run money illusion effect was not allowed in the results shown in section A because the model as formulated only allowed an influence for prices to the extent that they deviated from expectations.

$$\ln CND_t = \underset{(0.2)}{0.3} + \sum_{i=0}^{7} b_i \ln INC_{t-i} + \underset{(0.03)}{0.255} \ln NLA_{t-½} + \sum_{i=0}^{6} d_i \, \Delta \ln PCND_{t-i}$$

$$+ \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t \qquad (4)$$

$$se = 0.0046 \qquad \bar{R}^2 = 0.996 \qquad DW = 2.1$$

where

$b_i, i = 0 \ldots 7 =$ 0.259, 0.137, 0.069, 0.039, 0.035, 0.042, 0.048, 0.038 $\sum_{i=0}^{7} b_i = 0.668$
(0.041)(0.015)(0.023)(0.023)(0.016)(0.016)(0.021)(0.019) (0.041)

$d_i, i = 0 \ldots 6 =$ −0.127, −0.046, 0.019, 0.066, 0.091, 0.091, 0.061
(0.109) (0.082)(0.084)(0.084)(0.092)(0.099)(0.077)

$d_i^*, i = 0 \ldots 7 =$ −0.127, 0.081, 0.065, 0.047, 0.025, 0, −0.03, −0.061 $\sum_{i=0}^{7} d_i^* = 0$

where

Δ is the first difference operator.
d_i^* are the d_i transformed into coefficients on the levels of *PCND*.

In equations (1) and (3) long-run money illusion is allowed, whereas equations (2) and (4) restrict the sum of the lagged price parameters to zero. In each of the first two equations the impact effect of prices is shown to be significantly negative, and this is followed either immediately or after one period by a sequence of smaller positive parameters. The constraint that, in the long run, prices should have no impact on real expenditure is shown not to be satisfied by the data, because an F test on the addition to the residual sum of squares caused by the constraint took the value 10.1. However, in equations (3) and (4), liquid assets were reintroduced and the results are rather different. The coefficients on the price distribution are much smaller and no longer significant, and the long-run constraint of homogeneity of degree zero in prices holds. Although the standard errors of equations (1) and (4) are identical – and it is therefore difficult to choose between them – the presence of serial correlation in the first equation may be thought to indicate misspecification, which the introduction of net liquid assets overcomes. In this case, the existence of money illusion in both the short and the long run remains doubtful. However, this conclusion must be very tentative, first because of collinearity between the real income, price and liquid assets series and secondly because the price variable is included to measure the two potentially offsetting effects of money illusion and price expectations.

As a final attempt to separate these two influences, current prices were included as an additional variable, with Almon variables constructed on the deviation of prices from their current level.

$$\ln CND_t = a + \sum_{i=0}^{7} b_i \ln INC_{t-i} + c \ln NLA_{t-½} + d \ln PCND_t$$
$$+ \sum_{i=1}^{7} e_i (\ln PCND_{t-i} - \ln PCND_t)$$

By definition, the total impact of the e_i coefficients on consumption is zero but the possibility of long-run money illusion is allowed for by the inclusion of the current level of prices. If the coefficient d is significantly different from zero, prices have an impact on real spending in the long run. The estimates are shown below:

$$\ln CND_t = \underset{(0.8)}{2.9} + \sum_{i=0}^{7} b_i \ln INC_{t-i} + \underset{(0.04)}{0.13724} \ln PCND_t + \sum_{i=1}^{7} e_i (\ln PCND_{t-i}$$
$$- \ln PCND_t) + \underset{(0.04)}{0.12872} \ln NLA_{t-½} + \sum_{i=0}^{2} a_i DV_i + \sum_{i=0}^{2} \beta_i Q_i + U_t$$

$$U_t = \underset{(0.12)}{-0.263} U_{t-1} + \epsilon_t$$

$$se = 0.0036 \qquad \bar{R}^2 = 0.997$$

where

$b_i, i = 0 \ldots 7 =$ 0.203, 0.118, 0.065, 0.038, 0.027, 0.025, 0.025, 0.019 $\sum_{i=0}^{7} b_i = 0.522$
(0.036)(0.011)(0.016)(0.016)(0.011)(0.012)(0.017)(0.015) (0.057)

$e_i, i = 1 \ldots 7 =$ 0.190, 0.096, 0.049, 0.033, 0.036, 0.041, 0.034 $\sum_{i=1}^{7} e_i = 0.478$
(0.098)(0.046)(0.048)(0.035)(0.023)(0.038)(0.040) (0.139)

The impact effect of prices $(d-\sum_{i=1}^{7}e_i)$ is negative (−0.34) but the sum of the higher order lags, at 0.478, is significantly higher than that, with the coefficient on current prices (d) having a t statistic of 3.2. However, these conclusions about the existence of negative money illusion in the very short run, until expectations have caught up with inflation, and also about overadjustment to prices in the long run, must necessarily remain very tentative because of the statistical problems caused by collinearity among the variables. Finally, it is worth noting that the stock of liquid assets remains significant throughout, with the overall magnitude of its impact remarkably stable in the linear and log-linear formulations.

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