Bank of England

Discussion Paper No.3

A small monetary model of the UK economy

by

R.T.Coghlan

May 1979

Bank of England Discussion Papers

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The object of this series is to give a wider circulation to research work being undertaken in the Bank and to invite comment upon it; and any comments should be sent to the author at the address given below. The views expressed are his, and not necessarily those of the Bank of England.

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Introduction[1]

1 The Bank of England already possess a short-term macro-economic model which is used to forecast the economy.[2] The model is essentially 'Keynesian' in origin with quantities being demand-determined. The Bank are also developing a medium-term model, adopting a similar Keynesian approach, in order to take a longer view of economic performance. This paper reports on work in progress at the Bank on an alternative, highly aggregated, model which places much greater emphasis on the supply of money, and in which supply influences are given prominence.

2 That the Bank of England should be interested in trying to understand more clearly just how important money might be in influencing what happens in the rest of the economy should be obvious. The Bank stand at the centre of the financial system in the United Kingdom and are responsible for day-to-day management of the external currency reserves and the banking system, as well as playing a major role in providing advice to the Government and implementing monetary policy. Although in recent years money has increasingly been recognised as playing an important role in the economy, the exact channels of influence have remained unclear. The change in attitude has been due more to the force of events than to the acceptance of any particular monetary (or monetarist) philosophy. One way forward has been to introduce certain monetary influences into existing short-term forecasting models in order to seek to improve their performance. The possibility should be recognised, however, that potential conflicts may be created between these monetary amendments and the underlying Keynesian framework from which most existing models have been constructed. Another approach, of which this study is a part, is to construct alternative models,

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[1] This paper has been presented at the VIth International Conference of Applied Econometrics: Monetary and Financial Models; Rome, 7th-10th February 1979, and at seminars at the Bank of England, Liverpool University and the London School of Economics. The present version of the paper has benefited from the many helpful comments that resulted from these meetings. In addition, I would like to thank my colleagues at the Bank, particularly B.C.Hilliard, C.A.E.Goodhart and J.M.Hoffman, for their comments and assistance.

[2] The operation and development of this model was outlined in a recent paper by Latter (1978).

which can then be compared with the existing models. Work on both these fronts is continuing at the Bank. This model is only part of the Bank's continuing research effort and should in no way be interpreted as representing an official view. Rather, at this early stage of the model's development the views expressed here should be regarded as solely those of the author.

3 This paper is concerned first with a certain theoretical approach to modelling the economy and, secondly, with trying to formulate an empirical model which could be estimated, and which incorporated the main characteristics of this approach. This is the stage which has been reached; the estimates presented here seem to provide reasonable support for the approach adopted, even though the detailed equations may well be improved in the course of further development.

4 Further work on the model is at present in progress and may, in due course, give rise to other Discussion papers. A limited set of simulations made with the model have thus far proved encouraging, but much more work is necessary to explore and determine the properties of the model, and in particular to ensure that movements in the exchange rate can be adequately explained. There is, therefore, a long way to go before a model of this type could reasonably be employed for forecasting.

5 The next section presents an outline of the theoretical approach adopted, emphasising the main distinguishing characteristics. This is followed by a discussion of the detailed equations of the model together with the estimation results obtained.

Model outline

6 Monetary influences of one form or another have been incorporated into most existing macro-economic models. In general, incomes and expenditures have continued to be demand-determined, with the addition of a separate monetary/financial sector. Aggregated financial surpluses feed into the financial sector from the so-called 'real' sector and one or two rates of return on financial variables have some, though usually very small, effect in the other direction.

7 This separation of markets follows the Keynesian tradition as extended and developed by Brainard and Tobin (1968). Three financial models - Melitz and Sterdyniak (1978); Spencer et al. (1978); and Savage (1978) - have recently been completed for the United Kingdom adopting this framework. These models have provided valuable insights into the behaviour of the main financial flows, and the Treasury model (Spencer et al.) includes a particularly detailed interpretation of financial market behaviour.

8 The approach adopted here is different in that money is assumed to be held as intermediary to all transactions and therefore reflects behaviour in all markets. It is therefore not possible to make any clear distinction between money/finance and income/expenditure markets. In this view of the world, it is not enough just to include money in a model; the context within which it is introduced is also crucially important. There has already been work along these lines for the United Kingdom, the two main models being by Jonson (1976) and Laidler and O'Shea (1978). A major difference with the present model is the money supply process, which is a central feature of this study.

9 It is necessary to be clear from the outset what is meant by money in this model. Money narrowly defined (M_1) and bank reserves (base money), are, I would argue, in the United Kingdom at least, demand-determined, and are most unlikely to reflect any independent supply disturbances, except possibly under extreme conditions. It is therefore important to distinguish between the different definitions of money, and the institutional arrangements in existence. Because of the institutional structure, this model applies only to a broad definition of money - in this case sterling M_3 balances of the private sector.

10 The theoretical framework on which this model is based has been outlined in two papers - Coghlan (1978 a and b). The argument rejects the high-powered money multiplier model of money supply determination, on the grounds that the supply of reserves is endogenous and is not restricted by the monetary authorities.[1] This, however, does not result in the stock of money being determined by the demand for money as is frequently suggested. Instead the supply process outlined below depends crucially on the determinants of bank credit, i.e. the asset side of banks' portfolios.

11 The importance of money in this model stems from two sources. First, there is a disequilibrium effect of the type suggested by Archibald and Lipsey (1958). In these models, the way in which money comes into existence is not relevant, e.g. it is assumed that 'each individual wakes up on Monday morning to find his nominal money balances doubled', in other words it is 'helicopter' money. This is the justification employed in most models which incorporate disequilibrium monetary effects,[2] and has been termed the secondary effect of money in this model. Such an approach is useful for analysing the process of adjustment to exogenous real shocks, but leaves unexplained the process of money creation. It is therefore only half the story.

12 The second, and prime, role of money in the economy derives from the financing effect of new credit creation, on the grounds that there is a relationship between an increase in aggregate expenditure and the provision of new finance. This is an aspect upon which Keynes placed great emphasis after he had written the General Theory. The process of money creation - through credit markets - therefore reintroduces many influences more generally thought of as Keynesian which can drive the model, even though the channels of influence are through the money supply.

13 These two effects combine to provide a direct relationship between money and the economy. The model cannot really be termed monetarist since the money stock is not regarded as an exogenous variable directly under the control of the authorities, although they do have control over

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[1] Even if this were not the case it would still be necessary to include the demand for bank loans in the analysis - see Brunner and Meltzer (1976).

[2] As, for example, the innovative study by Jonson, Moses and Wymer (1977).

instruments which will influence the money supply. It, in fact, makes no sense even to talk about the effect of money on the economy - only the individual influences on the money supply. Money is simply the channel through which such changes work their way through the economy.

14 It is sometimes suggested that the demand for bonds can be thought of as the inverse of the demand for money. Even in a Keynesian world containing a variety of financial assets of differing type and maturity, this is difficult to justify; within this model such a presumption would be completely incorrect. The demand for bonds is likely to have a substantial effect on the <u>supply</u> of money, and may also have an effect on the demand for money - depending on relative interest elasticities. Money is envisaged to be a substitute for all goods, financial and real, in the economy, not simply for long-dated public sector debt.

15 Once we look more closely at the determinants of credit flows, it is clear that we should expect there to be some direct substitution between private sector borrowing from the banking sector and borrowing from abroad. An external capital inflow need not necessarily, therefore, be associated with an excess demand for money, but could result from an excess demand for credit. The possibility of such substitution is made more likely by the existence of large multinational companies operating in the United Kingdom. Inflows can occur because of credit demands without any prior change in the determinants of the demand for money. This is one reason (though others can be adduced) why the expansion of domestic credit (DCE) is unlikely to be exogenously determined by the monetary authorities.

16 If the supply of money is determined independently of demand, then the components of demand must adjust in order to bring demand into line with supply. This adjustment is likely to take some time, depending upon a variety of factors, and in the interim there may exist an excess supply of money. That there can be an excess supply depends critically on the unique characteristics possessed by money. Friedman and Meiselman (1963) viewed money as a residual store of generalised purchasing power, and Keynes (1940) also argued that money cannot be viewed in the same way as any other commodity; it is different in kind.

17 If an individual borrows money from a bank in order to purchase a commodity from within the private sector, then the payment when received will be deposited with the banking sector to be registered as an increase in the money supply. The money is accepted but it does not necessarily represent an equilibrium demand. While dynamic adjustment is possible, or rather inevitable, in the market for any commodity, and while these adjustments will necessarily have implications for other markets, the pervasive influence of money gives it an importance that results in a difference in kind rather than degree. The role of money as the means of payment means that it enters as intermediary into all market transactions. For this reason it is the perfect buffer to soak up any disequilibrium in an uncertain, imperfect world. Therefore, any disequilibrium in other markets is likely to be reflected in diequilibrium in the money market. People will accept money but it would be wrong to suppose that they necessarily wish to retain ownership of it. Money is a means to an end, and only to a relatively minor degree, compared with the transactions it facilitates, is it an end in itself. Money is held but this does not mean that it represents an equilibrium demand for money. Any increase in the supply of money above the equilibrium demand must be followed by an adjustment in the determinants of demand in order to move towards equilibrium. These adjustments can take the form of output, price or interest-rate changes, and the actual response is obviously very important.

18 It is possible to think of the total effect of a change in the money stock on the economy working through two separate channels: the primary effect and the secondary effect. The primary effect is directly related to the credit creation associated with the increase in money supply. In this view it is not sufficient for individuals in aggregate to <u>desire</u> to increase their investment - or more correctly their financial indebtedness - it is also necessary for the additional finance to be made available. For this purpose the banks play a crucial role in the provision of <u>new</u> finance. This was a point on which Keynes (1937 a and b) placed great emphasis. A raising of 'animal spirits', therefore, has different implications for investment, and the economy, depending upon whether new finance is readily available or not. And indeed the expectations themselves may be strongly influenced by the availability of credit. Even if an individual entrepreneur suffers no financial restraint, he may still

conclude that the existence of credit restrictions on others will severely limit the possibility of a sustained economic expansion. Premature expansion can be more harmful than waiting until a boom is half over. The actual outcome of this primary effect is likely to depend on the way in which the new money comes into existence, and the uses to which the new credit is put.

19 The secondary effect refers to the continuing influence of money on the economy in the process of bringing demand and supply into equilibrium. It is unlikely that the primary effect will complete this process, and there are anyway likely to be lags in adjustment which will change, and even perhaps reverse, the initial response. The exact speed and pattern of adjustment will depend on the interaction of the various agents in the economy, and their reactions to the disequilibrium. These secondary effects will probably take some time to be completed.

20 The money supply identity[1] which stands at the centre of this model can be written as:

$$\Delta M = [(PSBR - \Delta Dg) - \Delta B + \Delta L] + CA + \Delta N - \Delta NDL$$

where ΔM = change in the private sector's holdings of sterling M_3 balances

$PSBR$ = public sector borrowing requirement

ΔDg = change in the bank deposits of the public sector

ΔB = net private sector transactions in public sector debt

ΔL = flow of bank lending to the private sector

CA = nominal current account

ΔN = net private sector borrowing from abroad in sterling, which is a loose interpretation of net borrowing from abroad less the net foreign currency deposit/liability position of the private sector with the banking sector

ΔNDL = change in the non-deposit liabilities of the banking sector.

The model that has been estimated is mainly concerned with determining the behavioural relationships underlying each of the separate components making up the money supply identity. The expression in the square brackets is defined as DCE, and $CA + \Delta N$ is taken as representing the change in reserves, ΔR. The latter assumption is justified on the grounds that this total consists of the external influences on the money supply, i.e. external flows to the private sector converted to

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[1] See Appendix 3 for a detailed derivation, and further discussion, of this identity.

sterling. For this reason, and because the other components making up the balance for official financing are taken to be exogenously determined for the time being (see Appendix 3), ΔR is also interpreted as representing intervention by the public authorities in the exchange market.

21 It can be seen that external purchases, or sales, of public sector debt, ΔBf, do not enter into the money supply identity described in paragraph 20, and will therefore have no direct effect on the supply of money (see Appendix 3). It is possible, however, that an inflow into public sector debt may increase confidence in the performance of the economy, and/or the public sector's funding programme, resulting in increased domestic purchases of gilt-edged stocks and a reduction in the money supply.

22 The model contains no explicit demand-for-money function. This may at first sight seem rather surprising in a model stressing monetary relationships, as the demand function more usually stands at the centre of the stage in such models. A stable demand function is, however, still a fundamental requirement of the system. In this case, because the stock of money is assumed to be supply-determined, it is adjustment through the demand function that eventually achieves equilibrium. The components of the demand function therefore become dependent variables in the model. These changes do, however, in turn feed back on to the money supply, thereby further complicating the process of adjustment.

23 The supply of money is determined by the combined behaviour in all markets, real and financial, of the four sectors distinguished in the model: the private, public, banking and overseas sectors. These interactions also determine a demand for money. The process of bringing these two relationships into equilibrium provides the dynamics of the system, and the equilibrium properties of these functions determine the long-run properties of the model. These long-run properties are not necessarily anything we should expect to observe, but are more a state of mind, providing some underlying stability to the system. The fact that there is this underlying tendency to return to equilibrium does not, of course, mean that short-run stabilisation policies become redundant. This model has the characteristic that substantial disequilibrium can persist for some time, thereby providing possible justification for stabilisation policies, but within a system that is inherently stable.

24 The present approach does not follow the general financial portfolio model and can be seen as attaching unique importance to money. After all, the argument is really that credit demands are related to expenditure plans, not just to some desired financial portfolio position. Viewed in this way, the composition of the total balance sheet is an ex-post identity that results from many different types of behaviour which should, however, be related in a consistent manner. One possible way of interpreting the model is to view the stock of money as the means by which flows of finance are converted into flows of expenditure and output. In this sense it has something in common with Cohen's (1968) attempts to re-establish the importance of 'external finance' in explaining expenditures.

Competition and credit control

25 One aspect of this model which is worth emphasising is that it assumes unchanging behavioural relationships over the whole period since 1952. In particular the introduction of competition and credit control (CCC) in 1971 is not seen as bringing about any dramatic change in banking sector behaviour, nor in the behavioural responses of the private sector. While the development of non-bank financial intermediaries is perfectly capable of changing the demand for money, and therefore the equilibrium velocity of circulation of money, this should be measurable. The difficulty with CCC is that it is not clear why it should necessarily have changed the behavioural responses within the system. It made a lot of difference to the business conducted by the clearing banks, but it probably had less of an impact on the operations of the total banking sector. The traditional clearing bank business, current accounts and retail deposit accounts, was already rapidly declining as a proportion of total banking sector deposits.

26 It is sometimes argued that the new competitive environment inaugurated, and encouraged, by CCC resulted in banks operating as 'liability managers', i.e. adjusting their liabilities (predominantly deposits) in order to accomodate the asset side of their portfolios. CCC must surely have contributed to an increase in this method of operation but this influence may well have been over-emphasised. Although there has been a tendency to analyse bank portfolio behaviour by taking deposits as given, Keynes (1973 b, page 669) had described banks operating as liability managers as long ago as the 1930s.

27 Another argument is that the introduction of CCC resulted in an increase in reserve assets, which made banks more aggressive in their lending activities. However, if, as has been argued here, reserves were not controlled in such a way as to restrict bank lending, it is difficult to see why the creation of excess reserves should have resulted in an expansion of bank lending - except, that is, to the extent,that relative interest rates were changed. But then that influence should be picked up by existing equations - it does not represent a change in behaviour. Moreover, it is easy to exaggerate the increase in reserves made available as a result of the change-over to the 12 1/2% reserve ratio. For example, the reserve ratio for October 1971 was only 15.9%, and what is more this rose over the next three months, mainly as a result of an increase in money at call. In percentage terms, the main excess reserves were held by the non-clearing banks which had not previously been subjected to reserve control at all. It is therefore even difficult to argue that the reduction of reserve requirements on the clearing banks resulted in the creation of substantial excess reserves.

28 If it was not CCC, then what was responsible for the substantial increase in bank lending and deposits between 1971 and 1974? Bank lending to the private sector rose by over 100% between end-1971 and end-1973, and this was certainly exceptional. The answer proposed in this paper, and incorporated into the model, is that the main cause was the lifting of restrictions on bank lending to the private sector. These restrictions were removed in 1971, just as the CCC era was about to begin, having been in force since 1965. Furthermore, this is not the only such experience during the post-war period. Bank lending restrictions had been imposed in the 1950s and were removed in 1958; their removal was followed by a similar sharp expansion of bank lending.

Model details

29 This section discusses the detailed equations making up the model. The objective can be seen as attempting to explain the elements in the money supply identity described above. However, the pervasive character of money means that this cannot be done in isolation but requires estimation of the inter-relationships existing between money and other markets.

30 As already noted, the model is highly aggregative, and, in fact, consists of only eight equations, estimated employing annual data from 1950-52 to 1976. The degree of aggregation is therefore considerable and many elements which might be thought important have been left out. The more important of these are discussed below, and possible future work will include attempts to incorporate some of these influences. Even so, these preliminary results provide some interesting insights into how an alternative, monetary model might work.

31 It is also necessary to have an explanation of income tax receipts beyond the assumption of an exogenous average rate which has been employed in the expenditure equation. This latter assumption will produce an unstable response during simulation if employed to explain tax receipts, while there exists a non-zero PSBR in the base run.[1] It is unrealistic to estimate a tax rate employing time series data, since this is not a parameter but a policy variable which has been changed frequently. No equation has therefore been included to explain the marginal tax rate which will be described in a more ad hoc, but, it is hoped, realistic, way during simulation.

32 In a number of equations where there seemed good reason for expecting the short-run behaviour to differ from the long-run, this has been allowed for. The procedure, already well tried - Davidson et al (1978) and Hendry (1978) - has been to specify the dependent variable, and all short-run behavioural influences, in first differences, but also to include some form of equilibrium

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[1] The condition for stability, ignoring expenditure taxes for the moment, is that $\frac{G}{Y_p} < t_m$, where t_m is the marginal tax rate.

relationship(s). This approach can be seen clearly in the first equation explaining private sector expenditure.

33 Estimation results for each of the equations have been included in Appendix 1; ordinary least squares (OLS) and two-stage least squares (2SLS) results are given. The 2SLS results have been obtained under the assumption that both the exchange rate and the level of intervention are endogenous to the model. This is achieved by assuming an implicit trade-off relationship between intervention and the change in the exchange rate in which no other predetermined variables enter, other than those already included in the model. Including this assumption, there are a total of fifty-two pre-determined variables. With a maximum of twenty-six observations, and more generally only twenty-three, it was not possible to proceed directly to estimate the included current endogenous variables in the first stage of the two-stage process. The approximation employed to get round this problem was to construct principal components from the set of predetermined variables excluded from the equation being estimated, and to employ the main components in combination with the included predetermined variables. In most cases only six principal components were employed.

34 It is worth noting that 2SLS estimation will only eliminate simultaneous-equation bias as the sample size approaches infinity. With small samples, as here, the simultaneous bias may well not be greatly reduced. The 2SLS estimations are, however, consistent whereas the OLS ones are not.

Real private sector expenditure, EFC

35 The usual approach to the determination of expenditure employs a demand function in which the level of disposable income plays a dominant role. The simultaneity between aggregate expenditures and incomes is often ignored, and saving is treated as a residual. This approach does not generally measure, or enforce consistency with, any particular long-run properties, and there are no constraints on behaviour. It lays emphasis on the determinants of demand and assumes that the supply side of the economy is flexible enough to accommodate any change in demand, though the relationship between actual and potential output sometimes enters as one of the arguments in determining the rate of inflation. Klein (1978), among others, has recently argued

that the time has come to pay much greater attention to supply side influences. This is also an important element in the monetarist approach, e.g. Friedman (1968), which suggests that private sector expenditure should be determined over the long run by the real supply potential of the economy, and that the money supply, together with other demand influences, will have only temporary effects.

36 The absence of supply influences is an important lacuna in the majority of econometric models, and it seemed necessary to make some attempt to try to incorporate a self-equilibrating property of the type suggested above into the model. This has been achieved in the simplest way possible by assuming a constant exogenous growth rate of potential output, GDP, $\bar{Y}$, [1] close to, but always above, the actual GDP series: the relationship between the two series is illustrated in Chart A overleaf. This is obviously an extreme simplification but is possibly not too unreasonable as a first approximation. In any future developments of this type of model, it would be preferable to treat potential output as an endogenous variable. Conventional production functions are probably inadequate for this purpose. Although the stocks of capital and labour are almost certain to be important, the role of new technology and innovation in creating new products, and influencing both potential demand and supply, should not be neglected.

37 A monetarist might expect private sector expenditure, again at factor cost, EFC (= E - TE), in the long run to equal this potential output exactly. This condition has not been imposed since it implies that imports and exports of goods and services should be equal in the long run. Instead, the <u>static</u> equilibrium has been freely determined, defined as: [2]

$$EFC = \alpha (\bar{Y} - G).$$

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[1] Detailed definitions of all variables are given in Appendix 2.

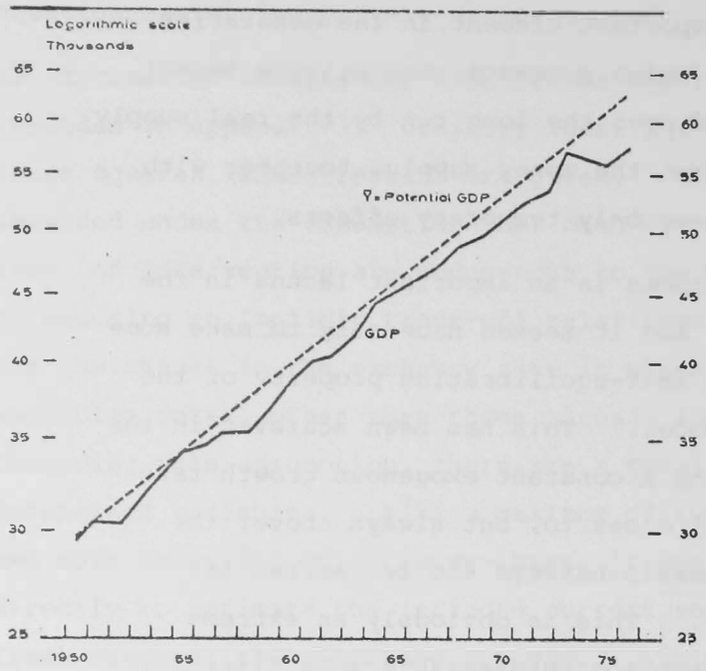
[2] If the short-run equation is defined as:

$$X = a_o + a_1 \Delta Z - a_2 \left[\frac{X}{Y}\right]_{-1}$$

the long-run static equilibrium will be derived by setting all changes equal to zero, and rearranging, so that:

$$X = \frac{a_o}{a_2} Y.$$

Chart A



Various variables were also included to pick up any temporary demand influences, e.g. a change in government expenditure, tax rates, foreign demand, changes in the real money supply and interest rates. Interest rates may also be expected to have a more permanent, long-run effect, either through their effect on the expenditure/saving decisions of the private sector, or by increasing the perceived real cost of capital accumulation:

$$\Delta EFC = f_{EFC}\left\{K,\ \Delta(M/P)_{-i},\ r_{-i},\ \dot{P}_{-i},\ \Delta G_{-i},\ \Delta t_{-i},\ \Delta s_{-i},\ \Delta F_{-i},\ \left[\frac{EFC}{\overline{Y}-G}\right]_{-1}\right\}.$$

38 The final estimated equations are included in Appendix 1, equations A(i) and (ii). It proved impossible to obtain any significant coefficients for real interest rates or for inflation separately. There is, however, evidence of a long-run effect of nominal interest rates on expenditure. Statistically it makes no real difference whether this long-run effect is related to the long rate of interest or to the short rate. The included equation employs the long rate, as this would seem to imply more reasonable long-run behaviour, although real rates would generally be considered more relevant. The coefficient on the foreign demand variable is not really significant, but is nearly so, and has been retained.

39 Several of the potential demand influences proved insignificant and have been excluded. Among these was the change in the expenditure tax rate, Δs, implying that expenditure at market prices will increase by the full amount of any increase in expenditure taxes.

It is interesting to note that changes in the real money supply have a substantial short-run effect on expenditure, but this disappears in the long run. An increase in the own rate on money, r_m, can be interpreted as increasing the demand for money and thereby reducing the direct effect of money on expenditure. The fit of the equation is not too bad, and the estimated standard error of the equation represents less than 0.5 of 1% of the mean of EFC over the estimation period.

40 In practice, it is not realistic to calculate equilibrium for a stationary economy since we know that potential income and therefore expenditure are growing over time. The equilibrium values of the equation have therefore been calculated using the mean values of most of the explanatory variables. Changes in the income tax rate are assumed to be zero, as are changes in prices. And if prices are not to change, this implies that the stock of money grows at a rate sufficient to accommodate the increase in expenditure (see the section on prices below). The resultant long-run equilibrium is:

$$\frac{EFC}{\bar{Y}-G} = 1.0353 - 0.0110r_b.$$

If we were to define an equilibrium interest rate as that which produced EFC = $\bar{Y}$-G, this would be 3.21%. This would, in fact, appear to be a very reasonable estimate of an equilibrium long rate. Over the fifty-five years from 1860 to 1914, which was probably a fairly 'normal' period, Bank rate averaged 3.56% and the Consols rate 3.02%. This was a period of relatively stable prices, with, if anything, a tendency for prices to fall. Within the model, to the extent that inflation leads to an increase in r_b, it will therefore reduce private sector expenditure.

The price level P

41 The obvious long-run property for a monetary model is that the price level should be a function of the money supply, under the assumption that velocity is stable (not necessarily constant). And since money has no long-run effect on expenditure (see above), this implies that prices will tend to increase in proportion with the increase in money supply, less the effect of real growth and

interest rates on the demand for money.[1] Even so, in the short run, sterling import prices may have a substantial direct impact on the domestic price level. This influence will, however, only be permanent to the extent that the money supply responds to any change in import prices. The actual speeds of adjustment have been kept flexible, and the possibility is also included that velocity may be a function of the own rate of interest on bank deposits and alternative interest rates.

42 The basic form estimated was:

$$\dot{p} = f_p \left[K, \dot{P}z_{-i}, \dot{M}_{-i}, \dot{E}_{-i}, \dot{r}_{-i}, \ln r, \ln E_{-1}, \ln \left(\frac{M}{EP}\right)_{-1} \right].$$

43 The fit of the equation is reasonably good, with a standard error below 0.5% of the rate of inflation - see equations B(i) and (ii) in Appendix 1.

44 In the long run with no changes in any of the variables:

$$\ln P = -5.081 + \ln M - 0.4237 \ln E.$$

Alternatively, the equation can be interpreted as defining the long-run demand-for-money relationship, so that:

$$\ln M = 5.081 + \ln P + 0.4237 \ln E$$

$$\text{or } \frac{M}{P} = 160.9E^{0.4237}$$

The long-run expenditure elasticity is much smaller than is generally expected for a broad money aggregate. A possible explanation is that it is really due to a trend increase in the velocity of circulation of money, resulting from such things as increased integration of industry or the development of non-bank financial intermediaries in competition with the banks. For this reason a trend term was included in the equation as a possible, naive representation of such developments. However, when included with the logarithm of expenditure the trend term was invariably insignificant.

45 The estimated long-run expenditure elasticity is, in fact, remarkably similar to that obtained by Laidler and O'Shea (1978) employing a very different approach, and estimating the demand-for-money function directly. Their estimate for the elasticity of the demand for money with respect to permanent income was 0.4. It is

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[1] The average growth rate of the money supply over this period has been 6.41% per annum while the rate of inflation has averaged 5.93% per annum.

not clear that values in this range are particularly unreasonable. While there are good reasons to expect saving, i.e. non-consumption, to be a luxury good, with an income elasticity greater than unity (and the same may also be true of the acquisition of financial assets), there seems to be much less justification for the demand for money to have this characteristic.

46 There is no long-run interest elasticity included in the equation. This means that any long-run effect of interest rates on the supply of money will be fully reflected in changes in the rate of inflation (or in the price level).

47 The long-run unitary elasticity relating money and prices was tested by including $\ln P_{-1}$ separately in the equation, in addition to the constraint variable, $\ln \left[\frac{M}{EP}\right]_{-1}$. The estimated coefficient was small and not significant.

48 The inclusion of expenditure and income tax rates failed to produce any additional explanation of movements in prices. The estimated coefficients were always insignificant, and, if added to the reported equations, made no difference to the estimated coefficients on the other explanatory variables.

49 It was noted above that an increase in the expenditure tax will, in fact, increase expenditure at market prices. This outcome, in combination with a fixed money supply, will have the effect of reducing the price level. As it is, the increase in expenditure tax receipts will reduce the PSBR and further reduce the price level. This type of reaction provides a good example of a major difference between Keynesian models which lay emphasis on fiscal policy, and monetary models in which the transmission of such measures is accomplished through changes in the demand for, and supply of, money. The final equilibrium value is uncertain, as interactions with the rest of the model must also be taken into account. Even so, the path to equilibrium will almost certainly be in the opposite direction to Keynesian models which would assume that an increase in expenditure taxes would be passed on, at least in part, to prices. The expenditure tax rate was included in the bank lending equation but this did not result in a positive effect that might offset the process just described.

Exports, X

50 The position of the United Kingdom as a relatively small country competing in large world markets suggests that one should expect reasonably high price elasticities of demand implied by such an assumption. In the limit these elasticities should be infinite, but it would be too much to hope to estimate such elasticities, particularly employing the composite price indices determined by the small scale of the model. It seems almost impossible to identify high elasticities even in markets where substitution is known to be virtually perfect. In addition, if domestic prices adjust to changes in import prices in the long run, as is necessary if the so-called 'law of one price' is to hold, then the change in relative prices must result in changes in the domestic money supply unless the exchange rate is to adjust. This is because in the long run domestic prices are determined by the money supply. Changes in relative prices therefore need to influence the current account so that this in turn will change the supply of money.[1]

51 It is also necessary to take account of the supply side of the economy and the substitutions which are likely to result from pressures on supply. It was found in the expenditure equation that in equilibrium, and with a reasonable value for the short rate of interest, domestic demand would fully account for potential domestic supply. This implies that in the long run equilibrium exports should approximately equal imports. Moreover, the main pressure to achieve this equality should come from the supply side rather than from the demand side. This is more properly a property of the model as a whole rather than of the individual import and export equations. However, it does suggest that we might expect a greater direct relationship between movements in imports and exports than that suggested simply in terms of the import content of exports.

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[1] However, this does not necessarily require high price elasticities. As long as the balance of payments (and the money supply) change in the desired direction, this flow will continue until price equilibrium is restored. Therefore, given certain minimum conditions, the size of the price elasticities is only important for the speed of adjustment not for the equilibrium conditions.

52 The explanatory variables included in the export equation reflect relative prices, the exchange rate, foreign and domestic demand pressure and imports to reflect supply responses:

$$X = f_X\left[K,\ E_{-i},\ G_{-i},\ F_{-i},\ Z_{-i},\ P_{-i},\ Pz_{-i},\ e_{-i}\right].$$

53 Prices are included separately in order to permit different patterns of response, given the diverse markets involved. It also allows for any differences in the basis upon which the indices have been constructed. Equations were also estimated in logarithmic form but these did not provide such reasonable results as the linear equations. This should anyway be expected if elasticities have not, in fact, been constant over the period of estimation.

54 Imports did not prove significant in the estimated equations C(i) and C(ii) in Appendix 1. The implied elasticities calculated at the mean are given in Table A.

Table A

Variable	Elasticity	
	Short-run	Long-run
P	0	-0.5445
Pz	0.3829	0.4603
F	0.6018	0.6018
E	-0.1902	-0.1902
G	-0.3356	-0.3356
e	-0.3335	-0.3335

Imports, Z

55 The explanatory variables included are the same as for the export equation but with exports in place of imports:

$$Z = f_z\left[K,\ E_{-i},\ G_{-i},\ F_{-i},\ X_{-i},\ P_{-i},\ Pz_{-i},\ e_{-i}\right].$$

56 Exports have quite a substantial effect on imports - equations D(i) and (ii) in Appendix 1 - far in excess of the import content of commodity exports which is about 1/7th of total value,[1] and should be even less when, as here, services are included. No significant role could

[1] Such a value implies a long-run elasticity of under 0.15.

be identified for foreign demand, at least as measured here. The implied elasticities of the included variables, calculated at the mean, are given in Table B.

Table B

Variable	Elasticity	
	Short-run	Long-run
P	0	0.9957
Pz	0	-0.7750
E	0.9720	0.9720
X	0.3052	0.6698
G	0.3614	0.3614

57 The price elasticities are not as high as might be expected on theoretical grounds, but are at least high enough to produce a stable long-run outcome on the current account as the result of a change in relative prices. The calculated elasticities naturally depend on the relative values of variables employed, and it might be of interest to consider some alternative estimates. In the case of the price series there is some tendency for the calculated elasticities to rise over time. Table C gives the long-run import and export price elasticities calculated at the beginning and end of the estimation period, as well as the mean.

Table C

Import and export price elasticities at different points in time

Year	Elasticities			
	Exports		Imports	
	P	Pz	P	Pz
1951	-0.4328	0.4830	0.9880	-1.0151
Mean	-0.5445	0.4603	0.9957	-0.7750
1976	-0.8019	0.6618	1.5335	-1.1651

Net overseas lending to the private sector in sterling, N

58 This aggregate is the net result of all forms of private sector external borrowing and lending, and reflects every variety of portfolio choice both here and abroad. There are, therefore, any number of potential behavioural influences on the final outcome.

Apart from trying to identify significant interest-rate effects the main emphasis has been placed on DCE, relative to nominal expenditure, EP, in the United Kingdom and the United States. The effect could work both through direct substitution for capital flows, and through the influence on exchange rate expectations which such changes might have. The rate of change and level of the exchange rate are included to represent expectations. The lagged stock of money was included to represent the long-run stock equilibrium of the private sector[1] (see the section on the private sector demand for public sector debt - paragraphs 69-74 - for a further discussion of this relationship). However, even without the lagged money stock, the estimated equation still has reasonable long-run properties.

59 The change in the value of the current account, ΔCA, has been included in order to measure accommodating financial movements generated by changes in trade flows. Such an influence has been suggested, and employed in empirical estimates of short-term capital flows for the United Kingdom, by Hodjera (1972), Branson and Hill (1971), and Fausten (1975). It would also be possible to justify the inclusion of the level of the current account, or the cumulated total, to reflect expectations of possible exchange rate movements, in which case a positive sign on the coefficient would be expected. Kouri and Porter (1974), however, have produced an alternative argument suggesting a negative sign on the current account. The sign to be expected on the level of the current account is therefore unclear, particularly as there are reasonable grounds for expecting capital flows to be more sensitive to exchange rate expectations than to relative interest rates alone. Capital flows may well be highly elastic with respect to returns available internationally. These returns, however, are not given simply by the rates of interest quoted, but are likely to be dominated by expected exchange rate movements, particularly in the short run.

60 The basic implicit equation was:

$$N = f_N\left[K,\ DCE_{UK_{-i}},\ EP_{UK_{-i}},\ DCE_{US_{-i}},\ EP_{US_{-i}},\ M_{-1},\ CA,\ \Delta CA,\ e,\ \dot{e}\right].$$

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[1] In this case, neither the dependent variable, nor the money stock, have been deflated by nominal income.

61 The level of the current account, and the lagged stock of money, turned out to be insignificant - see equations E(i) and (ii) in Appendix 1. It is possible to replace the exchange rate by the constant term and get practically the same result, but it is not possible to include both variables, presumably because the exchange rate has itself been so close to a constant over the estimation period. Including the level of the exchange rate as well as the rate of change does, however, produce a stable long-run response of net overseas lending.

62 This equation is a fairly good fit and has reasonable statistical properties, particularly considering the variability of the series and the usual difficulties encountered in trying to identify capital flow equations for this country. The inclusion of the expenditure variables in the form of changes was not an imposed restriction but resulted from freely estimating the equation employing levels of expenditures.

The interest rate on public sector debt, r_b

63 Because the United Kingdom is a relatively small country within the context of world markets, and given the obvious importance of foreign interest rates for domestic rates, the possibility should be considered that r_b is linked in some way to foreign rates; allowing, of course, for expected exchange rate movements. In the long run, assuming no balance of payments deficit, or expectations of exchange rate movements, and no change in domestic short rates, the long-run property of such an equation could be defined as:

$$r_b = k + r_{fb}.$$

64 In the short run, r_b is assumed to be influenced by changes in the domestic short rate, Δr_m, and variables influencing expectations regarding future exchange rate changes. This latter group of variables includes the external currency flow to the private sector, ΔR, relative rates of inflation $\dot{P}-\dot{P}_{US}$, and the percentage change in the exchange rate, $\dot{e}$:

$$\Delta r_b = f_{r_b}\left[K, \Delta r_{m-i}, \Delta R_{-i}, (\dot{P}-\dot{P}_{US})_{-i}, \dot{e}_{-i}, (r_b-r_{fb})_{-i}\right].$$

65 Some considerable effort was put into trying to identify a role for the PSBR or the domestic financing requirement (approximately PSBR + CA + ΔN) but this proved entirely unsuccessful. An

alternative hypothesis that the long rate is related to the short rate in the long run was tested by adding the constraint variable $(r_b - r_m)_{-1}$ to the best equation, but this was not significant.

66 The fit of the equation is quite good, with a standard error which is only 1/5th of 1% of the rate of interest - see equations F(i) and (ii) in Appendix 1. All included variables have the correct a priori sign and are significant. Unfortunately, the inflation differential was not significant, and the same was true for the current rate of change of the exchange rate. As far as the domestic rate of inflation is concerned, it is changes in the rate that seem to be important. In the long run, with no changes in any of the independent variables, and no external currency flows to the private sector:

$$r_b = 0.930 + r_{fb}.$$

67 The short rate of interest is taken to be a policy instrument of the monetary authorities. For the moment, no equation is included for the short rate, but future developments will include work on estimating a reaction function for this variable. For the time being, it is of interest to examine what effect the authorities might have on the economy, within the context of this model, through manipulation of the short rate of interest.

68 Separate interest rates have not been identified to measure both the borrowing and lending rates for banks. These are assumed to move in line with the official short rate, at least over the period of a year, which is the frequency of observation employed here. Given the close correspondence between these two rates and the difficulty in observing the actual marginal rate on bank credit, this may not be too unreasonable as a first approximation. It does mean that we cannot examine the influence of round-tripping (the 'merry-go-round'), but this may not be a great loss as this phenomenon was probably only a temporary one.

Private sector demand for public sector debt, B

69 The natural dependent variable, given that the objective is to explain the financing of the PSBR, is net private sector transactions in public sector debt. It does not, however, follow from this that there is no long-run adjustment towards a stock

equilibrium. Equations incorporating such a process could be specified along the lines already employed in the estimation of expenditure and prices above, and this form has been employed by Friedman,[1] incorporating the stock of assets and private sector wealth, as well as the changes.

70 In this study, a rather different approach has been adopted. It is an approach suggested by the theoretical model employed, and by the assumed characteristics of monetary disequilibrium, but which is also supported by the fact that there are no really reliable series available for wealth holdings. The nominal money stock relative to nominal expenditure, M/EP (the inverse of velocity), lagged one period, has been included in the equation to pick up any disequilibrium effect - in this case, disequilibrium between the stock of money and the stock of bonds. Bank lending also remains to be explained in similar fashion. In order to ensure a long-run stock equilibrium, it is necessary also to include at least one of these two stocks - bank lending or public sector debt.[2] For present purposes, mainly to avoid the problems of trying to measure the relevant stock of public sector debt, the lagged stock of bank lending was included in both equations. In fact, this variable was only significant in the equation explaining public sector debt.

71 In the short run, flow adjustments are very important, and this can be justified in terms of the institutional nature of the gilt-edged market which is dominated by the large long-term investment institutions - insurance companies and pension funds - which have massive annual funds to allocate and presumably long, planned holding periods.

72 A common feature of all the equations explaining financial asset and liability demands in the model, which should be emphasised, is that they do not represent the allocation of predetermined saving. Instead the separate transactions in assets and liabilities need to be aggregated in order to arrive at a total for saving. This view, that the accumulation of financial wealth is not independent of the forms it

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[1] Friedman (1977); however, see also the criticism in Ando (1978).

[2] I am grateful to Peter Spencer for emphasising the importance of this restriction.

takes, is important, and will be retained in future developments of the model. An interesting by-product of this approach is that it permits the value of private sector income to be derived without directly considering the markets within which incomes are generated.

73 The dependent variable is defined as total net purchases of public sector debt by the non-bank private sector divided by nominal private sector expenditure, $\Delta B/EP$. If preferred, it can be thought of as real transactions divided by real expenditure. Various interest rates were included, with lags to allow for the effect of levels and changes. In addition, a number of other variables were incorporated to reflect exchange rate expectations. These include relative rates of inflation, $\dot{p}_{UK}/\dot{p}_{US}$, and total external flows to the private sector (current account plus capital account flows) divided by nominal expenditure, $\Delta R/EP$. This last variable may also incorporate a direct effect of external flows into public sector debt on top of any influence on expectations.

$$\frac{\Delta B}{EP} = f_B \left\{ K,\ r_{-i},\ \left[\frac{\dot{p}_{UK}}{\dot{p}_{US}}\right]_{-i},\ e_{-i},\ \left[\frac{\Delta R}{EP}\right]_{-i},\ \left[\frac{M}{EP}\right]_{-1},\ \left[\frac{L}{M}\right]_{-1} \right\}.$$

74 The fit of the equation is reasonable, and does at least identify various interest-rate effects - see equations G(i) and (ii) in Appendix 1. The short rate, r_m, only appears as a first difference, indicating that it has no long-run effect. At first sight this may seem somewhat strange, but it is, in fact, consistent with the long-run properties of the implicit demand-for-money function which is independent of any interest-rate differential between money and public sector debt. There is also a long-run effect of any increase in r_b which is not directly accounted for by substitution out of other financial assets. According to the rest of the model, these transactions will be financed partly by reducing expenditures and partly by additional borrowing from the banks. The long-run properties of this equation are crucially dependent on the effect of the lagged money supply and stock of bank lending. The sign on this latter variable is consistent with rational portfolio behaviour in that the higher the stock of bank lending the lower the purchase of public sector debt, bearing in mind that there is also a positive effect of an increase in bank lending on public sector debt sales coming through the effect on the money supply. Reducing purchases of, or selling, public sector debt is an

alternative means of obtaining finance. If bank lending is regarded as a negative asset of the private sector, then the estimated relationship clearly helps to restore the natural balance of the portfolio.

Bank lending to the private sector, L

75 When quantitative restrictions have been placed on banks, a period of credit rationing should be expected during which it would not be possible to observe points along a demand curve for bank credit. It had originally been the intention to split the period up in this way, but there are, in fact, insufficient degrees of freedom to allow this. The alternative adopted has been to estimate a demand function including a dummy for those periods when quantitative restrictions were in force. This has the effect of shifting the whole demand function down at such times, but still assumes that the other behavioural determinants have the same influence as before. This is unfortunate and is likely to lead to an underestimate of the true effects of these variables during uncontrolled periods.

76 Most previous empirical work that has attempted to take account of the effect of quantitative controls has included this influence only in combination with qualitative instructions to the banks. This has been done by employing a 0, 1, 2 dummy, which is a variable I have also used in the past (Coghlan, 1975). Such an approach is, however, inadequate. Qualitative instructions and quantitative controls are not differences in degree, they are differences in kind. Separate dummies have therefore been included for each of these policy options; ID and QD respectively.

77 There is also another weakness associated with using a single dummy variable to represent quantitative controls (whichever way it is defined). If quantitative controls really do result in banks rationing credit to the private sector, as surely they must, then the longer these controls are in force the greater must become the pressure of pent-up demand for bank credit. In order to capture this effect, a pressure variable, PR, which reflects the duration of the quantitative controls, has been included at times when quantitative restrictions have been removed.

78 The other explanatory variables included in the specification are: the rates of change of real private expenditures, $\dot{E}$, and prices, $\dot{P}$, to represent both an acceleration in financing needs and expectations about the future; various interest rates; the percentage of special deposits called from the banks, SD;[1] the lagged stock of money relative to nominal expenditure so as to pick up the disequilibrium stock effects; the stock of banks' loans to the private sector relative to private sector money balances lagged one period $[L/M_{-1}]$ for similar reasons; and the change in the current account plus external capital flows to the private sector divided by nominal expenditures, $\frac{\Delta R}{EP}$, in order to capture any direct substitution between inflows from abroad and the need to borrow from the banks. To the extent that these foreign inflows influence expectations, this might be expected to be in a favourable direction and therefore result in the opposite sign in the equation, i.e. to increase bank borrowing. This suggests that perhaps other variables should be considered which might influence exchange rate expectations.

79 The basic form estimated was:

$$\frac{\Delta L}{EP} = f_L\left\{K, \dot{E}_{-i}, \dot{P}_{-i}, \left[\frac{\Delta R}{EP}\right]_{-i}, e_{-i}, r_{-i}, ID, QD, PR_{-i}, SD_{-i}, \left[\frac{M}{EP}\right]_{-1}, \left[\frac{L}{M}\right]_{-1}\right\}.$$

80 The only significant interest-rate effect was obtained for the long rate - see equations H(i) and (ii) in Appendix 1. Unfortunately it was impossible to obtain a significant coefficient for the own rate of interest, r_m. This may be because the rate used was an inadequate measure of the bank lending rate. Another possibility is that the inability to separate controlled and uncontrolled periods (see above) has obscured the interest-rate sensitivity of unrestricted demand for bank credit.

81 Instructions to the banks to restrict credit, including the supplementary special deposits scheme, appeared to have no effect.[2] Quantitative restrictions, on the other hand, significantly reduce bank lending, but the value of this appears to be more than offset subsequently by the force of the excess demand that builds up and is accommodated once the controls are removed. The imposition of

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[1] For a detailed justification of such an effect see Coghlan (1973).

[2] This does not necessarily mean that this variable has no effect since it may possibly be an alternative to changes in the short-term interest rate, which are taken to be exogenous for present purposes.

special deposits also has the effect of reducing bank lending, but this is only temporary and there is no significant long-run effect.

82 An increase in the value of the exchange rate seems to result in a temporary increase in bank lending. This will at least produce a stable response, increasing the money supply, and tending to offset any further increase in the exchange rate. A possible explanation of this effect could be the favourable influence on expectations referred to above, and/or a temporary decline in profitability not compensated for by any fall in import prices.

83 The Durbin-Watson statistic is rather high, but this is a poor indication of first-order autocorrelation given the size of the sample and the limited degrees of freedom available. Inspection of the residuals, in fact, indicates no evidence of negative first-order autocorrelation. As with the demand for public sector debt, the stock of money is an important determinant of bank lending in the long run.

Conclusion

84 The equations of the model have been estimated without the aid of dummy variables for strikes, prices and incomes policies, union organisation, unemployment or the introduction of CCC. It is perfectly possible that some of these variables have had a short-run influence, but it has still been possible to explain prices and expenditure, etc. quite well without them. If nothing else, these equations demonstrate the possiblility of explaining movements in important economic aggregates in terms which are very different from those usually employed. There is, therefore, some tentative support for the integrated monetary approach proposed here.

85 These equations represent a starting point for further development. There is a great deal that could be done in the future, as indicated above. The next stage in this particular project is to simulate the 2SLS model to provide evidence on the dynamic properties of the model, i.e. its stability and the dynamic effects of changes in exogenous variables. In the process it may be that it will become necessary to make amendments to the existing model, and require the re-estimation of certain equations. It is to be hoped that these changes will not need to be very great, although we should not be too surprised: all models, including those of long standing, are subject to continual, and quite substantial, adaptation and amendment - see McNees (1978).

Appendix 1

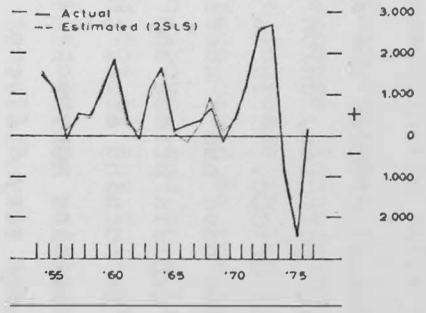
OLS and 2SLS estimation results [a][b]

A Private sector expenditure, EFC

The dependent variable is the change in private sector expenditure measured at factor cost, EFC

	K	$\Delta(M/P)$	$\Delta(M/P)_{-1}$	$\Delta(M/P)_{-2}$	r_{b-1}	Δr_{m-1}	Δr_{m-2}	Δt_{y-1}	ΔF_{-1}	$(EFC/\bar{Y}-G)_{-1}$
A(i) OLS	10465.1	0.1831	0.3860	0.2973	-108.65	-345.66	-99.02	-18607.9	0.01073	-9822.38
	(7.66)**	(4.41)**	(8.20)**	(3.47)**	(3.46)**	(8.11)**	(2.28)**	(3.40)**	(1.69)	(6.97)**
						$\bar{R}^2 = 0.983$	se = 143.71	DW = 2.003	df = 13	
A(ii) 2SLS	10478.0	0.1777	0.3870	0.2950	-108.24	-348.00	-99.85	-18717.7	0.01092	-9839.89
	(7.66)**	(3.95)**	(8.20)**	(3.44)**	(3.43)**	(7.98)**	(2.29)**	(3.41)**	(1.71)	(6.98)**
						$\bar{R}^2 = 0.983$	se = 143.52	df = 13		

The change in private sector expenditure at factor cost, ΔEFC

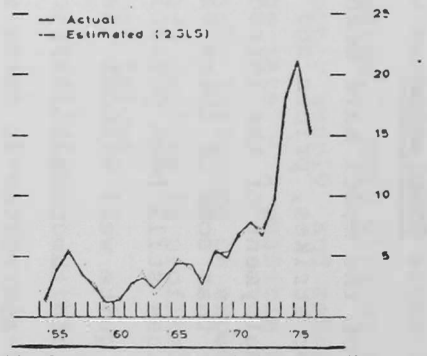


B Prices, P

The dependent variable is the rate of change of $P = \dot{P} = \Delta \ln P$

	$\dot{K}$	$\dot{P}z$	$\dot{P}z_{-1}$	$\dot{P}z_{-2}$	$\dot{M}$	$\dot{M}_{-2}$	$\dot{E}$	$\dot{E}_{-1}$	$\dot{E}_{-2}$	$\ln E_{-1}$	$\dot{r}m_{-1}$	$\ln\left[\frac{M}{EP}\right]_{-1}$
B(i) OLS	-1.009	0.0932	0.2425	0.2220	0.0952	-0.1778	-0.5495	0.3044	0.1046	0.1155	-0.0502	0.2094
	(4.06)**	(3.86)**	(7.54)**	(9.10)**	(3.45)**	(3.83)**	(5.32)**	(4.37)**	(2.65)*	(4.45)**	(4.63)**	(7.60)**
							$\bar{R}^2 = 0.994$	se = 0.00428	DW = 2.704	df = 11		
B(ii) 2SLS	-1.162	0.0703	0.2283	0.2276	0.0988	-0.1941	-0.6268	0.3349	0.1003	0.1318	-0.0561	0.2287
	(3.95)**	(2.40)*	(6.35)**	(8.68)**	(2.95)*	(3.87)**	(4.53)**	(4.22)**	(2.32)*	(4.30)**	(4.12)**	(7.18)**
							$\bar{R}^2 = 0.993$	se = 0.00454	df = 11			

The rate of inflation, $\Delta \ln P$



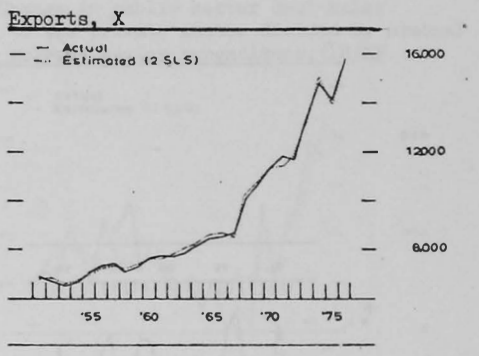
[a] The econometric results are given with the relevant t statistic in parenthesis below each coefficient. The other statistical measures reported are: the coefficient of determination corrected for degrees of freedom, $\bar{R}^2$: the standard error of the equation, se; the Durbin-Watson d statistic, DW; and the degrees of freedom, df, for the equation. The t statistic associated with each coefficient is starred to indicate whether it is significant at the 5% level* or the 1% level**. These significance levels are given for a two-tail test. In those instances for which we have some a priori expectation of the sign to be expected the criteria employed will understate the significance of the coefficients.

[b] Charts are also included showing the movements of the actual series relative to the estimated values. These provide a visual impression of the goodness fit of the equations together with the volatility of the individual series.

C Exports, X

The dependent variable is the level of exports of goods and services measured at constant prices, X

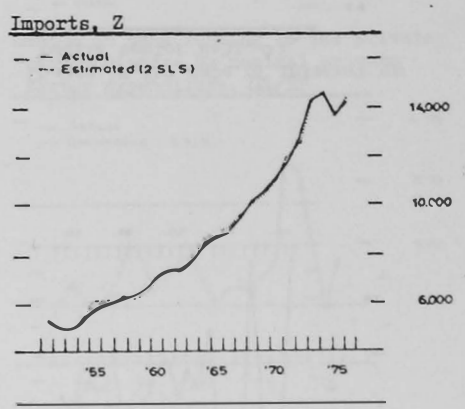
	K	TIME	P_{-1}	Pz	Pz_{-2}	e	F	G	E
C(i) OLS	10924.3	143.04	-5302.4	3137.3	613.49	-1015.7	0.03133	-0.2964	-0.08112
	(9.44)**	(3.40)**	(5.99)**	(8.13)**	(2.51)*	(2.97)**	(14.01)**	(5.23)**	(1.88)*
	$\bar{R}^2$ = 0.998	se = 131.64	DW = 2.725	df = 17					
C(ii) 2SLS	10859.1	131.00	-5686.6	3363.8	680.01	-1180.7	0.03019	-0.2884	-0.05548
	(8.56)**	(3.01)**	(5.60)**	(7.46)**	(2.65)*	(2.69)*	(11.90)**	(4.98)**	(1.14)
	$\bar{R}^2$ = 0.998	se = 133.83	df = 17						



D Imports, Z

The dependent variable is the level of imports of goods and services measured at constant prices, Z

	K	TIME	P_{-1}	P_{-2}	Pz_{-1}	Pz_{-2}	E	X	X_{-1}	G
D(i) OLS	-7352.7	-316.98	4786.01	4357.3	-3149.6	-2685.7	0.2983	0.2835	0.3421	0.2836
	(8.06)**	(8.15)**	(3.77)**	(3.93)**	(3.12)**	(3.78)**	(6.93)**	(4.50)**	(4.66)**	(5.45)**
	$\bar{R}^2$ = 0.999	se = 115.94	DW = 2.163	df = 16						
D(ii) 2SLS	-6730.4	-304.03	5207.82	4613.9	-3593.1	-2837.3	0.2678	0.2882	0.3443	0.2933
	(6.66)**	(7.06)**	(3.63)**	(3.98)**	(3.20)*	(3.82)**	(5.59)**	(3.63)**	(4.07)**	(5.40)**
	$\bar{R}^2$ = 0.999	se = 117.79	df = 16							



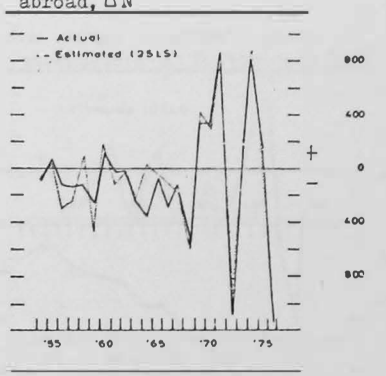
OLS and 2SLS estimation results (continued)

E Private sector capital flows, N

The dependent variable is the flow of net overseas lending to the private sector, ΔN

	e	DCE_{UK}	$DCE_{UK_{-1}}$	ΔEP_{UK}	DCE_{US}	ΔEP_{US}	ΔCA	$\dot{e}$
E(i) OLS	-98.12	-0.4087	0.1898	0.1711	0.01566	-0.00648	-0.2089	4991.6
	(4.25)**	(9.16)**	(6.77)**	(4.37)**	(5.28)**	(2.15)*	(3.28)**	(5.09)**
				$\bar{R}^2$ = 0.893	se = 154.7	DW = 2.140	df = 15	
E(ii) 2SLS	-100.07	-0.4289	0.1842	0.1893	0.01565	-0.00662	-0.2516	5075.5
	(4.21)**	(8.90)**	(6.24)**	(4.42)**	(5.11)**	(2.13)*	(3.46)**	(5.08)**
				$\bar{R}^2$ = 0.889	se = 157.2	df = 15		

Private sector capital flows from abroad, ΔN

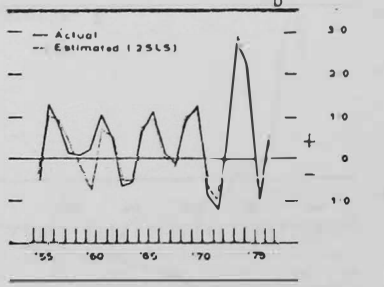


F Long rate, r_b

The dependent variable is the change in the rate of interest on public sector debt, Δr_b

	K	Δr_m	$\Delta r_{m_{-1}}$	ΔR	$\Delta \dot{P}_{-1}$	$\dot{e}_{-1}$	$(r_b - r_{fb})_{-1}$
F(i) OLS	0.2959	0.4929	0.1614	-0.000301	5.2502	-4.1603	-0.3271
	(4.74)**	(13.08)**	(4.40)**	(4.72)**	(2.28)*	(2.42)*	(4.39)**
				$\bar{R}^2$ = 0.956	se = 0.2062	DW = 1.489	df = 16	
F(ii) 2SLS	0.2767	0.5148	0.1492	-0.000237	5.598	-3.6400	-0.2832
	(4.18)**	(12.03)**	(3.81)**	(2.82)*	(2.34)*	(2.00)	(3.34)**
				$\bar{R}^2$ = 0.954	se = 0.2125	df = 16	

Change in the rate of interest on public sector debt, Δr_b

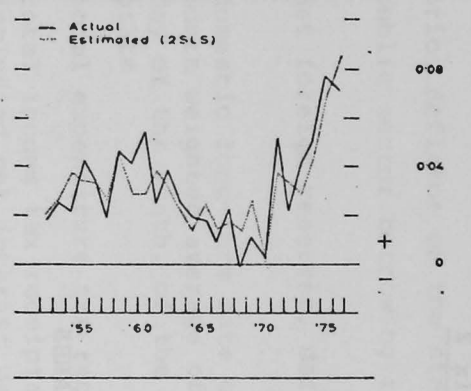


G Private sector demand for public sector debt, B

The dependent variable is the net transactions in private sector holdings of public sector debt, excluding notes and coins, divided by nominal private sector expenditure, $\Delta B/EP$

	r_b	r_{fb}	Δr_{r_o}	Δr_m	$(M/EP)_{-1}$	$(L/M)_{-1}$
G(i) OLS	0.01420 (4.68)**	-0.006248 (1.71)	-0.02336 (4.20)**	-0.005353 (2.77)*	0.04918 (4.17)*	-0.09324 (2.86)**
	$\bar{R}^2 = 0.898$ se = 0.01197 DW = 2.143 df = 19					
G(ii) 2SLS	0.01515 (4.69)**	-0.007067 (1.87)	-0.02367 (4.24)**	-0.005638 (2.86)**	0.05040 (4.23)*	-0.09761 (2.95)**
	$\bar{R}^2 = 0.623$ se = 0.01200 df = 19					

Change in public sector debt sales to the private sector divided by nominal private sector expenditure, $\Delta B/EP$

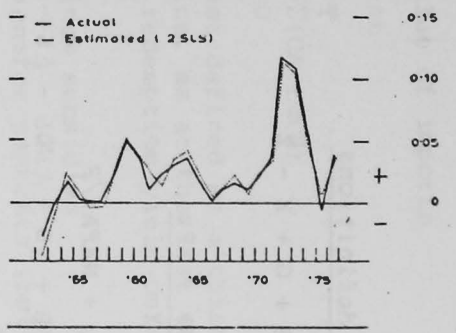


H Bank lending, L

The dependent variable is the flow of new bank lending to the private sector divided by nominal private sector expenditure, $\Delta L/EP$

	$\dot{E}$	$\dot{E}_{-1}$	r_b	QD	PR	PR_{-1}	ΔSD	$\dot{e}_{-1}$	$(M/EP)_{-1}$
H(i) OLS	0.3261 (6.55)**	0.1841 (3.95)**	0.006543 (9.97)**	-0.01159 (3.27)**	0.005484 (3.15)**	0.01087 (6.08)**	-0.005799 (2.62)*	0.1711 (2.57)*	-0.05362 (6.37)**
	$R^2 = 0.965$ se = 0.00781 DW = 2.901 df = 16								
H(ii) 2SLS	0.4147 (5.65)**	0.1746 (3.40)**	0.007003 (9.10)**	-0.01214 (3.12)**	0.004889 (2.53)*	0.00984 (4.83)**	-0.006007 (2.67)*	0.1822 (2.48)*	-0.06080 (6.02)**
	$\bar{R}^2 = 0.930$ se = 0.00855 df = 16								

Change in bank lending to the private sector divided by nominal private sector expenditure, $\Delta L/EP$



Appendix 2

Identities and definitions

$Y \equiv$ GDP $E + G + X - Z$

$Pz \equiv Pz\$/e$

$Ph \equiv \frac{P(Y + Z) - ZPz}{Y}$

$Yp \equiv E + (Ty + NAFA)/P$

$NAFA \equiv \Delta NC + \Delta B + \Delta D + \Delta NDL - \Delta L - \Delta N + \Delta NARES$

$t \equiv Ty/Yp.P$

$s \equiv T_E/EFC.P$

$EFC \equiv E - T_E/P$

$PSBR \equiv G.P - Ty - T_E + PBRES$

$CA \equiv X.P - Z.Pz + CARES$

$DCE \equiv PSBR - \Delta Dg - \Delta B + \Delta L$

$\Delta R \equiv CA + \Delta N$

$\Delta M \equiv DCE + \Delta R - \Delta NDL$

$\equiv PSBR - \Delta Dg - \Delta B + \Delta L + CA + \Delta N - \Delta NDL$

$D \equiv M - NC$

Variables included in the model

(i) Endogenous variables

B = net private sector lending to the public sector

CA = nominal value of the current account of the balance of payments

D = private sector sterling-denominated bank deposits

DCE = UK domestic credit expansion

E = total private sector expenditure at constant 1970 market prices

EFC = total private sector expenditure at constant 1970 factor cost

e = sterling/dollar exchange rate

L = bank lending in sterling to the private sector

Lg = bank lending to the public sector; in sterling, £Lg, and foreign currency, $Lg

M = private sector sterling-denominated money balances

NAFA = net acquisition of financial assets by the private sector including the residual error in the flow of funds accounts (identical to the residual in the national income/expenditure accounts)

N = net external liabilities of the private sector in sterling

NC = private sector holdings of notes and coins

P = price deflator of total final expenditure

Ph = domestic costs of production, i.e. the GDP deflator

Pz = price deflator of the sterling value of imports

PSBR = public sector borrowing requirement

R = net foreign reserves, defined as $\sum_{0}^{T}(CA + \Delta N)$

r_b = domestic long-term rate of interest defined as a thirteen-month weighted average of the value, as at the last working day of the month, of the average redemption yield on five-year gilts

T_E = total expenditure tax receipts minus subsidies

T_y = total income tax receipts less transfer payments (but not including net interest payments)

X = exports of goods and services valued at constant 1970 prices

Y = gross domestic product at constant 1970 market prices

Yp = private sector income at constant 1970 market prices

Z = imports of goods and services at constant 1970 prices

(ii) Exogenous variables

CARES = residual making up the current account identity, and consisting of the current value of net property income and transfers from abroad

DCE_{US} = domestic credit expansion in the United States, as defined in the IMF's International Financial Statistics

Dg = public sector bank deposits, in sterling, £Dg, and foreign currency, $Dg

EP_{US} = nominal private sector expenditure in the United States

F = an index of world demand; the constant 1970 dollar value of world exports, as listed in the IMF's International Financial Statistics, excluding the United Kingdom

ID = 0, 1 dummy variable to represent qualitative instructions to banks to restrict lending to the private sector, including 'corset' controls

G = public sector expenditure on goods and services valued at 1970 expenditure prices

NARES = residual making up NAFA by the private sector, essentially made up by public sector lending to the private sector

NDL = non-deposit liabilities of the banking sector; equity and reserves

P_{US} = United States GNP deflator

Pz$ = foreign currency price of imports

PBRES = residual making up the PSBR, made up of grants and transfers not already included, e.g. net interest payments, and changes in financial assets of (lending by) the public sector

PR = a dummy variable to reflect the removal of quantitative restrictions on bank lending when its value is the number of years controls were imposed, and zero at all other times

QD = 0, 1 dummy variable to represent quantitative controls (ceilings) on bank lending to the private sector

r_{fb} = overseas long-term rate of interest; defined as the US corporate bond rate (total), average of daily figures

r_{fs} = overseas short-term rate of interest; defined as the US Treasury bill rate, average rate of new issues

r_m = rate of interest on bank deposits and loans; pre-1964 this is Bank rate, post-1971 it is the inter-bank rate, and between these dates it is a weighted average of the two

SD = percentage of special deposits called from the banks, daily average

s = average expenditure tax rate

t = average income tax rate

T = time trend

$\overline{Y}$ = potential GDP at constant 1970 factor cost

Variables included in component identities but not included in the final model equations and identities

Bf = net overseas lending to the public sector, including all public sector flows entering the capital account of the balance of payments, but excluding that overseas lending which is a counterpart of the official financing requirement

BOF = balance for official financing

Df = bank deposits held by the overseas sector

$Dp = foreign currency bank deposits of the private sector

Lf = bank lending to the overseas sector

$Lp = bank lending in foreign currency to the private sector

Nf = net external claims on the private sector

Additional definitions

$x = \Delta \ln x$

Δ = first difference operator

x_{-i} = the ith period lag of x

Appendix 3

Derivation of money supply identity

86 To begin with we need to establish three basic identities: for money, for the PSBR, and for the balance for official financing (BOF).

87 The change in the stock of sterling M_3 ($£M_3$) can be derived from the banking sector's flow of funds accounts, plus non-bank holdings of notes and coins, as follows:

$$\Delta£M_3 \equiv \Delta NC + \Delta£Lg + \Delta£Lp - (\Delta Df - \Delta Lf) - (\Delta\$Dp - \Delta\$Lp) - (\Delta\$Dg - \Delta\$Lg) - \Delta NDL. \quad (1)$$

The change in $£M_3$ is equal to the changes in notes and coin (ΔNC), bank lending in sterling to the private and public sectors ($\Delta£Lp$ and $\Delta£Lg$), the net overseas indebtedness of the banking sector ($\Delta Df - \Delta Lf$), the net foreign currency position of the private and public sectors with the banks ($\Delta\$Dp - \Delta\$Lp$) and ($\Delta\$Dg - \Delta\$Lg$), and the change in the non-deposit liabilities of the banking sector (ΔNDL).

88 $$PSBR \equiv \Delta NC + \Delta Bp + \Delta Bf + \Delta£Lg + \Delta\$Lg - BOF. \quad (2)$$

The PSBR plus BOF is financed by issues of notes and coin, and net lending by the private, overseas[1] and banking sectors to the public sector (ΔBp, ΔBf, $\Delta£Lg$ and $\Delta\$Lg$).

89 $$BOF \equiv CA + \Delta Nf + \Delta Bf + (\Delta Df - \Delta Lf). \quad (3)$$

BOF is equal to the current account plus the change in net overseas lending from abroad to the private and public sectors (ΔNf and ΔBf), plus the banking sector's net overseas indebtedness.

90 By substituting for $\Delta£Lg$ in 1 from 2 we obtain:

$$£M_3 \equiv PSBR - \Delta Bp + \Delta£Lp + BOF - \Delta Bf - (\Delta Df - \Delta Lf) - (\Delta\$Dp - \Delta\$Lp) - \Delta\$Dg - \Delta NDL. \quad (4)$$

91 It is now possible to see that although BOF provides a reasonable measure of the balance of payments position of the United Kingdom, it fails to provide an adequate measure of external influences on the money supply. If BOF is to represent external influences on the

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[1] This obviously does not include that overseas lending which is a counterpart of the official financing requirement, but it does include all other public sector flows entering the capital account of the balance of payments.

money supply, what might loosely be called the 'change in reserves' (R) than the other items on the right hand side of the identity must add up to domestic credit expansion, i.e.:

$$\Delta M \equiv DCE + \Delta R. \qquad (5)$$

92 This, however, is a most unsatisfactory set of definitions, as should be clear from an inspection of the components making up BOF, identity 3. To take just one example, an increase in public sector borrowing from abroad will increase BOF and Bf, in identity 4, by an exactly equal, and offsetting amount. If BOF were to be interpreted as a change in the external counterpart to the money supply, this means that there is an exactly equal and opposite change in domestic credit and foreign reserves. A change in BOF, in fact, tells us absolutely nothing about the money supply, past, present or future. This is hardly consistent with the monetary approach to the balance of payments which at a very minimum requires the definition of domestic credit to be independent of the definition of the external couterparts. It is also not a very useful definition to employ for determining the money supply.

93 In order to provide a more consistent definition, and to concentrate attention on those elements of the external account that have an independent effect on the money supply, it is necessary to substitute in for BOF from identity 3. This gives:

$$\Delta £M_3 \equiv [(PSBR - \Delta \$Dg) - \Delta Bp + \Delta £Lp] + CA + \Delta Nf - (\Delta \$Dp - \Delta \$Lp) - \Delta NDL \qquad (6)$$

94 If we now subtract public sector sterling-denominated bank deposits from both sides to give $£M_3$ held by the private sector, M:

$$\Delta M \equiv [(PSBR - \Delta Dg) - \Delta B + \Delta L] + CA + \Delta N - \Delta NDL \qquad (7)$$

where

$\Delta M = \Delta £M_3 - \Delta £Dg$

$\Delta Dg = \Delta \$Dg + \Delta £Dg$

$\Delta B = \Delta Bp$

$\Delta L = \Delta £Lp$

$\Delta N = \Delta Nf - (\Delta \$Dp - \Delta \$Lp)$, i.e. net borrowing from abroad in sterling - which is a loose interpretation of net borrowing from abroad less the net foreign currency deposit/liability position of the private sector with the banking sector.

95 The definition of domestic credit in identity 6 is similar to the official definition. The only difference is that the change in external lending in sterling by the banks and the change in public sector foreign currency deposits should be added to the total and

subtracted from the 'reserves' component. The existence of these common elements makes the official definition less useful for present purposes. However, common elements do still exist in identities 6 and 7. This is because the current account includes the external transactions of the public sector which will also be reflected in the PSBR with the opposite sign;[1] while it is possible to identify some of these transactions it is not possible to do so for the majority. For the moment this problem has been ignored, but it might be possible to improve the series in future work.

[1] This, and other points, are discussed in greater detail in Coghlan (1978 b).

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