RULES VERSUS DISCRETION IN U.K.

MONETARY POLICY

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The purpose of this study is to analyse, compare and evaluate two alternative policies for stabilizing the economy. These refer to the "Rules versus Discretion" debate with particular reference to the U.K. monetary policy. With this aim in mind, a model is built which attempts to capture the main elements of both the income-expenditure approach as well as the monetarist approach. The rationale of this framework of analysis emanates from the fact that the income-expenditure camp advocates "discretion" whereas the monetarist camp supports "rules". Therefore particular attention is paid to the specification of each equation so that the alternative hypotheses which underlie the two opposing views would explicitly be taken into consideration. In addition, special emphasis is given to the interrelationships between the real and the monetary sector of the economy and the associated lags. The model thus specified is subsequently estimated by the method of A.R.T.S.L.S., and then evaluated by subjecting it to dynamic simulations. The strength as well as the timing of monetary policy is examined by deriving dynamic multipliers for various endogenous variables. Finally, policy simulations are conducted to test whether "Rules" or "Discretion" achieve a better stabilization in terms of reducing the amplitude of the cyclical behaviour of the economy. On these grounds, it turns out that "Discretion" is to be preferred over "Rules".
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CHAPTER I

THEORETICAL AND EMPIRICAL FOUNDATIONS OF
RULES VERSUS DISCRETION

I.1 Introduction

Current economic thinking regarding the management of the economy centres around two well distinct views. According to the first the economic system is equipped with automatic forces that stabilize the economy. The idea is very old, in fact dates back to the writings of Adam Smith who thought that all it was done by the "invisible hand". Faith in its efficacy has revived nowadays with the development of monetarism or the "monetarist revolution", as some economists have called it. (1) The advocates of this new lessez-faire view claim that active stabilization policy causes more fluctuations than it cures and therefore their main policy prescription can be summarized as a call for limited government intervention. (2)

(2) For example, Friedman, one of the main protagonists of this new lessez-faire view, has put it like this: "... the market ... is ... the only means so far discovered of enabling individuals to coordinate their economic activities without coercion. I recognize that government has an important role to play, but I am suspicious of assigning to government any functions that can be performed through the market, both because this substitutes coercion of voluntary cooperation in the area in question and because, by giving government an increased role, it threatens freedom in other areas". Friedman (1960, p.4).
The second view stems from the Keynesian revolution the message of which, according to Leijonhufvud, is that there is no "invisible hand" or an auctioneer and therefore government intervention is needed when the economic system shows signs of "malfunctioning".

The present thesis attempts to provide an answer to these opposite and conflicting views regarding government intervention in one important area: managing the economy through monetary policy. In particular, this study is concerned with whether the monetary authorities in the U.K. ought to pursue a discretionary countercyclical stabilization policy or ought to abstain from such practices and instead follow a policy of less intervention by adopting a simple rule for one of the monetary aggregates.

As it is well known monetary policy is only one instrument at the disposal of the government to influence the so-called macro-economic target variables; the other major instrument is fiscal policy, although in recent years incomes policy has also become equally important. It should be stressed though that the present thesis leaves aside the question of the efficacy of the other instruments of economic policy. This, of course, does not mean to imply that monetary policy is in any way more important than its rival policies.

The problem the authorities are faced with can be viewed as follows. The economy grows following a cyclical path as the one illustrated in fig. 1. The stabilization target can then be thought of as an attempt to dampen
these cycles; theoretically speaking one may visualize it as an attempt to fully eliminate these cycles, that is, allow the economy to grow on its trend. In terms of this analysis our objective is to analyse and evaluate different policy prescriptions for stabilizing the economy. In particular we examine two views. According to the one, the new lessez-faire view, the appropriate policy is the formulation of a simple rule for one of the monetary aggregates; for example a 5% increase in the money stock. According to the other, the Keynesian or better the non-monetarist camp, the appropriate policy is one of discretion, that is changing monetary policy by making it easy or tight in accordance with some indicators of the state of the economy in comparison with the desired state.

One must be clear nevertheless about the precise meaning and nature of the policy of a rule and of the policy of discretion. Rules may, in general, refer to the guiding of policy or to the structure of the system itself. A provision for increasing the money supply by a fixed rate each year would be a rule in the guiding sense. A 100 percent reserve ratio is a rule in the structuring sense. A commitment to confine open market operations to Treasury bills only is a rule in that it confines the limits whereupon a particular method is to be applied.

In these terms the controversy of Rules versus Discretion may seem to be one of degree. But reconcili-
ation on these grounds, as Whittlesey has pointed out, "is unlikely on either the role of rules in the exercise of discretion by central banks or the degree of discretion that should be allowed in the observance of rules". (3)

It must be stressed that the purpose of a rule is to preclude or to circumscribe discretion. A rule is inconsistent with discretion. But the opposite is not true: discretion is not inconsistent with rules. Indeed, a wise discretionary policy not only allows rules but also presumes their existence. Discretion is against universal rules. As Professor Sayers has once put it "we are doomed to disappointment if we look for rules applicable to all times and places. We have central banks for the very reason that there are no such rules". (4)

In our case, following a rule does not mean that the authorities remain idle but instead that they manipulate their instruments so as to achieve the desired percentage increase in the money stock, for example. Certainly what this means, and this is of enormous importance, is that the authorities do not attempt to set their instruments so as to change the actual path of some of the final target variables, e.g., the level of economic activity, as in the case of discretionary stabilization policy. What is at issue therefore is whether aiming at controlling intermediate targets (all monetary aggregates may be considered as such) or final targets produces better stabili-

(3) Whittlesey (1968, p.252)
(4) Sayers (1957, p.7)
lization. In this context it is the belief of the proponents of this new lessez-faire view that aiming at a desired percentage increase in one monetary aggregate, e.g., money stock, would produce a better stabilization than in the case where active stabilization would be undertaken. And we are led to ask why? Is it simply a matter of the authorities committing errors in the application of monetary policy? Or is it that the alternative policy prescriptions follow from different theorizing of how the economy works? If the answer depends on the first factor alone then the problem loses some of its importance in that it is restricted in time and place. For example, it might turn out that rules are to be preferred for the U.K. economy. But from such evidence alone nothing can be deduced, not even indicatively, about any other country. Even within the U.K. rules might be preferred today but tomorrow discretion might produce even better results. The problem in this case becomes one of perfecting information or technically speaking, one that belongs to the targets-indicators issue.

If on the other hand the problem stems from different theorizing of how the economy works then the implications are more general. We believe that although much depends on the first factor the significance of the latter is even more important. A definite answer, however, must await until after we have examined the theoretical framework that underlies the views of each camp.
1.2 The Theoretical Framework of the New Lessez Faire View

The central postulate of this view is that changes in the stock of money will cause, after a lag, changes in aggregate money income. In particular, it is argued that, while in the short run money affects real variables - output, employment, real rate of interest - in the long run - defined as the situation where expectations are realized - it determines the level of prices, the inflation rate. One implication is that there is no "trade off" between inflation and unemployment in the long run, only in the short run. Whatever the market shows as unemployment rate this is the "natural rate" due to friction and voluntary search activity. The causes of inflation are excess demand and expectations.

The insight of this postulate rests on the following argument: Starting from a position of long run equilibrium with constant prices a permanent increase in the rate of change of the money stock will have the effect of reducing the real as well as the nominal rate of interest. This will stimulate investment and hence output. Thus unemployment will be reduced in the initial stages. But the increase in income will lead to an increase in the demand for money and hence to a rise in the interest rate. Moreover, the demand for loans would increase too and this provides an additional reason for a rise in the
interest rate. Hence, while the initial effect of the monetary increase is a fall in the real and nominal rate of interest, at a later stage this effect will be reversed and both rates would tend to come back to their original levels. Since the prices of the products respond more quickly to excess demand than the prices of the factors of production - hence assuming a demand-pull approach to inflation - households will start asking for bigger wages. Expectations of further increase in prices will make wages grow faster than prices and this will reverse the initial tendency of unemployment to fall. Assuming now that expectations of price changes are based on the history of actual changes with a very high speed of adjustment only the nominal rate of interest will be affected which will move to clear the money market. However, since the nominal rate is assumed to have no effect on any real variables no further adjustment in output and employment will occur, as a result of the initial monetary action. Adjustment in output and employment, though, will still take place due to expectations alone - the rise in the rate of change of wages will help to create more unemployment. In the long run equilibrium - when all anticipations are realized - the unemployment rate will have come back to the point where it started from, i.e. the natural rate of unemployment, and the inflation rate will be the same as the rate of monetary increase.

The main task of the monetarists has been to provide a theoretical framework for the above insight of the work-
ing of the economy. While until now they have failed to provide a rigorous rationalization of their argument there are many monetarist writings which offer characteristic positions and assertions of the monetarist thought and which at the same time attempt to differentiate their position from the Keynesian view.

It is the purpose of the remainder of this section to show that the above insight of the working of the economy does not stem from a completely different structure than the Keynesian one. The main thesis is that in most of their writings monetarists usually charge Keynesian thinking with positions that do not characterize the view of the latter or with positions that are oversimplifications simply made by Keynesians for convenience in the handling of some problems or for pedagogical purposes. And that indeed although major differences exist between the two schools of thought these stem from an essentially common structure to which different assumptions have been made about particular parameter estimates and elasticities. (1)

We find it convenient for analytical purposes to examine the main monetarist assertions and tenets under five headings.

(1) This is a position that is shared by many economists. For example, Friedman in two papers (1970, 1971) has attempted to show his theoretical differences with the Keynesian school starting from a common structure - the IS-LM model. Tobin (1972) also explains Friedman's positions through an IS-LM model. See also Laidler (1970, ch.4), Smith (1956) and Teigen (1972). There are also some exceptions, see, Brunner (1971). See also footnote 2.
(A) The organizational framework for the monetarist analysis is the quantity theory of money especially in its post Keynesian reformulation. In two articles, however, Friedman abandons this framework and adopts the IS-LM. (2) But this may not be an important point after all, since as Tobin has pointed out the form of the organizational framework regards the language in which substantive arguments are expressed, not the substance of the arguments. (3)

(B) Belief that the central equation of macroeconomics is the demand for money. According to Friedman, "the quantity theorist ... regards the demand function for money ... as playing a vital role in determining variables

(2) Friedman (1970, 1971). Not all monetarists however view this particular model as an appropriate description on which to build an analysis. Brunner, for example, wrote: "It is useful to emphasize ... that the logic of the monetarist analysis based on the relative price theory approach requires that attention be directed to the interaction between output market, credit market and Walrasian money market. This requirement cannot be satisfied by the general framework used by Friedman. This framework is the standard IS-LM analysis offered in an essentially Keynesian spirit. And this very choice of basic framework actually creates the analytical problems clearly recognized by Friedman in his subsequent discussion ... Our analysis ... established however that the standard IS-LM diagram is not a very useful device for the analysis of monetary processes." Brunner (1971, p. 82).

(3) Tobin (1972).
that he regards as of great importance for the analysis of the economy as a whole, such as the level of money income or of prices. It is this that leads him to put greater emphasis on the demand for money than on let us say the demand for pins..."(4) In the "restatement" the quantity theory is presented as a theory of the demand for money. As H. Johnson has put it "the revival of a quantity theory that would claim to rival the Keynesian theory required a restatement of it that would free it from these objections ... (he means that the quantity theory in its pre Keynesian formulation was a tautology and that it assumed full employment) ... and give it an empirical content. Such a restatement was provided by M. Friedman's classic article, which redefined the quantity theory as a theory of the demand for money (or velocity)."(5)

(4) Friedman (1956, p.16)
(5) Johnson (1972, p.23). Not everyone accords with Friedman's "restatement" of the quantity theory. Patinkin, for example, believes that Friedman's analysis is similar to that of Keynes because the former treats the demand for money as an asset; Friedman's primary concern is the optimal relationship among stock of assets (which is also Keynes primary concern). Neoclassical theory, on the other hand, emphasized the optimal relationship between the stock of money and the flow of planned expenditure. Hence, Patinkin concludes, Friedman's work is "mislabeled" and it is not to be found either in the oral or written tradition of the University of Chicago. Patinkin (1969). Lately however Friedman has ceased to refer to the Chicago tradition and has admitted that the restated quantity theory has been much "influenced by the Keynesian liquidity analysis" Friedman (1969, p.73).
Friedman's treatment of the demand for money differs from that of Keynes in abandoning an analysis of the motives that prompt people to hold money. The relevant question according to Friedman is: Given that people hold money—since money is an asset one form of wealth, therefore introducing capital theory—what factors determine how much money people hold. (6) The demand for money is assumed to depend on asset prices or relative returns and wealth.

This theory of the demand for money, however, is also a theory of nominal income. Thus for example, D. Fand states: "the quantity theory, in its post Keynesian reformulation, is a theory of the demand for money and a theory of money income." (7) Also in another instance he writes: "the modern quantity theory uses the money demand function to predict the level of money income and prices if output is given ..." (8) To make the theory of the demand for money a theory of money income, Friedman needs three steps. The first step is to introduce homogeneity in prices and nominal income in the demand for money function. This is a sufficient step to enable him to derive his basic equation.

(6) Post Keynesians also regard money as an asset alternative to other assets. Nevertheless the main contribution of Friedman remains, as H. Johnson has pointed out, "that income is the yield on capital, and capital the present value of income..."; "its theoretical significance lies in the conceptual integration of wealth and income as influences of behaviour ..." Johnson (1972).

(7) Fand (1969, p.561)
(8) Fand (1970, p.228)
\[ Y = V(R, W, T)M \]

where \( Y \) = nominal income, \( R \) = a vector of relative prices, \( T \) = tastes, \( M \) = stock of money, \( V \) = the velocity function, \( W \) = human and non human wealth.

The second step is to assume that the money supply is exogenous, so that the causation runs from money to income and not the other way round. The third step is to assume that the velocity or what amounts to the same thing the demand for money is a stable function. According to Friedman, "the quantity theorist accepts the empirical hypothesis that the demand for money is highly stable ... The stability he expects is in the functional relation between the quantity of money demanded and the variables that determine it ... (and) ... he must sharply limit ... the variables that it is empirically important to include in the function. For to expand the number of variables regarded as significant is to empty the hypothesis of its empirical content; there is indeed little if any difference between asserting that the demand for money is highly unstable and asserting that it is a perfectly stable function of an indefinitely large number of variables". (9)

The stability of the velocity is very important since the stability of the money multiplier depends upon it. If the demand for money is more stable than the consumption function then the money multiplier is more stable than the autonomous expenditure multiplier and therefore mo-

(9) Friedman (1956, p.16).
ney is more significant than investment or autonomous expenditure in explaining changes in money income.

Friedman recognizes that a necessary condition for the stability of the velocity function is that either velocity is inelastic with respect to the variables that determine it or all these variables are to be taken as rigid or fixed. In either case his analysis rejects the Keynesian transmission mechanism and substitutes it with another one more direct. This brings us to the third point, the inelasticity of velocity with respect to the rate of interest.

(C) Until recently, monetarists thought that this elasticity was zero. One of the most serious attempts to discharge the Keynesian transmission mechanism is portrayed in Friedman's 1959 paper (10) where money is considered as consumer durable good, and the permanent income hypothesis is used to reconcile the different behaviour of velocity secularly and in business cycles. The use of

(10) Friedman (1959). The evidence provided by Friedman in support of the zero elasticity of velocity with respect to the rate of interest is doubtful and ambiguous: He first correlates velocity with permanent income and then finds that the residuals are not correlated with the rate of interest. Laidler (1966) using the same data and the permanent income hypothesis has shown that the interest rate is an important variable even secularly. The obvious implication is that this study by Friedman cannot reject the Keynesian transmission mechanism.
the permanent income hypothesis is very important for three reasons: (i) Since Friedman's empirical results show that the interest rate is unimportant in explaining the behaviour of velocity the Keynesian transmission mechanism can be rejected. (ii) Although velocity is not a constant, as the classical economists believed, it is a stable function of just a "few" variables. (iii) The effect on current income is very powerful, indeed much more powerful than the one predicted by the classical formulation.\(^{(11)}\)

However, the accumulation of empirical evidence\(^{(12)}\) showing the importance of the rate of interest has made Friedman and others to reject their view of a zero elasticity.\(^{(13)}\) Instead they now argue that it is the size of this elasticity that differentiates Keynesians and monetarists. Friedman argues\(^{(14)}\) that "only a finding of near absolute liquidity preference would raise ... fundamental issues" in monetary theory since it would

\(^{(11)}\) However, Tobin and Swan (1969) have shown that if velocity is made a function of interest and of money's own rate, the behaviour of velocity can be explained equally well and that permanent income coincides with current income. The implication is that monetary policy is not so powerful as the permanent income formulation would have led us to believe.

\(^{(12)}\) Some of this evidence is summarized in Laidler (1969).

\(^{(13)}\) Friedman (1966).

\(^{(14)}\) Friedman (1966, p.144).
imply an unstable velocity. On the other hand, monetarists view themselves as taking the position that "... although marginal and average velocity differ, the velocity function is sufficiently stable to provide a relation between changes in money and changes in money income." (15) However, these arguments attempt to identify the Keynesian position with the liquidity trap, and hence they are misleading. The fact of the matter remains that differences in the opinions regarding the response of velocity to a monetary shift do not depend on assumptions about the demand for money – liquidity trap e.t.c., as the monetarists claim – or on assumptions about the price level, but on assumptions regarding the labour market. In fact, Teigen (16) has shown that if the demand for and supply of labour are made functions of the real wage rate, and the market always to clear, one can obtain the quantity theory result: changes in the quantity of money leave the velocity unchanged – a "stable velocity" – no matter what the size of the interest elasticity of the demand for money.

On the other hand, if one assumes a Keynesian type of labour market where money wages are sticky, velocity may rise, fall, or remain constant to a monetary shift. The result depends on the sizes of the partial elastici-

(16) Teigen (1972). See also Smith (1956).
ties of the whole class of relationships in the system and not only on the interest elasticity of the demand for money.

(D) Another important aspect of the monetarist thought is the assertion that the demand for money is a demand for real, not nominal, balances, while the authorities control the nominal supply of money. Friedman has argued that "the distinction between real and nominal magnitudes ... is at the heart of the quantity theory". (17) The importance of this distinction is viewed by monetarists as providing a basis for their contention that their analysis implies a much broader transmission mechanism than does the Keynesian model. This transmission mechanism is based on a portfolio adjustment that includes financial as well as physical assets. At the same time it is assumed by monetarists that Keynesian analysis restricts the effect of a money change on a small group of financial assets, such as government or corporate bonds. In sharp contrast monetarists believe that an increase in the nominal stock of money will, in addition to changing the yields of financial assets and thence the prices of goods and services, also change directly the prices of physical assets, and therefore the general price level, through increased spending directly upon them. Thus, it is the preference of money

(17) Friedman (1970, p.69)
holders on real, and not nominal, balances that gives rise to a rationalization of the generalized transmission mechanism through the effects of spending decisions on the price level. In the monetarist model therefore the demand for money determines the desired quantity of real money balances and not the level of interest rates.

This argument rests fundamentally on the assumption that in the Keynesian model the price level is exogenously determined. Indeed this is the position assigned to Keynesians by many monetarists. For example, Friedman(18) argues that in the IS-LM model there is a "missing equation" - the model being underdetermined since its number of endogenous variables is greater than one from the number of equations. The differences between Keynesians and monetarists, he continues, arise from the different assumptions made by each camp to close the system. Keynesians, according to Friedman, assume that the price level is determined outside the system while monetarists make the assumption that it is the level of output that is determined outside the system. From the two assumptions the less satisfactory is, according to Friedman, the Keynesian one since it is much more arbitrary, "... a deus ex machina with no underpining in economic theory". (19)

The monetarist assumption on the other hand is less blatant since output is assumed to be determined by a Walrasian

(18) Friedman (1970)
(19) Friedman (1970, p.88)
system of equations and therefore the quantity theory may be regarded as a subset of a complete system.

It is true that in the static IS-LM model Keynesian analysis ignores the price level. This means that the price level does not change during the comparative static exercises of this model. This has sometimes been rationalized on the grounds that prices are rigid when dealing with mass unemployment or simply that it is an oversimplification merely made for pedagogical purposes.

Clearly therefore it would be a mistake to conclude from the argument offered by Friedman that the differences between the two schools of thought arise from the assumptions made to close the system. (20) In fact the price level is not necessarily exogenously determined when one considers the augmented IS-LM model - that is, the IS-LM with a production function and a labour market which substitute the Walrasian system of the monetarist approach. This system is closed by either assuming rigid wages in a downward direction or by assuming that the general price level is exogenously determined. The assumption of rigid wages however seems more plausible since it implies a solution of the system that is compatible with any level of employment - while the monetarist model provides only one solution, the full employment solution - and hence it remains in the true Keynesian

(20) Even some monetarists do not accept this point. See in particular footnote 2.
The situation therefore appears to be one in which the price level even in the Keynesian system is endogenously determined. (22) Thus it is not correct to argue in line with the monetarists that the Keynesian system is inconsistent with the general portfolio adjustment transmission mechanism implied by the monetarist model. And indeed, such a stance means one overlooks the work of Tobin and others in this field as well as the incorporation of such ideas in the econometric work of the Federal Reserve Board - MIT model. In other words, an endogenous price level permits the same process of adjustment to a change in the nominal stock of money through price level changes, as the monetarists believe.

The fundamental difference therefore between post Keynesians and monetarists is not that the model of the latter implies a much more general transmission mechanism than the one implied by the Keynesian model, but rather the difference lies on the quantitative importance attached to financial and physical assets as channels through which monetary impulses are transmitted - an empirical

(21) There is ample evidence that post Keynesian thinking take this position. For example Ackley: "Macro-Economic Theory" ch. IX; Allen: "Macro-Economic Theory" ch. 7; Bailey: "National Income and the Price Level" ch. 3; Smith: "A Graphical Exposition of the Complete Keynesian System", (1956).
(22) This does not mean that the comparative static Keynesian model offers an adequate explanation of the determination of the price level.
question. Post Keynesians believe that the burden of adjustment falls on financial assets with only a small effect coming through physical assets; on the other hand monetarists believe that the burden of adjustment falls on physical assets, with only a small effect coming through financial assets. This difference however has one important implication for the conduct of monetary policy. According to the Keynesian belief monetary policy is more effective if the authorities control the rates of interest while under the monetarist thought the authorities ought to control the stock of money in order to maximize the effectiveness of monetary policy.

(E) Another monetarist position relates to their view that their analysis provides a monetary theory of the price level while Keynesian analysis provides a monetary theory of the interest rate. According to this view the rate of interest in Keynesian analysis is either determined solely in the money market (23) or it is jointly determined by the interaction of the whole system (i.e. by some version of the IS-LM model). According to both views however, Keynesian analysis results in a relationship between interest rates and money stock in the opposite direction; that is, an increase in money supply would result in a lower interest rate.

(23) For example Fand (1969, p.564) argues that "In the Keynesian theory the exogenously given quantity of money, together with the liquidity preference function, determines the interest rate".
in the new equilibrium. This position is usually con-
trasted to the monetarist view of the response of the
interest, following a monetary disturbance. Indeed it
is argued that a positive relationship between money
stock and interest rates will be observed. (24)

Perhaps the best expression of this view is found
in Friedman's presidential address to the American Eco-
nomic Association. The immediate response of interest
rates, it is argued, will be in the opposite direction
of the monetary shift. This movement represents the
"liquidity effect" - the substitution effect of micro
theory. But there also exists an income effect: The
initial fall in the rate of interest would stimulate
investment and other forms of expenditure and thence
income and employment. The rise in income would in its
turn increase the demand for money and thus the rate
of interest would start rising. To the extent however
that the rising income is accompanied by rising prices
a "price expectation effect" is also set in operation

(24) Zwick argues that "(T)he alternative concepts of
Keynes and Fisher concerning the adjustment of the e-
conomy to monetary changes are mirrored in their dif-
f erent notions concerning interest rate determination
and the response of interest rates to monetary changes.
The IS-LM framework suggests that, so long as the IS
and LM schedules represent independent relations a mo-
netary expansion causes interest rates to fall because
of the outward shift of the LM schedule. In the Fisher-
ian model, a monetary increase raises the level of ex-
penditures; the upward response of loan demand due to
the increased expenditure causes interest rates to rise".
(1971, p.78).
for as inflationary conditions prevail lenders would increase the rate they charge and borrowers would be prepared to pay a higher rate of interest.

Thus, according to monetarists, Keynesian comparative static analysis recognizes only the liquidity effect and hence it implies an inverse relationship between the stock of money and the rate of interest. But this is certainly not true. The new equilibrium position of the rate of interest might be above the initial equilibrium and therefore the relationship between the stock of money and the interest rate might be positive if the IS schedule is positively sloped. This surely is the case when the sum of the propensities to spend is more than unity.

Some monetarists writings, however, give the impression that the relationship between the stock of money and the interest rate does not refer to comparative static equilibrium points but to the dynamics of the system. And it is argued that it is in this context that Keynesian analysis is inconsistent with a positive relation.

However, even within such an interpretation the Keynesian model is not inconsistent with a positive relation and surely it is misleading to assign it only the liquidity effect. Teigen has shown that "observed parallel movements between money and interest rates are quite consistent with the basic IS-LM structure no matter which way the IS curve slopes, given the
reasonable and widely accepted premise that the monetary sector adjusts much more quickly than the real sector to external shocks". (25)

To summarize, then, monetarists differ from Keynesians in two respects. First, on the behaviour assumed about the labour market and not, as it is argued by monetarists, about the behaviour of velocity. Second, on the quantitative importance attached to physical and financial assets as channels through which monetary impulses are transmitted to the economy and not, as it is again argued by monetarists, that their analysis implies a much more general transmission mechanism. Both differences though follow from a common structure.

(25) Teigen (1972, p.19)
I.3 The Logic of a Rule

The theoretical model put forward in the previous section provides theoretical justification for the adoption of a rule. The argument can be best seen by considering the role of monetary policy in stabilizing the economy. A good stabilization policy should be governed by two basic principles.

Figure 1

When the economy is in the region AEB (fig. 1) monetary policy should become less stringent and therefore the supply of money should increase. On the other hand when the economy is in the region BFC monetary policy should become more tight and the supply of money should therefore decrease. The policy of a rule secures that these broad principles are satisfied if and only if the economy behaves as it is implied by the above monetarist model. A caricature of the argument is provided by assuming that the economy behaves according to the
modern quantity theory of money

\[ Y = V(Y^P)M \]

where \( Y^P \) = permanent income and the others symbols stand as before. On the assumption that the velocity is a stable function\(^{(1)}\)

\[ \frac{Y_t - Y_{t-1}}{Y_{t-1}} = \frac{V_t(M_t) - V_{t-1}(M_{t-1})}{V_{t-1}(M_{t-1})} = \frac{M_t - M_{t-1}}{M_{t-1}} \]

the percentage increase in income equals the percentage increase in the money stock. That is, if income is to be on its trend, in other words if the economy is to be absolutely stable, a sufficient condition is that the stock of money grows at a constant rate equal to that of income.

Furthermore the behaviour of velocity over the business cycle secures that the above stabilization principles are met. For example, in the downswing of a cycle, DE in fig. 1, the demand for money decreases and thus with a constant increase in the supply of money there would be an excess supply of it in the whole of the region AEB. The effect is even greater if we assume in line with monetarists that money is a luxury good in which case the demand for money decreases proportionately more than income. Similarly in the upswing of a cycle, EF

\(^{(1)}\) Mathematically speaking it should be a constant in which case, however, a perfect stabilization occurs.
in fig. 1, the demand for money increases and with a constant increase in the supply of money there would be an excess demand for it in the whole of the region BFC. But this is exactly what active (discretionary) stabilization should attempt to achieve.

Thus the adoption of a rule automatically secures an excess demand for money in exactly those situations where monetary policy should have been tight, and an excess supply of money in exactly those situations where monetary policy should have been easy. But although the basic stabilization principles are met it is not at all certain that an active discretionary stabilization should not do better than a rule. The other leg therefore of the monetary thesis consists of an attack on discretion.

Thus although it may sound very strange, the biggest challenge to the view that discretionary monetary policy is effective has come about by one who believes that monetary policy effects are very powerful. Friedman argues that monetary policy effects are felt only after a long and variable lag, and that therefore the use of monetary policy may prove to be destabilizing while intended to be stabilizing. Indeed, Friedman argues, this is what has really happened in the case of the U.S. economy - monetary arrangements have become a primary source of instability. "In almost every instance major instability in the U.S. has been produced or, at the very least, greatly intensified by mone-
tary instability. Monetary instability in its turn has generally arisen either from government intervention or from controversy about what governmental policy should be. The failure of government to provide a stable framework has thus been a major if not the major factor accounting for our really severe inflations and depressions." (2) The authorities, according to Friedman, are not only to blame for not making the decisions at the right time but also for overreacting. On the part of the authorities "... there was a natural if regrettable tendency to wait too long before stepping on the brake, as it were; then to brake too hard; then, when this did not bring monetary expansion to a halt very shortly, to brake yet again". (3)

Thus Friedman and other monetarists believe that every major depression in history resulted from an absolute decline in the money supply and that every inflation was the result of excessive expansion of the money supply. Hence, the use of discretionary anticyclical instead of monetary policy increased/dampening the cyclical behaviour of the economy. This increased instability is due to two main factors. First, on the lag that exists between the time that a monetary stimulus is required and the time when a substantial proportion of it has actually been felt in the economy. Second, and most important, on the premise that the main determinant of spending is

(2) Friedman (1960, p.9)
(3) Friedman (1960, p.17)
the stock of money.

The inevitable result of these two factors is that unless business forecasting is relatively accurate, monetary policy cannot be properly timed. Even if it can be timed the long lag would pose a difficult problem. Suppose that the contemporary situation demands a monetary contraction and that accurate forecasting predicts that the effect would be felt after two years. However, the situation after two years might have been reversed on its own and so the effect of monetary policy would be to increase the perverse effects - that is to increase instability. To the extent, however, that the lag is not only long but is also variable, as it is argued by Friedman, monetary policy cannot be properly timed even if forecasting is good. According to this view, therefore, "the central problem is not to construct a highly sensitive instrument that can continuously offset instability introduced by other factors, but rather to prevent monetary arrangements from themselves becoming a primary source of instability". Indeed the basic premise is that the economy is basically stable and not necessarily subject to recurring periods of severe recession and inflation. "What we need ...(therefore)... is not a skilled monetary driver of the economic vehicle continuously turning the steering wheel to adjust to the unexpected irregularities of the route, but some means of keeping the monetary passenger who is in the
back seat as ballast from occasionally leaning over and giving the steering wheel a jerk that threatens to send the car off the road". (4)

It follows from this view that the obvious way of preventing major instability in the economy is to adopt a monetary policy that avoids sharp swings between monetary ease and restraint. The best way to do this is to abolish discretionary monetary policy and adopt a simple rule. "A satisfactory policy guide or rule should be connected more directly with the means available to the monetary authorities ... and ... the most important magnitude that the monetary authorities can effectively control ... is the stock of money". (5) According to Friedman, therefore, the stock of money is the relevant magnitude in terms of which to formulate monetary rules, the simpler being one that dictates a constant rate of increase of the money supply. To the monetarists, the precise rate is not so crucial, but its constancy is.

We may now summarize the argument as follows: The theoretical validity of a rule stems from the principle that the economy is basically stable. Destabilizing shocks in the economy are not caused by instability in the behaviour of the private sector, e.g. autonomous

(4) Friedman (1960, p.23)
(5) Friedman (1960, p.88)
changes in private investment but by instability in the application of monetary policy. The main factor that explains fluctuations in economic activity are monetary rather than real impulses.
I.4 The Role of Monetary Policy in the Interventionist Camp

The role assigned to monetary policy by the non-monetarist camp stems from a belief about the transmission mechanism. Monetary impulses are thought to be transmitted through interest rates\(^{(1)}\) to investment expenditure and then via the famous multiplier to income and employment. This process, however, might be hindered for several reasons: Firstly, the demand for money may be characterized by absolute liquidity preference — the so called "liquidity trap". Many Keynesian economists thought that this was the actual state of affairs and this meant that, if the economy was in a state of unemployment, monetary policy would, then, be completely impotent — the "money does not matter at all" thesis. Secondly, the process might be brought to a halt because investment expenditure might not respond to changes in the rate of interest.\(^{(2)}\) This means that even if absolute liquidity preference was not the case monetary policy would have a small effect. This small effect, however, would have been maximized.

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\(^{(1)}\) In fact, Keynes states that "the primary effect of a change in the quantity of money on effective demand is through its influence on the rate of interest". "General Theory" p. 298.

\(^{(2)}\) Radcliffe Committee: "Memoranda of Evidence" vol. 2 Part VII, 8. Also "Minutes of Evidence", especially questions 11543 and 11478. And the best known British investi-
if the authorities had manipulated directly interest rates in the first place rather than the money supply preferably by keeping them down as low as possible, what has come to be known after the Second World War as "cheap money policy".

Thirdly, the position has been put forward, especially in the Radcliffe Report, that money cannot even be defined so it is meaningless to discuss its controllability. The Committee emphasized that though money is defined by what it does - therefore money are all those assets that serve directly or indirectly the medium of exchange function - there would be no complete and permanent taxonomy between assets, and therefore no definition of money. What may be regarded as money today might not be regarded so tomorrow; instead, it is "liquidity" that affects expenditure and therefore it is this variable that should be controlled through interest rates.

Finally, there is another strand of Keynesianism that argues that the supply of money is endogenous and therefore cannot be controlled. (3)

The empirical evidence which has accumulated since

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(3) There are many variations in the way this argument is expressed. One is the position advanced by Cambridge Keynesians, e.g. Kaldor (1970). Another is the "New View" see for example Tobin (1963).
then, has brought a change of belief among Keynesians about the role of monetary policy. Indeed, the empirical evidence shows, beyond any doubt, that the liquidity trap has never been a reality; (4) this means that changes in the stock of money have an effect on interest rates. Accumulated evidence, too, has shown that substantial interest rate effects exist both in the consumption for durables and investment; (5) and this in its turn means that monetary policy affects real expenditure and hence real income and employment. In addition, to the extent that monetary policy intensifies and strengthens aggregate demand in excess of aggregate supply a substantial effect would be shown on the general level of prices. Therefore monetary policy has a role to play in fighting inflation too.

These ideas have led many Keynesians to the belief that monetary policy along with fiscal policy has a great role to play in countercyclical stabilization policy, that discretionary monetary policy is a useful instrument.

Lately, however, all these income expenditure theorists have come under severe attack by Leijonhufvud. The efficacy of monetary policy as a stabilization tool depends, according to Leijonhufvud, on the diagnosis

(5) For a summary of this evidence see Hamburger (1969), Fisher and Sheppard (1972).
especially in the case of deficient aggregate demand. Once the system came to depart from the full employment state with stable prices, and is still at the neighbourhood, the diagnosis points to a 'wrong' level of interest rate - the market rate departed from the 'natural rate' - and therefore the stabilization policy should rely on monetary policy. If, however, the characteristics of deep depression are present - the system is far away from the neighbourhood of full employment - the diagnosis points to entrepreneurial expectations as the source of the trouble. In this case monetary policy is unreliable; fiscal policy, instead, should do the trick.

To summarize, then, among Keynesian economists, there are those who attribute little, if any, importance to discretionary monetary policy simply because they believe that money does not matter; there are others, however, who believe in the potency of discretionary monetary policy because they recognize that there are channels through which money affects the economy. Even within this strand however monetary policy is considered to be a difficult weapon to use. The reason is that although monetary policy may have a substantial effect it might take a long time for its effects to be felt in the economy. Much of the empirical evidence that relates to the U.S. economy, as for example the FRB-MIT econometric model, suggests that there are long lags in the effects of monetary policy. Although these lags can prove very damaging to the effectiveness of
discretionary monetary policy it has not been suggested by the various studies that its effects may be destabilizing. What is even more important is that it has not been suggested that discretion should be abandoned in favour of a rule because of the difficulties referred to above. The major reason is that although money may be one of the factors that contribute to the cyclical behaviour of the economy other factors such as autonomous expenditure, expectations about economic developments e.t.c., are considered to play a much more important role in explaining business cycle. In this context a rule is not to be expected to secure stabilization.

If indeed the lags are very long and thus discretionary monetary policy a very dangerous weapon to use the non monetarist camp would not argue in favour of a rule but in abandoning monetary policy altogether in favour of another discretionary policy - such as fiscal policy.

Thus whether rule or discretion should be used depends on the causes of business cycles. Those who are in favour of discretion believe that the cyclical behaviour of the economy is mainly due to autonomous changes in the behaviour of the private sector. On the other hand, those who are in favour of a rule believe in a predominantly money caused business cycle mainly due to instability in the behaviour of the authorities. (6)

(6) This is true irrespective of whether the lags are
A straight answer, however, cannot be given to this question. We are thus led to investigate it indirectly by examining other factors. The most important of these are:\(^7\) The endogeneity/exogeneity of money. Obviously if money is endogenous, in the policy sense,\(^8\) then a rule is not feasible since the authorities would not succeed in increasing a monetary aggregate by a constant percentage in each year.

(b) The interest elasticity of the velocity function. If interest rates do not affect the velocity, monetary analysis can be divorced from analysis of the real long or short. Thus the St. Louis model provides evidence of short lags. Nevertheless Andersen (1971) is also in favour of a rule because it is argued that for various reasons policy makers destabilize with their actions the economy. The most important of these reasons are: (i) The policy makers overlook the importance of money. (ii) They use wrong indicators of monetary policy. (iii) Attempt to stabilize the economy with fiscal policy without paying much attention to the ways of financing it, though, it is argued, only by increasing the supply of money (as a means of financing the budget) can fiscal policy have any effect. (iv) They attach more importance to unemployment rather than to inflation. (7) These factors are only mentioned here but they are taken up separately in the next chapter where the model is specified. (8) Much of the controversy about the endogeneity/exogeneity of money stems from a confusion about its meaning. For a clarification and an extension of this point see footnote and the discussion of the supply function of money in the next chapter.
sector. In this case the causes of business cycles are solely due to instability in the behaviour of the authorities. If, however, interest rates affect the velocity then both the private sector and the authorities contribute to the instability of the economy and therefore a general equilibrium analysis is required.

(c) The channels through which monetary variables affect the real sector of the economy and the associated lags. (d) The sensitivity of consumption to changes in current income. Obviously the strength and stability of the autonomous expenditure multiplier depends on the relationship between consumption and current income. (e) The strength and stability of the money multiplier.

While each one factor has a role to play one cannot single out just one and disregard the others. All factors must be taken into account. Such treatment requires a general equilibrium analysis through the specification of a model. The model must be flexible, nevertheless, to capture the different views on the working of the economy. This task though presupposes the existence of a common structure. This is essential for an evaluation of the policies. (8) In this context although the controversy of Rules versus Discretion stems from different theorizing of the working of the

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(8) A common structure is indeed very important because in addition it gives us the opportunity to test through policy simulations the Rules versus Discretion debate.
It is not a product of two completely different structures. Indeed, the main task of section 2 is to establish that most of the differences follow essentially from the same structure to which, however, different parameter estimates and elasticities are assumed by each camp.

The next step in the analysis is the methodology upon which to build up such a model. Before we tackle this point, however, we must look at the empirical evidence regarding the Rules versus Discretion debate.
I.5 The Empirical Evidence Concerning the Strength and Timing of Monetary Policy

(a) The monetary case

There are two empirical issues underlying the debate about the usefulness of monetary policy as discretionary stabilization tool. First, is the well known question of the relative strength of monetary policy as measured by the monetary multiplier. The second empirical issue concerns the timing lags of monetary policy. This section provides a brief summary of the empirical evidence concerning the above two issues.

The starting point should be the definition of the lag. Friedman views the lag between the peak rate of increase in the money supply and the absolute peak in economic activity as a measure of the delay in effect of monetary changes or as the lag that would apply between a change in monetary policy and its effects. His findings, then, easily follow: "The rate of change of the money supply shows well marked cycles that match closely those in economic activity in general and precede the latter by a long interval. On the average, the rate of change of the money supply has reached its peak nearly 16 months before the peak in general business and has reached its trough over ... 12 months before the trough in general business ... Moreover, the timing varies considerably from cycle to cycle - since 1907 the short-
est time span by which the money peak preceded the business cycle peak was 13 months, the longest 24 months; the corresponding range at troughs is 5 months to 21 months". (1)

Many economists were simply not prepared to believe Friedman's estimates of either the length or the variability of the lag. As Culbertson put it, "if we assume that government stabilization policies, act with so long and variable a lag, how do we set about explaining the surprising moderateness of the economic fluctuations that we have suffered in the past decade?" Culbertson's own conclusion was that the "broad record of experience support(s) the view that (countercyclical) monetary, debt management, and fiscal adjustments can be counted on to have their predominant direct effects within three to six months, soon enough that if they are undertaken moderately early in a cyclical phase they will not be destabilizing". (2)

Leaving aside, at the moment, the question of whether the data provide support to the interpretation given by Friedman we first examine the validity of the method used. This method is simply to compare two time series and infer that one is the cause and the other the effect by simply observing that there is a lead/lag between the two series. The fallacy to this line of argument

(1) Friedman (1958, P.P.249-50)
(2) Culbertson (1960, p.621)
is suggested by the following reductio ad absurdum offered by Kareken and Solow: "Imagine an economy buffeted by all kinds of cyclical forces, endogenous and exogenous. Suppose that by heroic and perhaps even cyclical variation in the money supply and its rate of change, the Federal Reserve manages deftly to counter all disturbing impulses and to stabilize the level of economic activity absolutely. Then an observer following the Friedman method would see peaks and troughs in monetary change accompanied by a steady level of aggregate activity. He would presumably conclude that monetary policy has no effect at all, which would be precisely the opposite of the truth". (3)

The importance of the above argument is that the question of the effects of monetary policy can only be made through a model. It is therefore the case that if Friedman's findings are interpreted in accordance with his method they are compatible with many hypotheses about why events have turned out just so.

Supposing now that we ignore this methodological point then the relevant question is whether the data provide support to the interpretation offered by Friedman. It turns out the evidence depends on misleading comparison of time series. Friedman compares the rate of change of the money stock with the level

(3) Kareken and Solow (1963, p.16)
of economic activity. The question is if the result would have changed had the level of money stock been compared with the level of economic activity or had the rate of change of the money stock been compared with the rate of change of the level of economic activity. If this is the case then the result is arbitrary depending on the definition one cares to choose. On general terms the answer is provided by considering what would be the lag if the stock of money and the level of economic activity are assumed to reflect simultaneously smoothed cyclical fluctuations. In such a case the rate of the stock of money will show a constant lead over economic activity. If, in addition, each series is at all irregular either in its period or in the time shape then the lag would also be a variable one.

Even if we waive this general point the matter still remains that the answer depends on the definitions of the series to be compared. Kareken and Solow\(^{(4)}\) have shown that if one compares the change in the money stock with the change in economic activity the two series move more or less simultaneously and therefore that the "lead of the change in the stock of money over economic activity is a pure arithmetic artifact".\(^{(5)}\)

A second piece of evidence in favour of the long

\(^{(4)}\), \(^{(5)}\) Kareken and Solow (1963, p. 18).
and variable lag is provided by Friedman and Meiselman. (6) The evidence is based on simple correlations between the stock of money and consumption or on multiple correlation coefficients between current and past values of money and consumption. The highest correlation observed was between consumption and money two quarters earlier; this implies an average lag of six months. "But the lead will not be six months in every case. It may on one occasion be zero, on another twelve or fifteen months". (7) This finding, however, is not inconsistent with that reported in the previous study by Friedman. "The relation stated (in this study) is between the level of money and the level of consumption. The relation (in the previously cited study) is between the rate of change of money and the level of general business. Since the peak rate of change of money precedes the peak level of money by a substantial interval, it is entirely consistent that it should lead the level of business by 12 to 16 months, whereas the level of money leads by only 6 months". (8)

These results were also cast into doubt. At the very least the mass of correlation coefficients computed by the various discussants showed that it

(6) Friedman and Meiselman (1963)
(7) Friedman and Meiselman, op. cit. p.214.
(8) Friedman and Meiselman, op. cit. p.214, footnote 1.
would be impossible to reach a clear and definite verdict. Results turned out to depend on the sample period, on the simplicity or complexity of the model used. Moreover, the interpretation of the results was complicated by the inability of correlation techniques to distinguish between cause and effect - an influence of money on business from an influence of business on money. (9)

Most of these points were taken into consideration by the St. Louis Model. (10) According to this model the size of the money multiplier is very high and the total response of G.N.P. to changes in the money stock is completed within a year. In particular a once and for all increase in the money supply of £1 billion in quarter 1 will have raised the level of G.N.P. by £6.6 billion by quarter 4. In contrast, Davis (11) found that in the FRB-MIT model a once and for all increase in the money supply of £1 billion in a given quarter has almost no effect on G.N.P. in that quarter and, even after four quarters, the level of G.N.P. is only about £400 million higher than it otherwise would be. He commented, therefore, that the "most surprising

(9) In the U.S. the main discussants were Ando and Modigliani (1965); De Prano and Mayer (1965); Hester (1964); Friedman and Meiselman. In the U.K., Barrett and Walters (1966); Artis and Nobay (1969).
(10) Andersen and Jordan (1968); Andersen and Carlson (1970).
thing about the world of the St. Louis equation is not so much the force, but rather the speed with which money begins to act on the economy"; and he concluded that "what is at stake in the case of the St. Louis equation is not merely a 'shade of difference' but a strikingly contrasting view of the world - at least relative to what is normally taken as orthodox view roughly replicated and confirmed both in methods and in result by the FRB-MIT model".(12)

There seem to be two issues that need to be examined: First, how good are the purely statistical properties of the sort of relationship presented by Andersen and Jordan? Second, how much of the relationship they find is due to a reverse influence of business on money. Davis subjected the St. Louis equation into various statistical tests. He concluded that "neither omission of the fiscal variables nor different techniques for estimating the lag structure affect significantly the results of the St. Louis equation. Moreover, the coefficients were proved to be reasonably stable when the whole period was broken into subperiods.

In their critique of the St. Louis model de Leeuw and Kalchbrenner (13) hold that the surprisingly powerful and quick acting effects of money are biased because money or even the monetary base are not truly

exogenous. The monetary base includes borrowed reserves, and currency, which is affected by the behaviour of the public. Using the non-borrowed monetary base or non-borrowed member bank reserves instead of the money stock or the monetary base de Leeuw and Kalchbrenner find results similar to those reached in the FRB-MIT model. They conclude that the coefficients of the St. Louis equation are in fact heavily distorted by simultaneous equation bias, and that once this is removed "the results closely resemble the sort of world most of us have always believed in".

However, one might argue in defense of the St. Louis model that the theory put forward by monetarists is between money and G.N.P. (and not between non-borrowed reserves and G.N.P.) and thus the appropriate variable is the total base.\(^{14}\) The sole fact, therefore, that

\(^{14}\) It is surprising that Andersen and Jordan did not pursue such a line of defense. In their rejoinder to de Leeuw and Kalchbrenner they dispute the contention that borrowed reserves and currency should be subtracted from the base to obtain a more 'exogenous' variable. The truth of the matter, however, remains that the problem of identifying a suitable exogenous monetary variable does not seem to have an entirely obvious solution. In his examination of the evidence, Gramlich observed that "... just as the 1965 debate stalled on the inability to choose an autonomous variable that is really exogenous, the 1968 debate has apparently stalled on the inability to choose an autonomous monetary
the effect of non-borrowed reserves on G.N.P. is very small and slow acting might be a mere image of the wrong specification and test of the theory. It is possible, that money exerts a powerful and quick effect on G.N.P.. Indeed, Davis found that a substantial proportion of the variance of money was left unexplained when only the non-borrowed base was included as an explanatory variable; the result did not change substantially when the discount rate was also included. Furthermore, the influence of the base on money was found to work with a long lag. This result confirms the hypothesis that the relationship between money and G.N.P. is very much weakened if it is substituted by a relationship of G.N.P. and non-borrowed reserves and therefore the size of the multiplier is underestimated and the lag between money and G.N.P. is overestimated.

Whatever the validity of this point, however, the
the truth of the matter remains that reliability on
the estimates of the St. Louis equation can only be
attached if the reverse influence of G.N.P. on money
is eliminated. In fact, it is certain that the high
proportion of the variance of money that is left
unexplained contains the influence of business on
money. While this feedback effect may be large there
is no ample empirical evidence concerning its size.
Davis provides an estimate of this feedback effect
from G.N.P. to money that is rather small. He there­
fore concludes that "only a relatively modest part
of the gross relationship between money and G.N.P.
exhibited in the St. Louis equation may reflect a
feedback effect from G.N.P. to money. Much of the
powerful influence of 'business' on money ... must
be reflected by variables other than G.N.P. ... Th­
erefore it does not seem easy to dispose off the
association between changes in money and changes
in G.N.P. by showing that it is primarily or largely
a matter of reverse causation". (15)

monetary base on target.
(15) Davis (1969, p.130).
(b) The Keynesian case

Keynesian attempts to provide an estimate of the lag stem essentially from the mechanism through which a change in the money supply is thought to influence real income. Thus the effects and the lags of interest rate changes on components of aggregate demand seem to be the main determinants of the power and speed of monetary policy. On these lines Kareken and Solow provide estimates of the lag in the effect of monetary policy by examining the lag of inventory investment, and producer's durable equipment. They conclude that works "monetary policy/neither so slowly as Friedman thinks, nor/quickly and surely as the Federal Reserve itself seems to believe ... Though the full results of policy changes on the flow of expenditures may be a long time coming, nevertheless the chain of effects is spread over a fairly wide interval. This means that some effect comes reasonably quickly, and the effects build up over time so that some substantial stabilizing power results after a lapse of time of the order of six or nine months". (16)

However, as Mayer pointed out, "this statement is inconsistent with the evidence provided by Kareken and Solow. Estimates of the complete lag are reported only for inventory investment and this lag is much larger than Friedman's lag. For producer's durable equipment

(16) Kareken and Solow (1963, p.2)
they provided estimates for only part of the lag, but even this is longer than Friedman's lag. Thus, Mayer concludes that Kareken and Solow "should have criticized Friedman, not for overestimating, but for underestimating the lag". (17)

Overall, the overwhelming evidence that stems from studies of the financial determinants of various forms of private expenditure points also to long lags. (18) But is such an evidence sufficient to point to the conclusion that monetary policy, to the extent that its effectiveness comes from its power to influence expenditure through interest rates, works very slowly with a substantial lag and therefore cannot be used for cyclical stabilization? The answer is certainly no for lags and parameter values in other sectors of the economy play an equally important role in determining the dynamics of the system. In particular, Tucker (19) has shown that the lag in the effect of monetary policy depends on the response of interest rate to changes in the supply of money. If it were the case that the interest rate adjusts gradually to money supply changes then another lag would have to be added to the distributed lag of investment. If on the other hand, the initial response of the interest rate is a vigorous one then

(18) For a very good survey of this evidence see Fisher and Sheppard, op. cit.; Hamburger, op. cit.
(19) Tucker (1966)
it is possible that the lag in the effect of monetary policy is very small.

Tucker examined separately the evidence from various studies providing estimates of the lags of investment to changes in interest rates and of interest rates to changes in the money supply. He concluded that the lag in the money demand function tends to counteract, rather than reinforce, the investment lag. This result was not contradicted when the problem was pursued through a dynamic model. Tanner, by estimating a model that incorporated the real and the monetary sector, found that while there was indeed a long lag in the investment function the bulk of the effects of monetary policy on aggregate demand occurs within three to six months of the change in the money supply. He therefore concluded that "monetary policy is ideal for and consistent with short run stabilization requirements". (20)

Tanner's conclusion, however, must be qualified since (i) he treats the supply of money as exogenous; (ii) he makes no attempt to measure the impact of a shift in the IS schedule in response to a change in the money stock; and (iii) his results are very sensitive to the definition of income.

Maroney and Mason (21), unlike Tanner, treat the

(21) Maroney and Mason (1972).
supply of money as endogenous on the grounds that movements in the short term rate of interest, by influencing portfolio behaviour, will exert a positive impact on the money stock. Their results although indicate "... the important role of the money stock in determining the rate of aggregate economic activity"(22) point to a "careful management of the monetary base, which would seem to require avoiding erratic changes"(23) As such, their conclusion is at variance with Tanner and Andersen and Jordan.

The powerful impact of monetary policy in the model of Maroney and Mason, however, is due to the inclusion of the stock of money in consumption and to changes in consumption in the investment function. Maroney and Mason justify the inclusion of the money stock in consumption by arguing that it reflects a liquidity effect. However inclusion of other liquid assets as well as the money stock would have reduced substantially the effect of monetary policy as well as the length of the lag.

Large scale models also provide estimates of the lags in the effects of monetary policy. These estimates, however, differ substantially from one another mainly because of differences in the structure. One can in

(22) & (23) Maroney and Mason (1972, p.793 & p.810).
principle distinguish models that give little emphasis on the financial sector, the major role being kept for the real sector, and models that assign a great role to the financial sector and its links with the real sector. In the first category belong the Wharton Econometric model, the Evans model, the Office of Business Economics model, the Suits's Michigan model and others. In the second category belong such as: the Ando-Goldfeld model, the Brookings model, the FRB-MIT model. Obviously models of the first type cannot be relied upon in providing answers for the timing of monetary policy. Even within the second category however there are substantial differences in the results. The main reasons are the following: (a) The specification of the monetary policy variable. For example, the variable to represent open market operations has been treated differently in the large scale models. And while it is certainly true that there are a number of plausible variables to represent open market operations the use of different definitions will lead, in general, to different results. Hamburger, for example, argues that "the choice of the exogenous monetary variable has a significant effect on the estimate of the lag in the effect of policy. If the money supply, the monetary base, or total reserves are used as the monetary variable, the results suggest that the total response of G.N.P. to a change in policy is completed within four or five quarters. On the other
hand, those who consider unborrowed reserves to be the appropriate variable would conclude that less than 40 percent of the effect occurs in five quarters and that the full effect is distributed over two and a half years". (24) This finding is corroborated in a survey of the policy simulations of the effects of open market operations in Fisher and Sheppard. The Ando-Goldfeld model in which the monetary variable is represented by unborrowed reserves plus currency shows a strong and quick acting effect - five quarters. The FRB-MIT model, on the other hand, in which the policy variable is unborrowed reserves shows an effect distributed within 3 years.

(b) Differences in the choice of initial conditions. This becomes a very important reason for differences in the results if the model shows non-linearities.
(c) Differences in the structure of the financial sector. This is another important reason because the strength of monetary policy is mediated, in part, by the decisions of financial intermediaries.

In what way can the above empirical evidence help us to build a model for the U.K. economy? An answer must await until we have considered the methodology upon which to build up such a model. It is to this task that we now turn, our attention to.

(24) Hamburger, op.cit. p.293.
I.6 Reduced Forms or Structural Forms?

In this section we examine alternative ways which would enable us to construct the model. Basically there are two approaches, the reduced form and the structural form. The former is used by monetarists and the latter by Keynesians.

The reduced form approach attempts to formulate directly the effects of changes of policy variables on some target variable, such as the level of economic activity, without specifying any intermediate steps or causal links. There are two basic reasons that are usually put forward in favor of this approach. First, if one is primarily interested in explaining the behavior of a few key variables such as GNP, prices and unemployment, it is unnecessary to estimate all the parameters of a large scale model. Second, the economy is so complicated that even a large scale model would fail to capture the interrelationships and evaluate the structure. Therefore a structural approach might yield at least as much as misleading results as the reduced form approach. Whatever the merits of this approach it might be argued that the reduced form approach presupposes a given structure and therefore it provides the same amount of statistical information as the structural approach. This is certainly true in the case of a just-identifiable system for there is one-to-one correspondence between them. It is not however the case when the system is overidentified for then
the reduced form does not incorporate the extra a priori restrictions. In this case the reduced form is consistent with many structures and it might well be that these structures are "mutually exclusive." Hence there is no way to test the underlying theory and therefore to provide a significant interpretation of the results.\(^{(1)}\)

The truth of the matter, however, is that in the reduced form approach the equations are merely asserted to be reduced forms because the structure is never spelt out. In such a case it could be that the alleged reduced form has no acceptable structure. Gramlish\(^{(2)}\) for example examined the reliability that can be attached to results obtained from the reduced form approach. He estimated a whole class of reduced form equations of the same system with the purpose of determining whether all reduced forms imply internally consistent estimates of the underlying structural parameters. His results were not surprising: substantial inconsistencies were indeed found within the estimated reduced forms of the same system. Hamburger, on the other hand, in his survey of the evidence on the lag in the effect of monetary policy, argues that "the use of reduced form equations does not lead to estimates of the

\(^{(2)}\) Gramlish op. cit.
effects of monetary policy on the economy that differ from those obtained from a structural model." He bases his argument on the evidence provided by de Leeuw and Kalchbrenner, who using a reduced form approach estimated a lag which seems to lie within the region of results reached by the FRB-MIT simulations.

Although this is a pleasant coincidence it does not prove in any way the superiority of the reduced form approach over the structural approach, nor that reliance should be attached to the former; for one thing, it leaves a certain degree of ambiguity as to whether the preferred variables, their definition, or the form of the equation were simply chosen to satisfy the investigators intentions. Thus, Klein has experimented with the St. Louis equation using levels rather than first differences. His results totally contradict those of Andersen and Jordan. In addition, Gramlish shows that whether one takes a 'money mostly' stance, a 'fiscal mostly' stance, or a both matter stance, depends on the decision of which variable to take as exogenous. This is hardly a scientific method!

The lesson, therefore, seems to be that the reduced form approach always leads to unsatisfactory resolution of the issue if for no other reason than that one can never convince anybody else that one is right. On the

(3) Hamburger (1971, p.292)
(4) Klein (1971)
other hand, the case for the structural approach is put very convincingly by Frisch: "But no amount of statistical information ... can by itself explain economic phenomena. If we are not to get lost in the overwhelming, bewildering mass of statistical data ..., we need the guidance and help of a powerful theoretical framework. Without this, no significant interpretation and coordination of our observations will be possible". (5)

Turning now our discussion to large scale models we observe that these too suffer from some weaknesses. Apart from those already mentioned the following are in order: (a) Omission of intersectoral dependence. While in principle it is possible to construct a model with as many sectors as one wishes, in practice, at least three sectors seem to be essential: a non bank private sector, a banking sector and a government sector. Though this intersectoral dependence should be taken into account by incorporating a balance sheet equation, showing as assets of the one sector the claims of this sector on each of the others and, as liabilities, the claims of the others on this one, none of the models referred to above does so. (b) None of the models described has a government budget constraint equation nor the stock of privately held government securities appears as a policy variable. (c) With the exception of

(5) Frisch (1933, p.1)
the FRB-MIT model all models consider only the cost of capital channel of influence ignoring alternative or additional channels. Even within this channel, however, the cost of capital is presented by a small set of market interest rates while the monetarist approach has emphasized that a great number of interest rates determines the cost of capital. (d) The inclusion of nominal rather than real rates of interest in the various expenditure functions. In this context equations that explain price expectations are needed; and to the extent that these depend on current and past changes it will be necessary to include price wage equations in order to correctly specify and assess the role of monetary variables. None of the models uses real rates, and furthermore the price wage equations are relatively poorly specified.

Apart from the above weaknesses relating to economic structure large scale models also suffer from problems relating to econometrics. Disaggregation is a very serious problem. The greater the disaggregation the greater the probability of mis specification and the greater the difficulty of detecting it. Furthermore, the greater the disaggregation the harder it is to obtain appropriate reliable statistics and to the extent that such variables have to be constructed the reliability on the estimates is very much weakened. Finally the greater the disaggregation the greater the complexity in the estimation and the time dependence of the
error terms both within an equation and between equations.

Another serious problem is the assessment of the performance of a model since there are no standard measures of model performance.

From the above discussion it becomes clear that there is no correct answer on how to build up a model. Thus we are faced with a dilemma. We can either build up a model based on the reduced form approach or along the lines of large scale models. In the first case our conclusions would not be particularly strong for the reduced form approach conceals the transmission mechanism and provides no way of testing the validity of the results, thus making them largely a matter of opinion and formulation. On the other hand, by building up a large scale model we inevitably bias our results towards a Keynesian viewpoint. To illustrate, in these models representative market rates are sought and while these are consistent with a Keynesian viewpoint they are a burden to a monetarist viewpoint because there is an essential qualitative difference between the two schools of thought in terms of the range of assets and interest rates considered.

A reconciliation is therefore needed if one is to avoid the shortcomings and caveats of the two approaches. The clue is provided by small scale models. These models are in the spirit of the reduced form approach since a model of this form can meaningfully be solved
for an endogenous variable, such as income, thus providing a reduced form. At the same time, however, such a model makes the structure explicit and testable and thus it bypasses some of the criticisms of the reduced form approach. In small scale models, it is meaningful — that is, it is not biased towards a Keynesian viewpoint — to seek for representative interest rates for these now relate to very aggregated magnitudes.

Small scale models also suffer major weaknesses. In examining, in the previous section, the evidence from such models we found that the results are sensitive to omission or introduction of some variables in key relationships. We believe therefore that in building up a model we should not introduce variables on an ad hoc basis, however reasonable it seems to do so, but instead we should solely rely on theory. In this context chapter II makes explicit the underlying theory of the relationships that comprise our model for the U.K. economy.
II.1 Introduction

The purpose of this model is to explain aggregate economic activity which in very broad terms is determined by the interaction of aggregate demand and supply. In the textbook treatment, aggregate demand is disaggregated into consumption, investment, exports and government purchases. Our treatment follows the same approach but with greater disaggregation in consumption and investment. Clearly the determinants of purchases of consumer durables are much different from those of other consumption. Thus we have one equation for non durables and a separate one for durables. Investment is also disaggregated into three components: investment in dwellings, non residential fixed investment and inventory investment. The rest of the real sector consists of an equation that determines real disposable income; an equation for imports, and the equilibrium condition.

The monetary sector consists of a demand for and supply of money, an equation that determines the monetary base and an equation that determines the term structure of interest rates. We now turn to an examination of each one of the equations that comprise the model.
II.2 The Real Sector

II.2.a. Consumers Expenditure for Non-Durables and Durables

The new theories of the consumption function emphasize the role of the present value of total resources that are available to the consumer over some future period as the most important variable determining current consumption\(^1\): In particular, the permanent income hypothesis treats the present value as a flow concept defined as the amount a consumer unit could consume while maintaining his wealth intact; but due to lack of data it is approximated as a weighted average of current and past incomes over a near period - the "horizon" - of usually 2-3 years duration. The life cycle hypothesis, on the other hand, asserts that current consumption depends on lifetime's resources - a stock variable - comprised of current earned income, expected future annual earned income and the value of total assets at the beginning of the period.

Now, in Keynes formulation of the short run consumption function although a number of variables may prove to be important, current real disposable income is quantitatively the most important. Such formulation has two important implications. Firstly, it assigns to consumption a passive role in business cycles. Secondly, it provides the basis for a stable autonomous multiplier. This stability combined with the volatility attached to investment makes autonomous ex-

\(^1\) M. Friedman (1957); A. Ando and F. Modigliani (1963); R. Brumberg and F. Modigliani (1964).
penditure a very important variable accounting for the cyclic-
al fluctuations of income and points in favour of the use of
discretionary counter-cyclical stabilization policy over the
adoption of a rule.

This state of affairs, though, is inconsistent with the
monetarist thesis of a predominantly money caused business
cycle. It is the very essence, therefore, of the permanent in-
come hypothesis to deprive autonomous expenditure of its im-
portance in explaining the cyclical fluctuations. The theory
attaches such a small role to current income in determining
current consumption that renders the autonomous multiplier of
negligible value so that it is no longer worth bothering about
it. The same is also true, in theory at least, of the life
cycle hypothesis, but in practice this is not the case, for
fluctuations in current income are transmitted in the present
value of future income since Ando-Modigliani refer that the
best estimates are obtained by a formulation in which expected
average income depends only on current income. But is this a
fair criticism on the Keynesian consumption function? Taking
the implication of both theories to its extreme means, as
while Leijonhufvud\(^{2}\) has pointed out, that/an individual loses
his job/continuous to spend the same amount of money on con-
sumption. His level of consumption alters - while he remains
unemployed - only when, and to the extent, that his estimate
of long term income or resources is changed, which is obvious-
ly insensitive to short term fluctuations in income. Clower,\(^{3}\)

\(^{2}\) A. Leijonhufvud (1968).
\(^{3}\) R. Clower (1965).
in addition, has shown that in the context of a money econ-
omy and in disequilibrium situations income is not a choice
variable in the short run. Furthermore wealth is of no use in
the short run because the individual cannot liquidate it
without suffering a capital loss. Thus the individual is
constrained in the short run to make a decision on current
consumption based on current income. His behaviour would
change, however, if the unemployment state persists. In
such a case he will proceed to a liquidation of his assets
even at a capital loss. But obviously this will happen in the
long run. Therefore we can say that the Keynesian formulation
is relevant for the short run while the new theories provide
a formulation relevant for the long run.

For our purposes the importance of the previous analysis
rests in determining the length of the horizon in which the
consumer bases his estimate of long term income whereby the
quantitative importance of current income, when forming an
estimate of the long term income, can be assessed. The great-
er the weight attached to current income the greater the sta-
bility and quantitative importance of the autonomous multiplier
and therefore the stronger the case against simple rules of
the monetary aggregates.

The specification of our consumption for non-durables
emanates from these considerations. Thus we postulate that
desired consumption for non-durables, $C^*_t$, depends on the
present value of the resources, $R_t$, that are available to the
consumer over his "horizon" (to be specified empirically).
We define total resources in period $t$ as the sum of the expected average real disposable income, $Y^d_{pt}$, and the real value of accumulated liquid assets, $L_{t-1}/p_t$.

$$R_t = Y^d_{pt} + L_{t-1}/p_t$$

(2)

$$Y^d_{pt} = \sum_{i=0}^{n} b_i Y^d_{t-i}$$

(3)

And if we make the assumption that the weights, $b_i$, follow a geometrically declining series then (3) becomes

$$Y^d_{pt} - Y^d_{pt-1} = (1-b)(Y^d_t - Y^d_{pt-1}) \text{ or } Y^d_{pt} = \frac{1-b}{1-bL} Y^d_t$$

(4)

where $L$ represents the lag operator. By linearising (1) and combining equations (1), (2), and (4) the final form is obtained.

$$C^n_t = a_0(1-b) + a_1(1-b) Y^d_t + a_2 L_{t-1} - a_2 b L_{t-2} + b C^n_{t-1} \text{ RF1}$$

Our approach differs from that of Modigliani in that we have used liquid assets rather than total wealth. We have done so for two reasons: (i) Liquid assets can be more reliably measured than wealth, and so can be used as a proxy variable for wealth. (ii) It is believed that from all forms of wealth liquid assets play the greater role.

The inclusion of liquid assets in our definition of the long run income or resources quite apart from providing a more accurate measure of it, also helps in distinguishing our hypothesis from other rival hypotheses. One such hypothesis, advanced by Brown, (4) is that consumption depends on current, 

(4) Brown (1952)
rather than permanent, income and the level of liquid assets but because of habit persistence consumers are slow to react to changes in income - that is, there is, some inertia in their behaviour. This hypothesis can be stated as follows:

$$C^n_t = a_0 Y^d_t + a_1 (L_{t-1}/P_t) + a_2 + u_t$$  \(5\)

$$C^n_t - C^n_{t-1} = (1-b')(C^n_t - C^n_{t-1})$$  \(6\)

providing the following final form:

$$C^n_t = a_2 (1-b') + a_0 (1-b') Y^d_t + a_1 (1-b') L_{t-1} + b' C^n_{t-1} + (1-b') u_t$$

The two hypotheses, thus, differ by the inclusion of \(L_{t-2}\). Therefore if the coefficient of \(L_{t-2}\) proved to be negative and significant this would be interpreted as support for the permanent-income or the life-cycle hypothesis.

Other considerations, however, may be called for in analysing the role of liquid assets. It is argued, for example, that alternatively or in addition to the use of liquid assets as part of their total resources consumers are induced in changing their expenditure whenever there is an imbalance between desired and actual liquid assets.\(5\)

This hypothesis can be stated as follows:\(6\)

\(5\) This view is shared by many economists; for example M. Friedman (1959, p. 609) in his description of the workings of the quantity theory of money provides this kind of rationale for the mechanism through which the economy adjusts from a position of disequilibrium toward equilibrium.

\(6\) See, for example, Zellner, Huang and Chau.(1965).
\[ C^n_t = a_0 + a_1 y^d_{pt} + a_2 (L^d_{t-1} - L^d_t) \]  \hspace{1cm} (7)

Consumers may have a preferred amount of liquid assets because of the need to satisfy transactions, precautionary and speculative motives. Demand for liquid assets to finance transactions is undeniably important and self explanatory that needs no further comment. Demand for precautionary purposes, on the other hand, depends on the degree of uncertainty: the higher the degree of uncertainty the more it pays to be more liquid and to borrow less from the banks. Any level of liquidity in excess of that needed to satisfy the demand for both motives leads to excess spending.\(^7\)

A direct formalisation and estimation of this approach is very difficult however partly because of the problems involved with aggregating the behaviour of individuals and partly because of the difficulty in determining the desired level of liquidity. It is thus the case that, in general, statistical analysis cannot discriminate between the two hypotheses: that liquid assets are important in determining consumption expenditure because they are part of wealth, and that an imbalance in the desired level of liquid assets leads to changes in consumer spending. The desired level of liquid assets is assumed to be determined by one of the following forms:

\[ \frac{L^d_t}{P_t} = \lambda y^d_{pt} \] \hspace{1cm} (8a)  
\[ \frac{L^d_t}{P_t} = \lambda y^d_{pt} - \mu r_{st} \] \hspace{1cm} (8b)  
\[ \frac{L^d_t}{P_t} = \sum \lambda_j L_{t-j} \] \hspace{1cm} (8c)

\(^7\) We ignore the demand for speculative purposes.
Equation (8a) is typical of Friedman's approach - demand for liquid assets depends only on permanent income. On the assumption that long run income is determined as in (4) the reduced form of this hypothesis is as follows:

\[ C^n_t = a_0(1-b) + (a_1 - a_2\lambda)(1-b)Y^d_t + a_2L_{t-1} - a_2bL_{t-2} + bC_{t-1} \]

However, models R.F.1 and R.F.3 have the same reduced forms and because R.F.1 contains over identified parameters and R.F.3 a mixture of over- and under-identified parameters, the empirical estimates provide no information which would help to distinguish between the different theories underlying them.

Equation (8b) allows also some room for the interest rate, in line with the overwhelming evidence on the demand for money of a substantial interest rate effect. The reduced form of this hypothesis would be

\[ C^n_t = a_0(1-b) + (a_1 - a_2\lambda)(1-b)Y^d_t + a_2L_{t-1} - a_2bL_{t-2} + a_2r_{st} - a_2b_{st-1} + bC^n_{t-1} \]

Equation (8c), finally, states that the desired level of liquid assets is some sort of average of past levels. This hypothesis gives the following reduced form on the assumption that the weights in (8c) decline geometrically.

\[ C^n_t = a_0(1-b)(1-\lambda) + a_1(1-b)Y^d_t - a_1(1-b)\lambda Y^d_{t-1} + a_2(1-\lambda)L_t - \lambda y_{t-1} - \lambda bL_{t-2} + (b+\lambda)C^n_{t-1} - b\lambda C_{t-2} \]
Thus many hypotheses could account for the same reduced form. This would complicate things in explaining the empirical results.

It is not surprising that purchasing patterns for durables are quite different from those for other consumption. Purchases of durables depend on prior stocks and can be postponed or accumulated much more easily than other consumption. It is therefore believed that the determinants of expenditure for durables would differ from the rest of consumer expenditure.

Thus income, although important in itself, lacks the significance it has for non-durables because the consumer can draw much more easily either on liquid assets or on consumer credit.

Although the price of a durable is a much higher proportion of income compared with the price of non-durables and thus purchase of durables often needs prior saving, the use of credit enables the consumer to save after he has purchased a durable good instead of before. This situation arises in particular in the case of durables and therefore it is expected that the availability of credit has a much greater impact on durables than on non-durables. Restricting therefore the availability of credit unambiguously deters spending in the short run although the long run effect is ambiguous.

Apart from the availability of credit - considered here in two forms, bank advances and changes in hire pur-
chase - the conditions under which it is supplied are also of great importance although expenditure on durables is unlikely to be affected by changes in these controls in the long run. Changes in the conditions of hire purchase regard the minimum deposit to be paid by the consumer and the maximum period of repayment, and are subject to statutory control.

Neither the Radcliffe Committee nor the Commission on Money and Credit attached any importance to changing interest rates as a means of affecting consumer expenditure. The case however seems to be quite the opposite. Hamburger (1967), among others, has found a substantial interest rate effect; he thus concluded that "...consumer behaviour is influenced not only by the supply, but also (by) the demand for loanable funds, in particular the demand for credit by other sectors of the economy." (8) The inclusion of interest rates provides, according to Hamburger, "...an alternative to both the Keynesian and the Chicago views concerning the channels through which monetary policy operates. Contrary to the Keynesian income - expenditure approach, they would imply that monetary policy has a direct effect on consumer behaviour." (9) "This more direct link is recognised in the alternative approach expounded by Friedman and Meiselman, but they argue that it is neither very illuminating nor useful to view the effects of monetary policy as operating through interest rates." (10) Thus the inclusion of interest rates in the equation for non-durables brings closer to-

(8) Hamburger (1967, p.1145)
(9), (10) Hamburger (1967, p. 1131, p. 1149)
gether the Keynesian and monetarist views concerning the channels of monetary policy.

Thus the equation for durables has the following form

$$C^d_t = a_0 + a_1Y_t + a_2BA_t + a_3\Delta HP_t + a_4R_Lt$$

(9)

$$C^d_t - C^d_{t-1} = (1-v)(C^d_t - C^d_{t-1})$$

(10)

where BA and $\Delta HP$ are bank advances and changes in hire purchase respectively, and equation (10) is the famous stock adjustment principle.
II.2.b. The Investment Function

Investment is a key relationship, particularly in the Keynesian theory, since it affects other forms of expenditure. It is thus not surprising that much of the controversy for the importance or unimportance of money relates to investment - on whether and how changes in the stock of money affect investment expenditure. Formulations of the investment function, however, usually lack systematic treatment, being in essence ad hoc specifications without a sound theoretical justification. This was the case since it was questioned whether investment demand - ex ante investment - can be derived either at a micro or macro level from the demand for capital.

The conventional theory of the firm in its comparative static form - a profit maximizer firm would hire an input up to the point at which its marginal product equals its price - yields a demand function for capital which is negatively related to the rate of interest\(^1\). Although the rate of interest enters the analysis its role merely consists in affecting the optimal level of capital stock.

Planned investment remains unbounded. As Haavelmo has put it: "the demand for investment cannot simply be derived from the demand for capital. Demand for a finite addition to the stock of capital can lead to any rate of investment, from almost zero to infinity depending on the additional\(^1\)"

\(^1\) The derivation of this function is achieved by using either the present value rule or the internal rate of return rule and assuming diminishing marginal productivity. The subject of which method is superior has risen much discussion; see Hirshleifer (1958) and Alchian (1955)
hypothesis we introduce regarding the speed of reaction of capital users."(2)

It seems therefore important for our purposes to review the various theories from two points of view: (a) specification—whether they are derived rigorously from economic theory or constitute an ad hoc specification; (b) the role they assign to monetary variables. We begin by considering those studies that lie in the Keynesian tradition.

The comparative statics approach, as exposed by Lerner and Witte,(3) derives an aggregate investment function related to the rate of interest and the level of national income, though the point still remains that this function is not a demand curve for anything and is not derived by aggregation from similar micro investment functions. It depends on both demand and supply factors; its existence stems from the response of the capital goods supplying industry—considerations of rising costs, and capacity constraints on the part of the capital goods supplying industry.

The naive accelerator is characterized by the belief that monetary policy is impotent in affecting the real sector of the economy—the norm, after the Second World War was thought to be an almost vertical IS-curve. According to this Keynesian view the rate of interest has no role to play in investment decision. The optimum capital stock is assumed to bear a constant proportion with output. By incorporating

(2) T. Haavelmo: "A Study in the Theory of Investment"
the most restrictive assumption of an optimum adjustment of capital in each period, net investment is a constant proportion of the change in output.

Two rationales have been offered for the proportionality of the optimal capital stock to output. In the first a production function is assumed with fixed coefficients and constant returns to scale. Furthermore firms are assumed to be cost minimizers rather than profit maximizers. In the second, cost minimization is still assumed but the production function, now, provides some substitutability between capital and labour. The naive accelerator is still obtained by assuming that the relative prices of inputs remain constant. Whatever the rationalization the naive accelerator remains very restrictive because it suffers from two major drawbacks. Firstly, it assumes that firms are never working with excess capacity; and secondly, it assumes that the supply of capital is always optimally adjusted, that is the supply of capital goods is infinitely elastic. The latter assumption remains valid in the case of a relatively small firm, but becomes unreasonable if the naive accelerator refers to the macro level.

It is this very restrictive assumption that the flexible accelerator relaxes by recognising that there are lags in the adjustment process. These lags are due to the decision making process by the firm on the one hand, and on the response of the capital goods supplying industry on the other.

(4) In this model perfect competition in the goods market is incompatible since constant returns to scale make the size of the firm indeterminate. Thus an imperfect market is assumed; see Eckaus (1953).
Thus the rate of adjustment depends on both demand and supply elements. Hence the flexible accelerator still retains that the optimal capital stock is determined by a fixed relation with output but the adjustment of actual to desired capital stock is determined by the famous "capital stock adjustment principle".

This theory, however, does not provide a demand for investment; there is only a demand for capital stock, but realized investment is bounded due to delivery lags. Furthermore, the partial adjustment theory is ad hoc.

The above mentioned, two shortcomings of the flexible accelerator - both product of the application of comparative statics to a dynamic problem, i.e. investment - can be overcome by an explicit consideration of the dynamic behaviour of the firm. Using this approach Eisner and Strotz, (1963), provided a rigorous rationalization of the flexible accelerator deprived of the above mentioned deficiencies. The main concern in this type of analysis is with the adjustment path which the firm follows from one position of equilibrium to another. Thus the problem of the firm is to maximize the present value of future net returns by choosing optimal paths for the inputs.

To obtain a determinate micro investment demand Eisner and Strotz assume that adjustment lags are due to the fact that the unit cost of an addition to capital stock is higher the more rapidly the addition takes place. Under appropriate functional forms and with stability of the desired stock imposed as an additional assumption, the famous "capital stock
adjustment principle" is derived.\(^{(5)}\)

In this analysis the role of the rate of interest is of particular importance. Changes in the rate of interest affect both the steady state solution and the path toward the steady state. Thus, a rise in the rate of interest will have a two-fold effect; first, it will reduce the long run optimal capital stock, and second, it will slow down the optimal adjustment of capital stock towards its long run equilibrium value.

The neo-classical approach differs essentially from the Keynesian one. In the latter investment behaviour is seen as a set of two problems: (a) what determines desired capital stock, and (b) how the actual stock adjusts to its desired level. In the neo-classical approach a set of assumptions on the one hand, and the methodology employed - comparative dynamics - on the other, serve to sidestep the problem of how the actual capital stock adjusts to the optimal level.

The underlying assumptions of the neo-classical theory are: (a) No adjustment costs; thus firms have no incentive to delay adjustment of their capital stock. (b) No uncertainty about technology, future prices of products and factors.

\(^{(5)}\) A generalization of the Eisner-Strotz approach is provided by Lucas (1967), for the case of multi-fixed inputs. He demonstrates that the simple flexible accelerator does not generalise to the case of many capital goods. Instead, the rate of adjustment of the ith capital good in general depends on the difference between desired and actual stock of all goods.

Another restrictive assumption - that of decreasing returns to scale - is dealt by Treadway, (1969) who shows that investment demand is inversely related to the rate of interest and the price of capital independently of assumptions about the returns to scale.

Finally, another important drawback of the Eisner -
(including the rate of discount). (c) Perfect markets.
(d) Full-employment of factors of production. (e) A production function that satisfies all the usual neo-classical properties.

The result of these assumptions is that if the firm is a perfectly competitive long run profit maximizer then it always pays to optimally adjust, i.e., the actual capital stock would always be equal to the optimal capital stock for every period and problem (b)-above- is of no relevance.

The maximization of the present value of the firm over time produces dynamic marginal productivity conditions

\[
\frac{Q(t)}{L(t)} = \frac{w(t)}{P(t)} \quad (1); \quad \frac{Q(t)}{K(t)} = \frac{q(t)(r(t)+s) - q(t)}{P(t)} = \frac{c(t)}{P(t)}
\]

The great advantage of the above approach is that the rental price of capital - "the user cost of capital" as Jorgenson calls it - has been derived from an explicit multi-period optimization procedure. But looking back at conditions (1) and (2), as Nerlove (1972) points out, because no adjustment costs or anticipated or uncertain lags in the delivery of capital goods are incorporated, Jorgenson's conditions for maximization turn out to be essentially those of the purely static case - what is called the "myopic decision criteria". Thus what this approach implies is that if a firm anticipates that output prices are going to be lower in some future time period, say \( t_n \), it simply ignores it until it occurs; hence the optimal time path of capital

Stratton approach is that of stationary expectations - the entrepreneur anticipates that prices obtained at the beginning of the period will obtain forever after. Gould (1969) has shown that adjustment need not follow a flexible
stock up to $t_n$ is the same whether or not expectations of 
lower output prices exist.

Since the maximization procedure yields essentially 
marginal productivity conditions of the type of static micro 
theory, the neo-classical model of optimal capital accumu-
lation produces demand functions for labour and capital 
services and a supply function of output all having as ele-
ments the wage rate, $w$, the user cost of capital, $c$, and the 
price of output, $p$. Thus:

$$L^* = L(w,c,p) \quad (3)$$
$$K^* = K(w,c,p) \quad (4)$$
$$Q^* = Q(w,c,p) \quad (5)$$

Having derived a demand for capital Jorgenson's approach 
enables him to obtain an investment demand function that va-
ries inversely with the rate of interest. His approach by-
passes the problem raised by Haavelmo since on the one hand 
the assumptions of his analysis imply that $K_t = K^*_t$ for all $t$ 
and on the other hand his method of analysis - comparative 
dynamics - does not allow discrete changes in the variables. 
Jorgenson's method consists in comparing two alternative 
optimal capital accumulation paths. Thus the demand for 
investment, as a function of the rate of interest as derived 
from the neo-classical theory, is bounded.

Monetary policy in this type of neo-classical model 
can affect the rate of investment only through the influence 
of the rate of interest on the optimum stock of capital.

accelerator pattern in the case of non-stationary expectat-
ions. However, Gould does not obtain an investment demand 
function dependent on actual prices but only on expected 
prices.
This completes our survey of the various theories. Although the two main theories differ in various respects the key issue at an empirical level concerns the importance or unimportance of the relative prices as a determinant of investment.

The specification of our non-residential fixed investment equation follows from the neo-classical theory. That is on a micro level it is assumed that net investment, \( N_{I_t} \), is

\[
N_{I_t} = K_{t}^* - K_{t-1}^* = \Delta K_{t}^* \quad \text{or} \quad N_{I_t} = \frac{dK_{t}^*}{dt}
\]

that is, orders are placed sufficient to achieve \( K_{t}^* \) by the time they are delivered. However, although the firm attempts to adjust instantaneously \( \frac{dK_{t}^*}{dt} \), it is faced with unanticipated delivery lags. Thus on an aggregate level actual investment expenditure is a distributed lag function of current and past orders, or changes in desired capital stock. If \( m_j \) represents the proportion of the orders placed \( j \) periods ago which will be delivered this period and if in addition we assume that all orders are delivered, that is \( \sum_{j=0} m_j = 1 \), then net investment would be

\[
N_{I_t} = I_t - \sum K_{t-1} = m(L)\Delta K_{t}^*
\]

\[
\Delta K_{t} = m(L)\Delta K_{t}^* \Rightarrow K_{t} = m(L)K_{t}^*
\]

where \( L = \) the lag operator.

We assume that \( m(L) \) is a rational lag function and therefore can be approximated by the ratio of two finite polynomials in \( L \). That is

\[
m(L) = \frac{s(L)}{w(L)}
\]
or \[ K_t = \sum_{i=0}^{1} s_i K_{t-i} + \sum_{j=1}^{k} w_j K_{t-j} \] (9)

Since our interest lies in gross investment, equation (9) was transformed using the expression

\[ I_t = K_t - \left(1 - \sum\right) K_{t-1} \] (10)

\[ I_t = \sum_{i=0}^{1} s_i \left[ K_{t-1} - \left(1 - \sum\right) K_{t-i-1} \right] + \sum_{j=1}^{k} w_j l_{t-j} \] (11)

This equation can be estimated as long as \( K_t \) is specified. Desired capital stock is assumed therefore to depend on the user cost of capital and the level of output.

\[ K_t = K^*(p/c, Q) \] (12)

One however could object to our using of \( Q \) as a predetermined variable, not on statistical grounds because simultaneous equation techniques can be used to overcome the problem, but mainly on the grounds that the treatment of \( Q \) as a predetermined variable is inconsistent with the neoclassical theory of the firm since output depends on input and output prices. Following Coen and Hickman (1970), however, we can bypass this criticism by assuming that the typical firm is a cost minimizer rather than a profit maximizer in which case the treatment of \( Q \) as a predetermined variable is justified.

Now the long run properties of the two explanatory variables of \( K_t \) seem to depend on the underlying product-
Jorgenson always makes use of the Cobb-Douglas production function in which case the long run elasticities of the desired capital stock with respect to output, $E_q$, and the relative prices, $E_p/c$, are unity. These properties follow from the unit elasticity of substitution, $\sigma$, of the Cobb-Douglas production function. Thus in a critical appraisal on Jorgenson's empirical work, Eisner and Nadiri (1968), argue that "the central feature of the neo-classical theory (the response of the demand for capital to changes in relative factor prices) is assumed rather than demonstrated since it appears that it follows from crucial, a priori, constraints put upon parameters". (6) If one had started with a C.E.S. production function as an alternative to the Cobb-Douglas then $K^*$ turns out to be:

$$K^* = A(p/c) Q + \frac{1-\sigma}{v} = A(p/c) \frac{E_p/c}{Q} E_q$$

where $v$=returns to scale. It follows that if the C.E.S. production function exhibits constant returns to scale, $v=1$, then the elasticity of output is unity. Therefore for every homogeneous production function it is true that $E_q=1$ as long as it is characterised by constant returns to scale. The same is not true for the price elasticity since from (13) it follows that $E_p/c=\sigma$, which is true only in the case of a Cobb-Douglas production. Thus our formulation for $K^*_t$ is such as to allow the long run elasticities to be different from unity. Confirmation of the neo-classical theory is found if the estimated long run elasticities are equal to unity. If on the other

hand it turns out that \( E_p/c = 0 \) and \( E_q = 1 \) then this provides support for the flexible accelerator models.

In addition following Bischoff (1969), we allowed both relative prices and output to have different lag response functions, because by restricting both determinants of \( K^* \) to have the same lag structure we might introduce a bias on the effect of relative prices by picking up some of the effect of output.

Finally we should comment on the variable we used as proxy for the cost of capital. Jorgenson uses two measures - interest and earnings and the U.S. government long term rate. We use a long term rate - the \( 2^{1/2} \) Consol rate - for two reasons: Firstly, because of the belief that a correct measure of the true cost of capital is almost impossible, at least at this level of aggregation. Secondly, we are more interested in the response of investment to the rate of interest rather than the whole cost. Following Eisner and Nadiri we accept that although the true cost of capital is more than the government long term rate, it is very likely that it may only be proportionately greater than this interest rate, because market arbitrage is expected to establish a fairly constant ratio between the interest rate and the true cost of capital.

Thus the specification of our non-residential fixed investment is as follows:

\[
I_t = \sum_{i=0}^{k} s_i (\Delta r_{t-n-i} + \Delta r_{t-n-1-i}) + \sum_{i'=0}^{k'} s_{i'} (\Delta y_{t-n'-i'} + \Delta y_{t-n'-1-i'}) + \sum_{j=1}^{1} w_j I_{t-j}
\]

(14)
We now turn to a discussion of the determinants of investment in residential construction. Orders for new dwellings are put by two basic groups. Individuals who contract for or build a house for their own use, builders or developers who start new units with the purpose of either renting or selling them.

Orders for residential construction depend on two separate decisions: (a) The number of dwellings to be built; (b) The average size, quality and value of each unit. Then expenditure on new dwellings is the product of the number of units times their average value.

The relevant question, now, is what factors determine the number of new dwellings the entrepreneurs will order? Ex post, the actual number of completions is a lagged function of previous housing contracts or starts. Ex ante, the desired number of new dwelling units will depend on the relationship between completions and vacancies. If completions grow at a greater rate than final demand, vacancies will build up and vice versa. Thus in equilibrium the number of new dwellings will equal changes in final demand. During disequilibrium, for example when vacancies exceed changes in final demand builders' profits will decline for two reasons: Firstly, because excess vacancies exert a downward pressure on the selling price of dwellings; secondly, because there is a foregone income by holding vacancies.
The decline in profits will result in a reduction in new starts. Changes in profits and thus changes in builders' plans for new starts result also from changes in wages or the price of materials.

We already stressed that expenditure for new housing depends on the number of units started as well as on the average value for each unit. The latter depends upon both the amounts households will spend for rent or imputed rents and the rates at which these rents are capitalized to give current values. In addition, the average value of dwellings should depend on credit terms as well. These take three forms: the interest rate payment, payments to capital and the required downpayment. Following Maisel (1965) we assumed that all three forms of credit can be represented by the short term rate. The short term rate is preferred to a long term mortgage rate on the assumption that all dimensions of credit move closely in line with the short term availability, as reflected by its rate.

Thus our equation for fixed investment in dwellings is

\[ I_t^d = n(L)S_t \quad \text{where} \quad S_t = S(Y_t, r_{st}) \]

where \( I_t^d \) = investment in dwellings, \( S_t \) = starts and \( n(L) \) = polynomial in the lag operator.
II.2.c. Inventory Investment

Inventory investment fluctuates more than any other component of aggregate demand during the business cycle. Thus we believe that a correct specification of its determinants and lag structure are essential for monetary policy. While disaggregation by industry and by type of asset is important, for there are differences among them, (1) a total stock equation is specified for all industries taken together. Total stocks are defined, here, as the sum of the value of the physical increase in stocks of materials and fuel, of finished goods, and the change in work in progress.

The specification of the inventory investment equation is along the cost minimizing approach of Holt, et. al. (1961). In particular, the firm is assumed to choose its inventory level so as to minimize the costs associated with inventories \( C_t \). Further it is assumed that the firm incurs two kinds of costs - disequilibrium costs and adjustment costs. Any deviation of the actual, \( H_t \), from the desired or equilibrium level, \( H^*_t \), gives rise to disequilibrium type of costs. A positive deviation, for instance, leads to increased costs of storage, insurance, warehousing, etc, both in the case of raw material and finished goods. A negative deviation is associated with costs that arise from orders placed at irregular intervals and in uneconomic batch lots in the case of raw materials, and to foregone earnings in the case of finished goods. The second type of costs - adjustment costs - arise whenever the

(1) See Trivedi (1971).
current level of stocks is different from last period's. Such costs might take the form of administrative costs that usually arise with changing patterns of purchases of raw materials. An uneven pattern of purchases may also give rise to uncertainty to the suppliers of raw materials and result in loss of price discounts that usually accompany a steady volume of purchases. Thus the typical firm is assumed to minimize the following quadratic cost function:

\[ C_t = c_0 (H_t - H^*_t)^2 + c_1 (H_t - H_{t-1})^2 \]  \hspace{1cm} (1)

The minimization produces the partial adjustment equation. In this study the dependent variable is the net change in stocks since from a macroeconometric point of view it is this variable and not the level of stocks that is in accordance with the income identity. Thus

\[ \Delta H_t = k (H^*_t - H_{t-1}) \]  \hspace{1cm} (2)

The desired level of stocks is assumed to depend on the level of expected demand for the output, the expected rate of interest, and the liquidity or internal funds of the firm. The rate of interest represents both the opportunity cost of carrying stocks, and the cost of funds needed to facilitate inventory investment. The higher the cost, the smaller would be the desired stock, ceteris paribus.

\[ H^*_t = b_0 + b_1 \psi_t + b_2 r_t + b_3 (L_{ct-1}/p_t) \]  \hspace{1cm} (3)

It is assumed that expectations are formed according to the following rules represented by rational lag functions:

\[ \psi_t = s(L) \psi_t; \quad r_t = v(L) r_t; \quad (L_{ct-1}/p_t) \]  \hspace{1cm} (4)
Thus the inventory investment equation to be estimated has the following form:

\[ \Delta H_t = k_{b_0} + k_{b_1}s(L)Y_t + k_{b_2}v(L)r_t + k_{b_3}u(i)(L_{ct-1}/p_t) - kH_{t-1} \]
II.2.d  The Rest of the Real Sector

The rest of the real sector consists of the import function, an equation that determines current real disposable income and the equilibrium condition. We examine each one separately.

The specification of the imports function is very simple and straightforward. Our only excuse is that we do not believe that for our purposes the simplicity of this function would affect our results, for one reason that the interaction between the monetary and the real sector is not greatly affected by the behaviour of imports.

Thus the desired level of imports, \( IM^*_t \), is assumed to depend primarily on the demand for both consumer and capital goods. Consumer demand in the U.K. is very important given the predominance of the foods component. In this case current real disposable income or some measure of long run resources should be the appropriate variable to use. On the other hand a proxy for the level of the demand for capital goods is the level of economic activity measured in this case by G.D.P. Thus on these grounds one should introduce both elements, \( Y_t \) and \( Y^d_t \), into the imports function. But obviously such a specification would be erroneous. Thus a choice must be on statistical grounds.

A variable that might possibly affect imports is the ratio of the general price level of the U.K. to that of the rest of the world. Obviously if the U.K. experienc-
es a greater inflation rate than the rest of the world, it would make the price of imports relatively cheaper to the domestic goods and therefore more attractive.

From the monetary variables that might affect imports the availability of import credit, IC_t, is considered to be the most important.

Finally we assume that because of capacity and delivery constraints on the one hand and lags in the decision making process on the other, imports are only partially adjusted within each quarter.

Thus the import function is

\[ IM^*_t = IM \left[ (Y_t \text{ or } Y^*_t, L_{t-1}/P_t), IC_t, (P/P^*_t) \right] \]  

(1)

\[ IM_t - IM_{t-1} = m(IM^*_t - IM_{t-1}) \]  

(2)

For the disposable income the following empirical observation is used

\[ Y^d_t = \alpha_1 Y_t + \alpha_2 Y^d_{t-1} \]  

(3)

In this formulation we have suppressed the constant.

Finally the equilibrium condition is postulated as

\[ Y_t = C^n_t + C^d_t + I^d_t + I_t + \Delta H_t + \bar{C}_t + \bar{X}_t - IM_t + \bar{E}_t \]  

(4)
where $E_t$ stands for a small residual error so that the equation is always satisfied. A bar over a variable means that this variable is exogenous. This has no further implication, apart from reasons of completeness, as far as the specification is concerned, but it becomes important for estimation purposes. The reason is that although the $G_t$, $X_t$, and $E_t$ do not enter in any one function, they would be used as instruments in the first stage of the T.S.L.S. in estimating each equation.
II.3. The Monetary Sector

II.3a. The Demand for Money

The role the demand for money plays in the monetarist model has already been analysed and criticized in chapter I. In order to avoid repetitions, therefore, we simply add here how we have formulated the demand for money equation. The formulation is a standard one as it is implied by the voluminous evidence that has been accumulated in the last few years.

The consideration of the store of value function of money, in addition to that of the medium of exchange, makes money an asset alternative to other assets and therefore justifies the treatment of the demand for money as an application of portfolio analysis. In this context the role of income or wealth— including or excluding human wealth—is that of a constraint in a maximization problem. In this formulation both forms of the constraint have been applied.

The inclusion of the rate of interest in the demand for money follows from the widely accepted principle both in theory and in practice that the adjustment of an individual's portfolio from a position of disequilibrium to equilibrium falls at least initially on the financial assets.

The price level is explicitly introduced into the demand for money to test the proposition that the demand for money in real terms is invariant with respect to the price level.

Finally it is recognised that the adjustment of an individual's portfolio to equilibrium does not occur in any single time period, for it takes time for money holders
to become aware of changed conditions and therefore to rearrange their assets. In particular it is assumed that in any single period only a fraction of the desired difference is in fact adjusted.

Thus the model of the demand for money is

\[ M^*_t = a_0 + a_1 W_t + a_2 P^*_t + a_3 r_t \]  

(1)

\[ W_t = Y_t \]  

(2a)

\[ W_t = Y^*_t \]  

(2b)

\[ M_t - M_{t-1} = K( M^*_t - M_{t-1} ) \]  

(3)

\[ Y^*_t = l(L) Y_t \]  

(4a)

\[ r^*_t = m(L)r_t \]  

(4b)

\[ P^*_t = n(L)P_t \]  

(4c)

The above model includes a wide selection of special cases. Thus equation (2) examines whether current income or wealth (both human and non-human) is the relevant variable in the demand for money. In addition, equation (4a) permits a number of specifications for the wealth variable. Equation (4b) provides different formulations for the Keynesian "normal backwardation hypothesis". Finally equation (4c) examines various short-run responses of the demand for money to changes in the price level.

The only thing that remains to be considered is whether the above model is a mis-specification since it ignores the effect of non-bank-financial-intermediaries (NBFIs) on the demand for money by overlooking the amounts of or rates of return paid on near bank claims. The basic problem starts from the definition of money which becomes an open question when in its distinguishing characteristics is added the store of value function of it. There is not a clear cut case then of what constitutes money. In this context Gurley and Shaw
(1955;1960) argue that the liabilities of NBFI possess also the role of money. Since according to Gurley and Shaw, the present methods of control discriminate against the commercial banks a rapid rate of growth in NBFI is to be expected associated with a fall in the demand for money which in its turn implies a reduction in the effectiveness of monetary policy. But the growth of NBFI is a long-run phenomenon and as such does not impede with the conduct of monetary policy. As Clayton (1962) argues "In the long period the growth of NBFI implies that money, defined as currency outside the banks plus current accounts, will become a smaller proportion of total financial assets, and therefore the velocity of circulation of money will be higher than it would be in the absence of their growth. But it does not necessarily follow that, because the long-term velocity of circulation is higher, the short-term effectiveness of monetary policy has also declined.... (f)rom the point of view of cyclical policy the important problem is whether the switch from money to near-money assets is likely to occur during the short period when the monetary authorities are attempting to restrict monetary demand."(1)

This question boils down to whether money and near money assets are very close substitutes. Evidence is provided by introducing into the demand for money the yields on near money assets.(2)

(1) Clayton (1962)p.p. 871 and 877
(2) For example, Feige (1964;1974) finds a small substitutability between money and near money assets and that the demand for each one of those has exhibited a remarkable stability over both periods of monetary ease and stringency.
But this is an indirect approach and therefore small reliability can be attached to it. In other words one is never sure how high the degree of substitutability should be so that the effect of NBFI would be regarded as harmful. A direct approach involves the construction of general equilibrium models of the type used by Tobin-Brainard (1967) for the U.S. economy or by Clayton et.al. (1974) for the U.K. economy. Though a positive answer cannot be given, since the subject is still open, it does not seem to us that our specification of the demand for money is meaningless.
II.3.b The Supply of Money

The case against or in favour of a rule heavily depends on whether the money supply is endogenous or exogenous. If the supply of money is endogenous there is no point in trying to follow a rule.

Nevertheless much confusion over this debate arises from an ambiguity over the meaning of the endogeneity/exogeneity since there are two notions involved that do not always correspond. According to the first, the statistical notion, the endogenous/exogenous term refers to a specific model in whose context a variable is characterised as endogenous or exogenous depending on whether it is explained by some variables of the model. According to the second notion exogenous means a variable subject to control by policymakers. (1)

Clearly the debate over the endogeneity/exogeneity of the supply of money does not relate to the first meaning since the issue is not over a specific model but over the real world. Indeed the endogeneity/exogeneity issue refers to the determination of the money stock where all three—the authorities, the non-bank private sector, and the commercial banks—have a role to play; and it is concerned

(1) The two definitions do not always correspond; for example, tax receipts are exogenous in the policy sense of being subject to manipulation by policymakers, but they are clearly not exogenous in the statistical sense of not responding to current movements in the endogenous variable income.
with whether and more importantly with the extent to which
the public and the banks can initiate a change in the mo-
ney supply contrary to the willingness of the authorities;
mORE technically the issue is whether changes in the stock
of money are caused by a shift in the demand or supply
schedule of it and with the interdependence between them.

The debate can best be expressed in terms of the
money multiplier. Early theories, from the exogenous camp,
of the determination of the stock of money have been more
or less mechanical arguing that the supply of money is
linked to the monetary base via a multiplier, the latter
being determined by the reserve ratio observed by the
banking system, and the ratio between currency and deposits held
by the public. On the assumption that the two ratios are
constant the money multiplier is also a constant and there-
fore changes in the stock of money are solely due to changes
in the monetary base. Assuming that the latter is determined
by the authorities makes the supply of money exogenously
determined.

More recent theories(2) comprising the weaker version
of monetarism emphasize the treatment of these ratios as
behavioural relationships reflecting asset choices. The
element stressed by these new theories of the money supply
is that commercial banks are profit maximizing institutions
with economic behaviour patterns on which the central bank
must operate to control the money supply. Recent theories

(2) See Brunner(1961); Brunner and Meltzer(1964); Meigs(1962);
Teigen(1964); Goldfeld(1966).
have departed from the money multiplier approach in two respects: (a) they stress the micro rather than the macro behaviour of the banking system; (b) in determining the level of desired reserves they apply economic theory and explain fluctuations in the assets held by the banks as emanating from changes between actual and desired reserves.

According to this formulation the money supply is no longer under the complete control of the authorities; rather it is jointly determined by the authorities and the economic behaviour of the banks and the public. A simple model along these lines can easily be constructed.

Thus commercial banks are assumed to respond to changes in the return from lending, \( r \), as well as to the cost of borrowing, \( r^d \). Banks tend to increase their borrowing and decrease their excess reserves when the return from lending adjusted for risk rises, ceteris paribus. Similarly banks tend to increase their excess reserves if the cost of borrowing increases, ceteris paribus. Thus when it becomes more profitable to make loans, banks are assumed to be willing to increase the supply of money through increased deposits. Thus if \( p \) is the reserve ratio then their behaviour is described as

\[
p = p(r, r^d) \quad (1); \quad p_1 < 0, \quad p_2 > 0
\]

The behavior of the public is assumed to be influenced by the level of economic activity, the rate of interest paid on deposits, and on other assets. Thus the desired currency ratio of the public is

\[
c = c(r, r^t, Y) \quad (2); \quad c_1, c_2, c_3 < 0
\]
The rationale for \( c_3 < 0 \) is that as income rises the demand for both currency and deposits increases but the demand for the latter increases proportionately more than the demand for the former since it becomes more attractive and luxurious to finance transactions by cheque than by cash.

Combining equations (1) and (2) with the definitional equations

\[
B = R + C \quad (3) ; \quad M = C + D \quad (4)
\]

gives the following equation

\[
M^S = f(B, r, r_d, r_t, Y) \quad (5)
\]

Whether the supply of money is endogenous or exogenous now depends on: (a) the stability of the reserve and currency ratios; (b) the predictability of these ratios and the ability of the authorities to offset any changes in them by manipulating the various instruments which are under their control; and (c) the speed with which such offsetting action can be taken.

Those in the monetary camp that recognize this formulation argue that the reserve and currency ratios are stable and predictable functions and that the influence of the authorities on the money supply mainly via their ability to control the monetary base dominates the other two influences emanating from the behaviour of the public and the banks so that the money supply as a whole can be taken as exogenous or rather autonomously determined. The argument can best be seen by taking the total differential of (5) on the assumption that \( r_d \) and \( r_t \) are kept constant

\[
dM = f_1 dB + f_2 dr + f_5 dY \quad (6)
\]
and assuming that $f_1$ is greater than $f_2$ and $f_5$ taken together.

The non-monetarist camp has put forward several counterarguments but the most important and elegant is expressed in what has come to be known as "new view." The central approach of the "new view." is that "monetary theory broadly conceived is simply the theory of portfolio management by economic units: households, businesses, financial institutions and government. It takes as its subject matter stocks of assets and debts (including money) and their values and yields."(3) In this approach the link between the real and the monetary sector is not the quantity of money but the structure of interest rates and the availabilities of credit.(4)

The major implication of the "new view" is that the quantity of money is an endogenous variable: "the quantity of money as conventionally defined is not an autonomous variable controlled by governmental authority but an endogenous or inside quantity reflecting the economic behaviour of banks and other private economic units."(5)

In this general-equilibrium approach the demand for bank deposits (or more generally the demand side of every asset and their interrelationship) and the role played by other financial institutions than commercial banks becomes very important. To illustrate, the preferences of the public may be such that the supply of money will be at its maximum

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(3) Tobin (1967, p. 2)
(4) This is why H. Jonson (1972) has argued that the "new view" provides a theoretical foundation of the Radcliffe Committee's position on monetary theory.
(5) Tobin (1967, p. 3)
determined by the size of the monetary base and the banks minimum reserve ratio. In this case the banks will be fu-

lly loaned up. If, however, demand is lower then the supply of money will be lower and the banks will be operating with a reserve ratio higher than the minimum necessary. They will appear to have excess reserves.

The important issue the "new view" raises is best ex-

pressed by H. Johnson: "The crucial issue is whether the interrelationships (deduced from rational maximizing be-

haviour on the part of all economic actors) in the fina-

ncial sector are stable enough to permit changes in the monetary base to be used to analyse and predict changes in the real sector (including both output and price level changes), or whether detailed understanding of the finan-
cial sector and the effects of monetary changes on the structure of interest rates, asset yields, and credit av-

ailabilities is a necessary prerequisite of this endeavour."(5)

In this connection the "new view" does not offer any test-
able theoretical propositions. It is true that it provides good reasons for the existence of slippage in the control of the money supply but it does not really answer the weaker version of the monetarist case--- for it has to show that the slippage is of considerable quantitative importance relative to changes in the monetary base.

In this context the investigator is left with a me-
thodological problem: He can either indulge in the task of

(6) H. Johnson (1972, p. 41)
constructing a general equilibrium model in order to analyse the role of money or retain that the link between the real and the monetary sector is the quantity of money but recognize also that there are reverse influences on money, thus keeping in line with the spirit only of the "new view". We have chosen the latter view.

The last point to be dealt with is whether this formulation of the money supply is inapplicable in the case of the U.K. economy because of peculiarities in the institutions and the policies pursued by the Bank of England. The view has been put forward that reserve ratio theories cannot explain the volume of bank deposits and hence the money supply in the U.K. The argument is that a reduction in banks' reserves resulted from sales of securities to the customers of commercial banks would not compel the banks to reduce their deposits since the banks have the power to replenish their reserves by recalling money loaned to the discount houses. (7)

This the banks can do since, because of existing arrangements, the Bank will never refuse to lend money to the dis-

(7) The reader will have noticed that we persistently used the term "reserves" of the banks avoiding to specify to what they refer - cash or liquid assets. The reason is that in late 1950s and 1960s there was a great debate over which method - cash or liquid assets ratio - was the best to control the level of bank deposits. The issue is of no importance since the introduction of competition and credit control in 1971 which established a uniform minimum reserve ratio of 12½% in certain assets. (see Griffiths 1973)
count houses whenever they experience shortage of cash. Although the Bank always acts as lender of last resort to the discount market they can provide the money at a rate at their own discretion: it could be the Bank rate or above it - "front door" assistance; alternatively it could be the current market rate of interest - "back door" assistance. In the latter case the Bank reverses its initial action of keeping the market short of cash and therefore there would finally be no effect on banks reserves. On the other hand, whenever the Bank provides assistance at the "front door" creates an incentive to the discount market, by reducing the margin of profitability between treasury bills and the cost of borrowing, to repay as soon as possible its debt to the Bank. In this case the discount houses borrow money from the non bank public by selling securities to them - thus reducing their assets. (8) The inevitable result will be a

(8) It is not at all obvious whether the discount houses can and will do so. The routes by which they can raise the money are: (a) By trying to reduce their taking in new treasury bills; (b) by trying to increase their borrowing from non bank lenders. The first method would be a very difficult one because of institutional arrangements according to which the discount houses agree to bid to cover the entire weekly tender of treasury bills. This arrangement makes it very difficult for the discount houses, by reducing the tender price, to reduce their holdings of treasury bills to any degree of precision simply because of the unpredictability of outside bids. The second method by which the discount houses can raise the
multiple contraction in banks deposits. It seems therefore that whether or not reserve ratio theories explain the volume of bank deposits depends on the policy of the Bank - front or back door assistance.

But why, one might ask, would the Bank on some occasions lend at the front door and on others at the back door? The answer is that by doing so they can influence the short-term rates of interest. By providing back door assistance the Bank indicates to the participants of the financial markets that it does not wish to oppose any trend in interest rates. On the other hand, whenever the Bank provides assistance at the front door it indicates that it does not wish to see interest rates fall significantly.

money-borrowing from non-bank lenders - can take several forms but the most probable is from sales of short bonds. By doing so, however, they put upward pressure on short bond rates which the authorities might not be prepared to concede. In this case the authorities intervene in the market and purchase the bonds being sold, thereby providing the money to the discount houses. If the discount houses try to raise the money by selling from the existing stock of treasury bills or commercial bills to the non-bank public they might not succeed in doing so because their actions may lead to an interest rate adjustment - a competitive bidding up of short-term interest rates.

The issue however is an empirical one; the question is whether treasury bills are a close substitute for other short-term assets - e.g. local authority temporary debt - in the portfolios of the public. In the case of perfect substitutability the burden of adjustment falls on interest rates with quantities changing very little if not at all.
Thus as soon as the rates take the desired course the Bank relieves the market from the shortage of cash, either with back or front door lending, by reversing their initial open market operations. In this case it is the authorities' choice to let the banks choose their own reserves and hence make the supply of money endogenously determined. The overall conclusion therefore seems to be that whether or not reserve ratio theories explain the volume of bank deposits "relates to the characteristics not of a system, but of a particular policy, which may apply or not, from day to day" (9).

The question therefore of whether the money supply is endogenous in the U.K. depends on how vigorously the monetary authorities pursued a "policy of leaning into the wind!" The authorities' intentions - whether they have been successful is an empirical matter - for most of the 1960s were to influence interest rates only in the short-run without resisting any trend, i.e., they tried to influence only the deviations from the trend not the trend itself. This of course tantamounts to saying that whereas the money supply has been endogenous for each separate short period, for an overall period of 10 years it could be regarded as exogenous.

Whatever the verdict for the pre 1968 period, the formulation of the money supply equation makes more sense for the post 1968 period, when the authorities changed their tactics and especially since 1971 with the introduction of competition and credit control.

(9) Newlyn (1971)
In our discussion of the determinants of the supply of money we made the assumption that the monetary base is exogenous, under the control of the policymakers. Although this is the conventional approach taken by most of the studies in this field - a notable exception is Teigen (1969) - it is clearly wrong to regard the monetary base as exogenous or rather as a policy target for two reasons: (a) in the first place why should the authorities attempt to set the monetary base at any particular value? It is reasonable to assume that the authorities do not behave randomly but instead "react" in a predictable and consistent manner to changes in economic variables according to their objectives, given the all too apparent conflicts between them and the corresponding attached weights. (b) The monetary authorities, particularly in the U.K. where one of their tasks is the management of the National debt, are not free to set the values of their instruments according to their targets but they are constrained by the need to provide finance to the governments' budget deficit.

On these grounds the investigator should incorporate into the model of the economy another model that explains the authorities' behaviour, and proceed to a joint estimation of the system. One notable advantage of such an approach would be to obtain consistent estimates of the parameters of the system.

The specification of our monetary base equation follows from the above two broad ideas. We begin therefore by briefly
summarising the framework for analysing the behaviour of the authorities.\(^1\) It is assumed that the authorities have a number of instruments at their disposal. An instrument, \(I_t\), is a variable that is completely under the control of the authorities and is relatively immune from exogenous influences, e.g. the Bank Rate, the security portfolio etc. An instrument is assumed to affect some intermediate variables, \(F\), such as the rates of interest or financial quantities which in their turn affect the ultimate targets, \(Y_t\), such as the rate of growth, the price level, the balance of payments etc. On the assumption that the monetary authorities change the values of their instruments according to the latest available information about the value of the target variable(s) the following type of reaction function is obtained.

\[
I_t = I(Y_{t-n}, Y^*)
\]

(1)

where \(n\) is the information lag. The reaction function will determine whether variables that in theory are regarded as instruments have been treated in practice as such. Thus Fisher (1970) found that special deposits, hire purchase controls and the Bank Rate "revealed" as instruments of monetary policy in the U.K.

\(^1\) Since the introduction of the concept of a reaction function by Reuber (1962) a number of investigators examined the behaviour of the authorities, e.g. Dewald and Johnson (1963), Fisher (1970), Kern and Babb (1969), Nobay (1974), Wood (1967).
There are however two basic approaches to the formulation of the reaction function. The one, e.g. by Wood, is a maximization procedure of the authorities' preference function, which states their objectives, subject to the authorities' model - their "view" of the working of the economy. This approach provides a formulation of how the authorities ought to behave given their preference function and their model of the economy - that is it tests a normative hypothesis. Although such an approach provides a rigorous treatment of the problem, it suffers from a number of deficiencies. (2) The alternative approach provides a less "rigorous" but more pragmatic or ad hoc framework and as such bypasses some of the problems of the first approach. We can say that our approach is based, in principle, on the utility maximization method. This is so since our problem relates only to the behaviour of the authorities with respect to the monetary base as it is influenced by one instrument - open market operations - and thus avoids, because of its simplicity, many of the problems associated with the first approach.

We begin by assuming that the authorities have two objectives: price stability, and full employment. Furthermore, it is assumed that, through their model of the economy, the authorities can estimate the long run values of the price level, $P^*$, and of the level of income, $Y^*$, associated with full-employment. In addition it is recognized that the authorities when formulating and pursuing a policy might turn

(2) See, for example, Nobay (1974), and Schwartz (1969)
out to be wrong either because of the lags involved or because of miscalculations in the required values of the instruments. Accordingly they are allowed to adjust by altering both their instruments and their policies in accordance to the latest information available. This means that the authorities have, in addition to their long-run objectives, short run target values designated by $Y^{*}_{t+m}$ and $P^{*}_{t+m}$ for the level of income and the price level respectively; the $m$ represents the lag - which according to the authorities' views is needed for the effect of a change in the instrument to have worked out. This behaviour is described by the following equations

\[ Y^{*}_{t+m} = Y_t + a_1(Y^{**}_{t+m} - Y_t) \quad 0 < a_1 < 1 \quad (2) \]

\[ P^{*}_{t+m} = P_t + a_2(P^{**}_{t+m} - P_t) \quad 0 < a_2 < 1 \quad (3) \]

where $Y_t$ and $P_t$ are the latest information for the values of the long-run objectives. Thus, according to equation (1), the desired value of income $m$ periods ahead equals the value of the latest information increased or decreased by a proportion of the difference between long-run and actual value; alternatively, if the actual value of income turns out to be smaller than the long-run value, the desired level of income to be realised $m$ periods ahead will be adjusted upwards.

Since $m$ is usually large, of the order of 2-3 years, the authorities treat some of the financial qualities, $F$, as indicators of the state of the economy, and in addition as even shorter objectives than $Y^{*}_{t+m}$ and $P^{*}_{t+m}$. We assign this role to the monetary base, and thus we have
This means that if according to the latest information the desired value of income, m periods ahead, should increase, the desired value for the even shorter target of the monetary base must also be increased. Since the effect on the monetary base would come sooner than that on income it could also serve as an indicator of the success of the policy. Similarly if it is judged that the desired price level, m periods ahead, ought to decrease the desired level of the monetary base must also decrease.

Further it is assumed that our intermediate variable, $B_t^*$, is affected by the open market operations, $SP_t$, the instrument of the authorities. And, finally, because severe changes in the authorities' actions might provoke panic in the market, it is assumed that the authorities do not pursue with much vigour their policies, but, instead, go gently about them allowing only a partial adjustment of the desired change in the monetary base within each quarter. Thus

$$B_t - B_{t-1} = c_1(B_t^* - B_{t-1}) + c_2SP_t \quad 0 < c_1 < 1, c_2 > 0 \quad (5)$$

We now come to our second basic determinant of the monetary base - the constraint on the monetary authorities' ability to influence the monetary base because of their obligation to finance the budget deficit. It must be stressed, however, from the beginning that this constraint is not always effective and thus impairative to monetary policy. Indeed, the constraint becomes effective only when fiscal policy
works in opposite direction to monetary policy, that is, only in those periods when the authorities attempt to apply restrictive monetary policy and the Treasury runs a substantial budget deficit. The crucial question, therefore, is how often does such a situation arise. The Governors of the Bank, in their various public speeches, complain that, during the last years, this is the usual case and even more importantly that it happens in exactly those periods when the monetary authorities feel that it is of utmost importance to apply restrictive monetary policy. Whether, however, in reality the situation has been as described by the Governors of the Bank is an empirical question: How important has the government's borrowing requirement, BR, been in determining the monetary base? Thus on these grounds one should introduce the governments' borrowing requirement into equation.

Goodhart (1973), however, has argued that not only does the borrowing requirement affect the monetary base but that the latter is not a choice variable; it is rather determined as a residual in the constraint of governments' finance—that is, as a decision that has to be taken once other interrelated decisions have been taken. His argument can best be understood by looking at the following identity that describes the various sources of government finance

\[
\text{BR} = \text{SP} + \text{NMD} + \text{ECF} - \text{MAT} + \Delta B
\]

or

\[
\Delta B = \text{BR} - \text{SP} - \text{NMD} + \text{MAT} - \text{ECF}
\]
These sources/grouped, for analytical purposes, in three main categories: (a) Domestic borrowing; (b) external borrowing; and (c) finance which brings about an increase in the monetary base. Domestic borrowing involves transactions in marketable and non marketable debt, NMD, and funds needed to repay maturing debt, MAT.

Obviously the borrowing requirement, BR, and the funds needed to repay maturing debt, MAT, are not under the control of the authorities. In addition, since the authorities, for various institutional reasons, do not vary the rates of interest on marketable debt the inflow of funds from this source is not expected to contribute significantly to the governments' finance; rather the inflow of funds from this source has tended to vary inversely with the market interest rates. (3)

Finally, under a regime of fixed exchange rates the authorities are constrained even further in their attempt to control the monetary base because capital flows tend to respond to changes in domestic interest rates.

Thus for all these reasons, Goodhart argues, it is impossible for the authorities to control the monetary base; rather it is determined as soon as the other inflows of funds have been determined so that the constraint is satisfied. While we agree with Goodhart that all these elements constrain the authorities' ability to control the monetary base, we cannot agree that, in reality, the

(3) See Goodhart (1973)
authorities could not offset such movements—by varying the marketable government debt, i.e., open market operations—had they wished to. Now whether the authorities are prepared to do so and whether they have done so in the past, we believe is an empirical question.

Thus it seems to us that we are justified in treating B as an endogenous variable which, though, could be influenced by the authorities. In addition recognizing the constraint for government finance we introduce in equation (5) the government borrowing requirement

\[ B_t - B_{t-1} = c_1(a_t^* - B_{t-1}) + c_2S^P_t + c_38R_t \quad c_3 > 0 \]  (7)

Hence the equation for the monetary base is the reduced form of equations (2), (3), (4) and (7)
II.3.d The Term Structure of Interest Rates

The equation for the term structure of interest rates follows from the "preferred habitat" theory now associated with the names of Modigliani and Sutch (1966, 1967). We thus begin by summarising its main points.

The starting point of this theory is one of the basic propositions of the "expectations theory", namely that under rational behaviour, perfect markets, certainty, and negligible transactions costs, the holding period yield must be the same regardless of the securities purchased.

In the real world, however, transactors, being either ultimate wealth owners or borrowers, are uncertain about the future course of interest rates. Furthermore, they might have definite preferences as to the length of time for which they want to invest or borrow (that is, they have a preferred maturity habitat). In addition, transactors might be risk averters and pursue a policy of matching the maturities of their assets and liabilities, as the "hedging theory" suggests. Finally the theory recognises the existence of arbitrageurs who, although they have a preferred maturity habitat, are prepared to invest or borrow in maturities different to their preferred habitat if they are sufficiently compensated for the risk they undertake.

The "preferred habitat" theory incorporates elements from the other three main theories on the term structure of interest rates, (1) being in essence an amalgam of all

(1) That is, expectation theory, Hicksian liquidity premium theory, and the hedging theory.
three. We may now examine the way in which the theory can be formalised. First, although future short term interest rates are uncertain, the theory assumes that these rates can be described by a probability distribution of possible rates. Second, if a transactor, with an $n$ period habitat, is a risk averter, the only way to secure certainty of the return is to invest for $n$ periods; since if he invests for a shorter period he exposes himself to risk about the interest-income of the principal, and if he invests for a longer period he exposes himself to risk about the principal because of price fluctuations. It is, furthermore, recognised that although transactors are risk averters, they might invest in different maturities if the expected return is sufficiently high to induce them to undertake the risk.

Therefore, according to this theory, the expected return from all bonds, regardless of term to maturity, will be identical for any given holding period. The return is defined as the sum of cash payments plus any increase in the money value of a bond. Thus, if

\[ r_{Lt} \] = the current long term rate
\[ r_{st} \] = the current short term rate
\[ g^e_t \] = the expected capital gain (or loss) on long term bonds over the holding period
\[ a \] = risk premium
\[ r^e_t \] = rate of interest on long term bonds expected in period $t$ to rule in-period $t+1$

then the above proposition can be stated as

\[ r_{Lt} + g^e_t = r_{st} + a \] (1)
Strictly speaking equation (1) holds if either the holding period is equal to the maturity period of short term debt or the expected short term rate is equal to the ruling rate. If neither of these conditions holds, the expected capital gain must be considered as the difference between capital gain (or loss) on long term and short term debt.

Now, if we denote the price of a long term bond by $P$, then by definition we have

$$g_t^e = \frac{p_t^e - p_t}{p_t} = \frac{1}{r_t^e} [r_t - r_t^e]$$

(2)

If we make the assumption that the expected capital gain is proportional to the expected fall in the long rate, equation (2) can be written as

$$g_t^e = -b [r_t - r_t^e], \quad b < 0$$

(3)

where $b$ is a proportionality factor and in general depends on the number of debts considered as well as on $r_t^e$. The above equation can be shown to remain a good approximation even if the bond does not sell at par, but in the neighbourhood, and $r_t^e$ is defined as the average yield to maturity.

To close the model one needs a hypothesis about the formation of expectations. However, one of the major difficulties with the empirical tests on this subject lies in the hypotheses advanced about the formation of expectations. The question is whether the empirical evidence refutes the theory that is tested, or merely some investigat-
or's empirical version of the formation of expectations.\(^{(2)}\)
The only way out of this problem is to formulate a general hypothesis that includes alternative hypotheses as special cases and then let the data reveal the appropriate pattern of expectations. We have developed such a model elsewhere\(^{(3)}\) and the results were very encouraging. However this formulation – as most in this field – attempts to capture the formation of expectations by advancing a hypothesis that relates past movements of interest rates with investor's expectations of the future. But apart from the history of past rates investors take, for sure, into account other factors as well, such as prices, output e.t.c. \(^{(4)}\) Here a preliminary attempt is made to take both approaches into account and we hope that in a later report we will be able to present a more sensible formulation. At the moment the equation for the formation of expectations has the following crude form

\[
r_{lt}^e = \frac{1}{w(L)} \left[ b(L)r_{lt-1} + c(L)y_t + d(L)p_t \right]
\]

\(^{(2)}\) For an elaboration of this point see ch. 1 of the author's M.Sc. thesis (1975).
\(^{(3)}\) Karakitsos (1977)
\(^{(4)}\) For such an approach see the rational expectations process as proposed by Muth (1961).
II.4 The Model: A summary

The model described so far can, in principle, be reduced to the following equations which can either be thought of as reduced forms of the various submodels or as general specifications which include as special cases the alternative hypotheses underlying a specific structure.

(1) $C^n_t = c_0^n(L)Y_t^d + c_1^n(L)L_{t-1}/P_t + c_2^n(L)r_{st} + c_3^n(L)C_{t-1}^n$

(2) $C^d_t = c_0^d(L)Y_t + c_1^d(L)BA_t + c_2^d(L)\Delta P_t + c_3^d(L)L_t + c_4^d(L)C_{t-1}^d$

(3) $I^d_t = i^d_0(L)Y_t + i^d_1(L)r_{st} + i^d_2(L)I_{t-1}$

(4) $I_t = i_0(L)\left[\Delta r_{Lt} + \Delta I_{Lt-1}\right] + i_1(L)\left[\Delta Y_t + \Delta Y_{t-1}\right] + i_2(L)I_{t-1}$

(5) $\Delta H_t = h_0(L)Y_t + h_1(L)L_t + h_2(L)L_{t-1}/P_t - h_3(L)H_{t-1}$

(6) $IM_t = IM\left[(Y_t or Y_t^P, L_{t-1}/P_t), IC_t, (P/P_w) t, IM_{t-1}\right]$}

(7) $Y^d_t = \gamma_1 Y_t + \gamma_2 Y^d_{t-1}$

(8) $Y_t = C^n_t + C^d_t + I^d_t + I_t + \Delta H_t + \bar{\sigma}_t + \bar{\lambda}_t - IM_t + \bar{E}_t$

(9) $M^d_t = d_0(L)Y_t + d_1(L)r_{st} + d_2(L)P_t + d_3(L)M_{t-1}$

(10) $M^s_t = m_0 + m_1 r_{st} + m_2(L)B_t + m_3 r_{dt} + m_4 P_t + m_5 Y_t + m_6 M_{t-1}$

(11) $M^d_t = M^s_t = M_t$

(12) $B_t = b_0 + b_1 Y_t + b_2 P_t + b_3 B r_t + b_4 S P_t + b_5 B_{t-1}$

(13) $r_{Lt} = p_o + p_1(L)r_{st} + p_2(L)Y_t + p_3(L)P_t + p_4(L)r_{Lt-1}$
CHAPTER III

THE EMPIRICAL EVIDENCE

III.1 Introduction

Before presenting the results of the estimation we briefly discuss the data and the methods of estimation used. The study is quarterly and covers the period from the first quarter of 1963 through the closing quarter of 1975. All data are seasonally adjusted and at constant (1970) prices. All variables are in billions of pounds unless otherwise stated. Interest rates are expressed as percentages (that is, a rate of 5 percent is expressed as 5.00). A more detailed description of each of the series used is given in the Appendix.

The criteria for judging the performance of an equation are the standard ones: goodness of fit; the t-test for significance of coefficients; the extent to which the signs of regression coefficients agree with prior expectations; the degree to which the residuals exhibit serial correlation, etc.

As it is very well known the estimation of relationships involving time-series variables, which are typically highly correlated with one another, is confronted with many difficult problems. In this context
the investigator is faced with, among others, the problem of free or constrained estimation of coefficients. Free estimation involves the risk of distorting the results because of multicollinearity; constrained estimation on the other hand involves the risk of incorrectly constraining the coefficients. There are no a priori criteria that can guide the investigator in choosing between the two methods and hence an element of personal judgment is unavoidable. We are no exception to this rule and thus we offer no special justification for our assumptions. Nonetheless a comment must be made about multicollinearity. We should note that "multicollinearity is not a condition that either exists or does not exist in economic functions, but rather a phenomenon inherent in most relationships due to the nature of economic magnitudes".\(^{(1)}\) The presence of strong multicollinearity will impair the variances and covariances of the estimated regression coefficients making them infinitely large in the case of perfect multicollinearity. Thus our t-statistics would tend to go to zero, with the obvious implications that some explanatory variables will be shown as insignificant. Nevertheless, even high multicollinearity leaves the statistical estimates of the coefficients unbiased; only perfect multicollinearity will make the coefficients indeterminate.

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\(^{(1)}\) Koutsoyiannis (1969, p. 225)
There is no conclusive evidence, however, concerning the degree of multicollinearity which, if present, will affect seriously the parameter estimates. All econometricians accept that multicollinearity impairs the estimates due to lack of sufficient independent variation in the sample. The information in the sample is not sufficient for reliable estimation of all coefficients. Thus the corrective solutions which are suggested involve the use of more information, acquired from extraneous estimation, from increased sample etc. This procedure is justified for multicollinearity, although creates estimating difficulties, "it does not impair the theoretical validity of the model; it is a "disease" of the sample data and not of the construction of the model." (2)

A second problem that usually arises in estimation is that of autocorrelation. The problem is particularly keen in the presence of lagged endogenous variables as regressors. In this case the standard Durbin Watson statistic is biased and hence there is, in addition, the problem of detecting autocorrelation. Nonetheless use of generalised least squares (G.L.S.) will provide consistent estimates. The problem however becomes even worse when one uses the data to distinguish between

(2) Koutsoyiannis (196 p. 245)
different lag schemes as in our case. Then as Griliches (1967) points out "we may be asking too much of our data". (3)

The point is that any lagged variables that may appear to be significant might be due either to autocorrelation or to a distributed lag model. To illustrate, consider the equation:

\[ Y_t = a_0 X_t + a_1 X_{t-1} + b_0 Z_t + b_1 Z_{t-1} + c_1 Y_{t-1} + c_2 Y_{t-2} + u_t \quad (1) \]

Such an equation could arise either from the distributed lag model

\[ Y_t = \frac{1}{1 - c_1 L - c_2 L^2} \left[ (a_0 + a_1 L) X_t + (b_0 + b_1 L) Z_t \right] + v_t \quad (2) \]

or from a first order lag scheme and a second order serial correlation scheme in the residuals

\[ Y_t = \frac{1}{1 - d L} (a X_t + b Z_t) + \frac{v_t}{(1 - p L)(1 - d L)} \quad (3) \]

To complicate things even more equation (1) could also arise from a model with different order lag schemes

\[ Y_t = \frac{a X_t}{1 - \lambda_1 L} + \frac{b Z_t}{1 - \lambda_2 L} + u_t \quad (4) \]

Actually, however matters are not as bad as they look. As long as there are some exogenous variables in

(3) Griliches (1967, p. 17)
the model, additional restrictions between the coefficients may help to distinguish between these hypotheses. (4)

To illustrate this point take a simpler case

\[ Y_t = a_1X_t + a_2X_{t-1} + bY_{t-1} \quad (5) \]

If this equation comes from the slightly generalized Koyck model

\[ Y_t = W(L)X_t + \nu_t \quad (6) \]

where

\[
W(L) = W_0 + W_1 L(1 + \lambda L + \lambda L^2 + \ldots )
\]

then \( a_2 \) (the coefficient of \( X_{t-1} \)) should be positive.

If on the other hand equation (5) comes from the model

\[ Y_t = aX_t + \nu_t \quad (8) \]

with serially correlated residuals

\[ \nu_t = pu_{t-1} + e_t \quad (9) \]

then

\[ Y_t = aX_t - a'X_{t-1} + pY_{t-1} + e_t \quad (10) \]

(4) For an excellent statement of the problem see Griliches (1967). The present analysis rests heavily on that paper.
In this case the coefficient of $X_{t-1}$ should turn out to be significantly negative and equal to minus the product of the $X_t$ and $Y_{t-1}$ coefficients. Thus this constraint would help to distinguish between the two hypotheses.

Fortunately Professor Sargan (5) has suggested a method that deals with this problem. We briefly summarize its main points. Assume that the model to be estimated can be represented by the equation

$$y_t = b_0 + b_1 x_t + b_2 y_{t-1} + u_t$$

(11)

and the error term follows a first order autoregressive scheme

$$u_t = p u_{t-1} + e_t$$

(12)

where $e_t$ is a pure random error satisfying all the usual assumptions, and $p$ is the autoregressive parameter. Lagging equation (11) one period and multiplying through by $p$ and then subtracting from (11) we have

$$y_t = b_0 (1-p) + b_1 x_t - b_1 p x_{t-1} + (b_2 + p) y_{t-1} - b_2 p y_{t-2} + e_t$$

(13)

in which no autocorrelation exists. This equation, which is called the "restricted transformed equation",

(5) Sargan (1964)
involves a non linear restriction between the parameters. One can ignore, however, the restriction and proceed to the estimation of the so called "unrestricted transformed equation"

\[ Y_t = d_0 + d_1 Y_{t-1} + d_2 Y_{t-2} + d_3 Y_{t-3} + d_4 Y_{t-4} + e_t \quad (14) \]

The correct procedure, now, is to test the validity of the restriction, which is, in effect, a test of the correctness of the dynamic specification of equation (11). The test is a \( \chi^2 \)-test which if it proves to be insignificant means that the restriction is satisfied and that therefore the lags are due to autocorrelation. In this case one can proceed by approximating (14) by (13) and then go on to find that \( p \) that minimizes the residual sum of squares using an iterative procedure.

Now a \( t \)- and a \( \chi^2 \)-test is employed to see if autocorrelation exists. If it does not exist then we choose (11). If it exists then we choose (13) on the grounds that autocorrelation has been detected and eliminated. On the other hand the \( \chi^2 \)-test for the validity of the autoregressive restrictions might prove to be significant. In such a case we cannot approximate (14) by (13) and test for autocorrelation since the lagged values that appear in (14) are due to a distributed lag model that has been omitted from the specification of (11). Thus the correct procedure in this case - a significant \( \chi^2 \) - is to reformulate the dynamic speci-
fication of (11) with the help of the lagged variables contained in the "unrestricted transformed equation," and repeat the method.(6)

The above method can be used with ordinary least squares, (O.L.S.), instrumental variables, (IV), and two stage least squares (T.S.L.S.). But the power of the test is very strong when it is used with O.L.S. while it becomes weak in the case of IV and T.S.L.S. In this case the $\chi^2$ is a test of the independence of the instruments used with error term. But application of O.L.S. in our model is likely to produce biased estimates because of simultaneity. Thus we have used both methods - O.L.S. and T.S.L.S. - O.L.S. was used to test the dynamic specification of each equation - that is whether the lagged variables are due to autocorrelation or to a distributed lag. Then the "best" equations - that is, those whose lagged variables were due to a distributed lag - comprised a model that was estimated using the T.S.L.S. technique allowing for autoregressive disturbances (A.R.T.S.L.S.). Some further experimentation was then carried out to distinguish, if possible, among different lag schemes.

From the plethora of models that were tried table 1 presents the "best". As can be seen the model performs

(6) To be able to employ this method we have used the program "GIVE" written by D.Hendry, L.S.E.
### Table III.1

**The Model**

**A.R.T.S.L.S.-estimates**

\[
\begin{align*}
C^n_t &= 1.0678 + 0.4092Y^n_t + 0.0338L_{t-1}/P_t + 0.3756C^n_{t-1} - 0.1411C^n_{t-2} \\
&\quad \quad \quad \quad (5.48) \quad (6.42) \quad (5.84) \quad (3.55) \quad (4.47) \\
p &= -0.6059 \quad s = 0.0839 \\
&\quad \quad \quad \quad (3.67)
\end{align*}
\]

\[
\begin{align*}
C^d_t &= -0.2428 + 0.0682Y_t + 0.02218A_t + 0.9216\Delta HP_t - 0.0083r_{Lt-3} + \\
&\quad \quad \quad \quad + 0.2194C^d_{t-1} \\
&\quad \quad \quad \quad (2.58) \quad (5.12) \quad (3.59) \quad (7.54) \quad (2.21) \\
&\quad \quad \quad \quad (2.10)
\end{align*}
\]

\[
\begin{align*}
Y^n_t &= 0.1400Y_t + 0.8364Y^n_{t-1} \\
&\quad \quad \quad \quad (2.87) \quad (14.09) \\
&\quad \quad \quad \quad s = 0.1502
\end{align*}
\]

\[
\begin{align*}
I^n_t &= -0.4490 + 0.1440Y^n_{t-1} + 0.1049\Delta Y_t - 0.0112r_{Lt-3} - 0.0342\Delta r_{Lt-1} + \\
&\quad \quad \quad \quad + 0.4639I^n_{t-1} \\
&\quad \quad \quad \quad (2.54) \quad (3.87) \quad (2.54) \quad (2.13) \quad (2.13) \\
&\quad \quad \quad \quad (3.84)
\end{align*}
\]

\[
\begin{align*}
I^d_t &= 0.0628 + 0.0107Y_t - 0.0025r_{st} + 0.6377I^d_{t-1} \\
&\quad \quad \quad \quad (1.69) \quad (2.12) \quad (1.77) \quad (9.17) \\
&\quad \quad \quad \quad s = 0.0180
\end{align*}
\]

\[
\begin{align*}
\Delta H^n_t &= -0.1773 + 0.3767Y_t - 0.3603Y^n_{t-1} - 0.0125r_{Lt-1} + \\
&\quad \quad \quad \quad + 0.0260L_{ct-1}/P_t + 0.8428\Delta H^n_{t-1} - 0.2294\Delta H^n_{t-2} \\
&\quad \quad \quad \quad (1.12) \quad (4.27) \quad (4.13) \quad (1.79) \\
&\quad \quad \quad \quad (1.76) \quad (6.43) \quad (1.65)
\end{align*}
\]

\[
\begin{align*}
p &= -0.5842 \quad s = 0.926 \\
&\quad \quad \quad \quad (3.78)
\end{align*}
\]
\[ IM_t = -0.6013 + 0.1144Y_t + 1.16951C_t + 0.7760IM_{t-1} \]
\[ (1.80) \quad (2.25) \quad (3.25) \quad (9.47) \]
\[ s = 0.0845 \]

\[ Y_t = C^t + C^d_t + I_t + I^d_t + \Delta H_t + O_t + X_t - IM_t \]

\[ M^d_t = -1.1301 + 0.1755Y_t - 0.0536r_{st} + 2.2402P_t + 0.7454M_{t-1} \]
\[ (2.25) \quad (2.49) \quad (3.76) \quad (5.65) \quad (11.09) \]
\[ s = 0.1789 \]

\[ M^s_t = -0.0943 + 0.0046r_{st} + 1.2469B_t - 0.75208_{t-1} + 1.1433P_t - \]
\[ (0.39) \quad (0.30) \quad (3.26) \quad (2.04) \quad (2.02) \]
\[ -0.0825r_{st} + 0.7469M_{t-1} \]
\[ (1.22) \quad (11.07) \]
\[ s = 0.1687 \]

\[ M^d = M^s = M \]

\[ B_t = -0.4914 + 0.1024Y_t + 0.7556P_t + 0.02548R_t + 0.1035P_{t-1} + \]
\[ (2.66) \quad (3.11) \quad (2.93) \quad (1.49) \quad (2.97) \]
\[ + 0.5855B_{t-1} \]
\[ (4.80) \]
\[ s = 0.0594 \]

\[ r_{Lt} = -1.5089 + 0.1621Y_t + 0.8539P_t + 0.1060r_{st} + 1.2094r_{Lt-1} - \]
\[ (1.86) \quad (1.65) \quad (1.69) \quad (3.01) \quad (6.24) \]
\[ -0.4242r_{Lt-2} \]
\[ (2.14) \]

\[ p = -0.4462 \quad s = 0.4244 \]
\[ (2.88) \]
very well. All coefficients have the correct sign and all but three are significant at the conventional 5% level. However such a success conceals many problems. The next section discusses and evaluates the present results. It shows that in some cases the equation stands for more than one lag scheme; in others that the lag structure is very sensitive to minor changes in the specification; in still others that some of the standard criteria have failed us and how our value judgment has then played a role in choosing between alternatives.

(7) In some cases a one tail test is needed. This is quite legitimate since economic theory puts a priori constraints, on most of the coefficients.
III.2 Evaluation of the Results

(A) In chapter II we discussed various formulations for the non-durables equation. The overall conclusion was that many hypotheses could produce the same reduced form thus restricting the discriminatory power of the empirical tests. Table III.2 presents some of those results and attempts to get the maximum information for the underlying hypothesis.

A minute's inspection of the table shows that liquid assets have a role to play. Equation (1) is the reduced form of Brown's hypothesis - RF2 of II.2a. Clearly this equation is badly determined. Although all coefficients have the right sign the coefficient of $C_{t-1}$ is abnormally low, implying an instantaneous adjustment. Nevertheless not even the slightest confidence can be attached to this result because of the so close to zero statistical significance of the coefficient. The same picture emerges from equation (2) - the RF1 and RF3 of II.2a. In addition the insignificance of $L_{t-2}/P_{t-1}$ - though in itself a weak test(1) - is not inconsistent with the hypothesis that current income is much more important than long-run resources.(2) But statistical problems - as for example multicollinearity - might be so severe as to distort the results and thus

(1) See pp. 73-75.
(2) Since equation (2) is the reduced form of both hypotheses RF1 and RF3 we are not at all sure if this is
Table III.2

Non-Durable Expenditure Functions

<table>
<thead>
<tr>
<th></th>
<th>Const.</th>
<th>( Y^d_t )</th>
<th>( Y^d_{t-1} )</th>
<th>( L_{t-1}/P_t )</th>
<th>( L_{t-2}/P_{t-1} )</th>
<th>( C^d_n_{t-1} )</th>
<th>( C^d_n_{t-2} )</th>
<th>( p )</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>1.4724</td>
<td>0.5386</td>
<td>0.0371</td>
<td>0.0104</td>
<td>0.08</td>
<td>0.0922</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>5.88</td>
<td>7.30</td>
<td>3.39</td>
<td>0.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>1.3952</td>
<td>0.4875</td>
<td>0.0354</td>
<td>-0.0002</td>
<td>0.4214</td>
<td>0.0840</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>6.72</td>
<td>6.89</td>
<td>3.25</td>
<td>0.07</td>
<td>3.78</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(3)</td>
<td>1.3688</td>
<td>0.4382</td>
<td>0.1308</td>
<td>0.0250</td>
<td>0.0846</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>8.47</td>
<td>10.03</td>
<td>2.59</td>
<td>2.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>1.0678</td>
<td>0.4092</td>
<td>0.0338</td>
<td>0.3756</td>
<td>-0.1411</td>
<td>-0.6059</td>
<td>0.0839</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>5.48</td>
<td>6.42</td>
<td>5.84</td>
<td>3.55</td>
<td>4.47</td>
<td>3.67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>0.6993</td>
<td>0.5047</td>
<td>-0.2381</td>
<td>0.0226</td>
<td>-0.0002</td>
<td>0.5948</td>
<td>-0.1106</td>
<td>-0.8322</td>
<td>0.0843</td>
</tr>
<tr>
<td>t</td>
<td>2.92</td>
<td>6.81</td>
<td>2.37</td>
<td>0.05</td>
<td>4.51</td>
<td>3.18</td>
<td>5.24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
erroneously lead to rejection of the true hypothesis – RF1 or RF3. A direct test of the importance of long-run resources is carried out in equation (3). Because of the plausibility and significance of all coefficients it seems that statistical problems conceal the role of long-run resources. In view of this evidence, therefore, one can proceed by making strong assumptions, thus sacrificing any delicate results, in order to avoid distortions from statistical problems.

On these grounds equation (4) is derived by making the assumption that equal weights are attached to income and liquid assets when forming an estimate of long-run resources, and in addition that there is some inertia in consumers' behaviour. This is the only equation

\[ c^*_t = a_0 + a_1 y^d_t + a_2 (L_{t-1}/P_t)^e \]  

(1)

\[ y^p_t = \frac{1 - b}{1 - bL} y^d_t \quad (L_{t-1}/P_t)^e = \frac{1 - b}{1 - bL} \frac{L_{t-1}}{P_t} \]  

(2)

\[ c^n_t - c^n_{t-1} = (1-k) \left[ c^n_t - c^n_{t-1} \right] \]  

(3)

providing the following reduced form:

\[ c^n_t = a_0 (1-b)(1-k) + a_1 (1-b)(1-k)y^d_t + a_2 (1-b)(1-k)L_{t-1}/P_t + (b+k)c^n_{t-1} - bk c^n_{t-2} \]
that seems to be well determined; but is it because of its simplicity that is well determined or is it the case that this is the actual state of affairs? One does not know for sure; an attempt to disentangle the weights attached to income and liquid assets - equation (5) - is fraught with too many difficulties. On the one hand the inertia hypothesis must be dropped - the lags now arising from expectations; on the other hand one cannot be sure whether liquid assets are part of expected resources or they give rise to consumer expenditure in disequilibrium situations as in RF5 of II. 2a.

Thus it seems that this is as far as one can go.\(^{(4)}\)

Equation (4) provides some support for the real liquid assets variable. This result seems to be important since in their study of consumer behaviour, Hilton and Crossfield (1970) - the first to examine systematically the role of liquid assets in the U.K. - could not find an important liquid assets variable although they tried very hard. Lately, however, Townend (1976) reports a significant but very small effect for liquid assets. Furthermore, equation (4) has the additional advantage, if one wishes to stretch the data to their capacity limit, of being distinguishable from any formulation that postulates that an imbalance in desired liquid assets gives rise

\(^{(4)}\) No interest rate effect was found to be significant thus providing no support for RF4.
to increased spending; the underlying hypothesis of equation (4) seems to be that liquid assets affect consumption through their influence of long-run resources. But such conclusions are not so reliable; delicate hypotheses and subtle questions such as these require better data and techniques than the ones we have available.

(8) The performance of the equation for durables seems quite satisfactory well in accordance with a priori expectations; thus income, bank advances, changes in hire purchase are all significant with correct signs. This is not surprising since other studies in the U.K. have also isolated such a relationship. What sets this study apart from others is the small but statistically significant interest rate effect. Here a comment is required about the optimal lag structure which is derived statistically. The adjustment of the dependent variable in response to changes in each one of the explanatory variables is assumed to begin at different time periods. Thus the equation is

\[ C_t^d = a_0 + a_1 y_{t-n_1} + a_2 BA_{t-n_2} + a_3 \Delta HP_{t-n_3} + a_4^r L t-n_4 \]

(5) See, for example, Ball and Drake (1963), Hilton and Crossfield (1970), Townend (1976).
### Table III.3

**Durable Expenditure Functions**

**A.R.T.S.L.S.-estimates**

<table>
<thead>
<tr>
<th></th>
<th>Const.</th>
<th>( Y_t )</th>
<th>( \Delta H P_t )</th>
<th>( B A_t )</th>
<th>( r_{Lt} )</th>
<th>( r_{Lt-1} )</th>
<th>( r_{Lt-2} )</th>
<th>( C_t )</th>
<th>( C_{t-1} )</th>
<th>( C_{t-2} )</th>
<th>( p )</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>-0.2987</td>
<td>0.0786</td>
<td>0.9712</td>
<td>0.0240</td>
<td>-0.0061</td>
<td>0.1167</td>
<td>0.3727</td>
<td>0.0330</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>1.74</td>
<td>3.47</td>
<td>5.92</td>
<td>2.44</td>
<td>0.92</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>-0.2541</td>
<td>0.0711</td>
<td>1.0096</td>
<td>0.0205</td>
<td>-0.0040</td>
<td>0.1361</td>
<td>0.3711</td>
<td>0.0330</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>1.59</td>
<td>3.49</td>
<td>6.58</td>
<td>2.42</td>
<td>0.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>-0.3157</td>
<td>0.0811</td>
<td>0.9597</td>
<td>0.0245</td>
<td>-0.0080</td>
<td>0.1224</td>
<td>0.3446</td>
<td>0.0326</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>2.17</td>
<td>4.36</td>
<td>6.80</td>
<td>3.10</td>
<td>1.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>-0.2428</td>
<td>0.0682</td>
<td>0.9216</td>
<td>0.0221</td>
<td>-0.0083</td>
<td>0.2194</td>
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<td></td>
</tr>
<tr>
<td>t</td>
<td>2.58</td>
<td>5.12</td>
<td>7.56</td>
<td>3.59</td>
<td></td>
<td>2.21</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>-0.2721</td>
<td>0.0735</td>
<td>0.9438</td>
<td>0.0217</td>
<td>-0.0082</td>
<td>0.1658</td>
<td>0.1612</td>
<td>0.0327</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>1.99</td>
<td>4.12</td>
<td>5.12</td>
<td>2.89</td>
<td></td>
<td>2.20</td>
<td>1.87</td>
<td>0.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
\[ C_t^d - C_{t-1}^d = (1-v)(C_t^{d*} - C_{t-1}^d) \]

and \( n \) represents the lag of the independent variables. A non-zero value for \( n \) implies that a change in an explanatory variable has initially a negligible effect on expenditure for durables, then rises to its peak, and declines geometrically thereafter. The maximum effect for all but one of the explanatory variables occurs in the initial time period; thus the response of expenditure on durables to changes in income, bank advances and hire purchase occurs immediately. The exception is the interest rate, a result not the least surprising given the overall evidence on the response of various forms of expenditure to changes in interest rates. Here a lag of three quarters elapses before any effect is felt in the economy as can be seen from the first four equations of table 3. But our formulation assumes that within the fourth quarter the effect rises from a zero level to its maximum. This introduces an error which, however, is very small in our case as can be seen by looking again at the first four equations of table III.3. More general treatments of the distributed lag model were also tried but the problems created were more severe.

---

(6) The results of these tests are not presented but the overall picture was as follows. Whenever lagged values for each of the explanatory variables turned out to be significant they had a smaller than the initial effect.
than the problems which were solved.\(^{(7)}\) For example the coefficient of \(C^d_{t-2}\) in equation (5) has the wrong sign and its size is so high implying an unstable lag structure. On these grounds equation (4) seems to be the best.

\[(c)\quad\text{From a first look the equation for non-residential fixed investment seems to perform very well. But in fact there are some problems with the lag structure of the rate of interest.}\quad\text{(8)}\quad\text{Table III. (4) presents some of those results and illustrates the problems. While a substantial interest rate effect appears in the third quarter - as it is shown from equation (2) - the peak is reached in the fourth quarter - equation (4). This means that the appropriate lag-structure is an inverted V-type. We tried to capture this scheme by equation (3) but the results are unsatisfactory. To overcome this we still tried an unconstrained estimate - equation (5) - for the ascending part of the inverted V structure but this was fought with even more difficulties. Thus we are faced with the problem of choosing between equation (2) and (4), that is either to disregard the peak of the}\]

\(^{(7)}\) The results of these tests are not presented too. \(\text{(8)}\) The lag structure of income does not seem to have the same problems. Lagged values of income seem to have smaller effects than current values of income whenever they were introduced in equation 2 - the "best" equation. Results are not presented for this case.
### Table III.4

**Non-Residential Fixed Investment Functions**

<table>
<thead>
<tr>
<th>Const.</th>
<th>$Y_{t-1}$</th>
<th>$\Delta Y_t$</th>
<th>$r_{Lt-2}$</th>
<th>$\Delta r_{Lt-1}$</th>
<th>$r_{Lt-3}$</th>
<th>$\Delta r_{Lt-2}$</th>
<th>$r_{Lt-4}$</th>
<th>$\Delta r_{Lt-3}$</th>
<th>$I_{t-1}$</th>
<th>$I_{t-2}$</th>
<th>$p$</th>
<th>SEE R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>-0.4292</td>
<td>0.1401</td>
<td>0.1063</td>
<td>-0.0122</td>
<td>-0.0065</td>
<td>2.12</td>
<td>0.41</td>
<td></td>
<td>0.4791</td>
<td>0.379</td>
<td>0.0513</td>
<td>0.9477</td>
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<tr>
<td>t</td>
<td>2.19</td>
<td>3.46</td>
<td>2.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>-0.4490</td>
<td>0.1440</td>
<td>0.1049</td>
<td></td>
<td>-0.0112</td>
<td>-0.0342</td>
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<td>2.13</td>
<td>0.4639</td>
<td>3.84</td>
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<td>0.9501</td>
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<tr>
<td>t</td>
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<td>3.87</td>
<td>2.54</td>
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</tr>
<tr>
<td>(3)</td>
<td>-0.4182</td>
<td>0.1439</td>
<td>0.1134</td>
<td></td>
<td>-0.0104</td>
<td>-0.0340</td>
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<td>2.13</td>
<td>0.3966</td>
<td>0.0476</td>
<td>0.0501</td>
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<tr>
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<tr>
<td>(4)</td>
<td>-0.4726</td>
<td>0.1466</td>
<td>0.1135</td>
<td></td>
<td></td>
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<td>2.69</td>
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</tr>
<tr>
<td>(5)</td>
<td>-0.4449</td>
<td>0.1382</td>
<td>0.1305</td>
<td></td>
<td>0.0212</td>
<td>-0.0117</td>
<td>-0.0353</td>
<td>-0.0384</td>
<td>0.5064</td>
<td>2.08</td>
<td>2.43</td>
<td>4.12</td>
</tr>
<tr>
<td>t</td>
<td>2.37</td>
<td>3.55</td>
<td>3.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9546</td>
</tr>
</tbody>
</table>
fourth quarter for the sake of not ignoring the substantial interest rate effect of period three or indeed ignore it and start from the peak. In either case we introduce a bias in the lag structure. We believe that for our purposes a smaller bias is introduced by choosing equation (2) than (4) since the impact effect of the third quarter little differs from that of the peak.

Another drawback is that our formulation of the non-residential fixed investment equation assumes a perfect capital market, that is a market where, in addition to all other conditions, firms always get the funds they need in order to finance their expenditure as long as they are prepared to pay the price of credit. In other words in our model firms never experience credit rationing. But this is clearly wrong; it is a fact of life that credit rationing takes place. Consideration of an imperfect capital market however requires an explicit recognition of the role internal liquidity plays in the investment decision. This is a very difficult problem, if it is to be treated properly, since liquidity acts like a constraint which in some cases is binding and in others it is not. Thus whenever firms are liquid they can easily undertake the investment they wish without being constrained. This does not mean, however, that spare liquidity would persuade firms to undertake an investment project that looks unprofitable. The fact remains that liquidity alone is neither sufficient
to induce increased investment nor necessary as long as the firm has access to credit.

Due to great difficulties in formulating a proper test for this hypothesis we examined the proposition that liquid assets held by the company sector exert a positive influence on investment expenditure. We found no support for this proposition; nor we found any support when we introduced changes in bank advances.

On the positive side our results support the hypothesis that the lagged effect of relative prices on the capital stock operates more slowly than the lagged effect of changes in output. This means that our model provides some support for the "putty clay" model advanced by Bischoff (1968). That is, the production function allows ex ante substitution (putty) but ex post factor proportions are fixed (clay). Thus changes in relative prices do not have any effect on investment in the short-run till the old capital is worn out, while changes in output have a more rapid effect.

The investment in residential construction on the other hand turns out to be of the "putty-putty" variety. In this industry there can be no question of ex post fixed labour-capital coefficients. This finding is in broad line with that by Kalchbrenner (1972) for the FMP model.
(D) The inventory investment equation also needs some comments. Equation (5) of II.2c. was estimated by approximating the rational lag functions, specified in equations (4), by a ratio of two finite polynomials. Thus

\[ s(L) = \frac{c(L)}{z(L)}; \quad v(L) = \frac{d(L)}{z(L)}; \quad u(L) = \frac{e(L)}{z(L)} \]

In addition each one of those ratios was specified as follows

\[ c(L) = c_0 + c_1 L + c_2 L^2 \]
\[ d(L) = d_0 + d_1 L + d_2 L^2 + d_3 L^3 + d_4 L^4 \]
\[ e(L) = e_0 + e_1 L + e_2 L^2 \]
\[ z(L) = 1 - z_1 L - z_2 L^2 \]

The degrees assigned to these polynomials proved sufficient to indicate the optimum pattern of lags which turned out to be as follows

\[ c(L) = c_0 + c_1 L \]
\[ d(L) = d_1 L \]
\[ e(L) = e_0 \]
\[ z(L) = 1 - z_1 L \]

Results are only presented for the specification of the lag structure of the rate of interest, \(d(L)\), and appear in table III.5. The first three equations provide some of the results obtained by assigning the optimum values to \(c(L)\), \(e(L)\) and \(z(L)\) and experimenting with \(d(L)\).
## Table III.5

### Inventory Investment Functions

<table>
<thead>
<tr>
<th></th>
<th>Const.</th>
<th>$Y_t$</th>
<th>$Y_{t-1}$</th>
<th>$r_{L-1}$</th>
<th>$r_{L-2}$</th>
<th>$r_{L-3}$</th>
<th>$L_{ct-1}/p_t$</th>
<th>$\Delta H_{t-1}$</th>
<th>$\Delta H_{t-2}$</th>
<th>$p$</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>-0.1773</td>
<td>0.3767</td>
<td>-0.3603</td>
<td>-0.0125</td>
<td>0.0260</td>
<td>0.0260</td>
<td>0.8428</td>
<td>-0.2294</td>
<td>-0.5842</td>
<td>3.78</td>
<td>0.0926</td>
</tr>
<tr>
<td>t</td>
<td>1.12</td>
<td>4.27</td>
<td>4.13</td>
<td>1.79</td>
<td>0.0260</td>
<td>1.76</td>
<td>6.43</td>
<td>1.65</td>
<td>-0.5842</td>
<td>0.0926</td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>-9.6901</td>
<td>0.4879</td>
<td>0.4399</td>
<td>-0.0968</td>
<td>-0.0471</td>
<td>-0.0471</td>
<td>-0.5015</td>
<td>-0.1729</td>
<td>0.9617</td>
<td>0.0853</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>5.31</td>
<td>6.44</td>
<td>5.08</td>
<td>3.81</td>
<td>1.58</td>
<td>4.47</td>
<td>1.79</td>
<td>48.91</td>
<td>0.0853</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>-0.1281</td>
<td>0.3365</td>
<td>-0.3220</td>
<td>0.0127</td>
<td>0.0234</td>
<td>0.7950</td>
<td>0.2591</td>
<td>-0.5646</td>
<td>0.0930</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>0.89</td>
<td>3.42</td>
<td>3.23</td>
<td>1.75</td>
<td>1.60</td>
<td>5.43</td>
<td>1.85</td>
<td>3.53</td>
<td>0.0930</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>-0.2464</td>
<td>0.5888</td>
<td>-0.5599</td>
<td>-0.0089</td>
<td>0.7981</td>
<td>8.28</td>
<td>-0.5340</td>
<td>0.0987</td>
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<td></td>
</tr>
<tr>
<td>t</td>
<td>1.46</td>
<td>5.73</td>
<td>5.34</td>
<td>1.25</td>
<td>0.5340</td>
<td>8.28</td>
<td>0.0987</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>-12.0634</td>
<td>0.6316</td>
<td>0.4701</td>
<td>-0.0959</td>
<td>-0.4944</td>
<td>0.9613</td>
<td>0.0915</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>5.66</td>
<td>6.39</td>
<td>4.97</td>
<td>3.53</td>
<td>0.9613</td>
<td>58.13</td>
<td>0.0915</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>-0.1858</td>
<td>0.5116</td>
<td>-0.4880</td>
<td>-0.0079</td>
<td>0.8826</td>
<td>0.1629</td>
<td>-0.5784</td>
<td>0.0959</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>1.11</td>
<td>4.70</td>
<td>4.54</td>
<td>1.16</td>
<td>0.8826</td>
<td>0.1629</td>
<td>0.0959</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7)</td>
<td>-11.802</td>
<td>0.5913</td>
<td>0.4702</td>
<td>-0.0911</td>
<td>-0.5306</td>
<td>-0.1474</td>
<td>0.9655</td>
<td>0.0888</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>5.56</td>
<td>6.23</td>
<td>5.14</td>
<td>3.44</td>
<td>-0.5306</td>
<td>-0.1474</td>
<td>0.9655</td>
<td>0.0888</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8)</td>
<td>-12.067</td>
<td>0.5718</td>
<td>0.4692</td>
<td>-0.0968</td>
<td>-0.5397</td>
<td>-0.1691</td>
<td>0.9700</td>
<td>0.0881</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>5.45</td>
<td>6.22</td>
<td>5.21</td>
<td>0.99</td>
<td>0.5397</td>
<td>-0.1691</td>
<td>0.9700</td>
<td>0.0881</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(9)</td>
<td>-12.843</td>
<td>0.6300</td>
<td>0.4719</td>
<td>-0.0977</td>
<td>-0.4995</td>
<td>-0.1428</td>
<td>0.9700</td>
<td>0.0906</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>5.33</td>
<td>6.62</td>
<td>5.10</td>
<td>3.48</td>
<td>-0.4995</td>
<td>-0.1428</td>
<td>0.9700</td>
<td>0.0906</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
One can immediately see that the introduction of $r_{Lt-2}$ - equation (2) - destroys completely the specification of the equation in the sense that it assigns to the rate of interest eight times a greater impact and alters the signs of almost all of the rest coefficients. To explore this new situation we changed the polynomials $c(L)$ and $e(L)$. Equations 4-9 of table III.5 present some of those results for the case where $e(L) = 0$, that is for the case where liquid assets have no role to play. Equations (6) and (7) reveal that the introduction of liquid assets is not responsible for the distortion of the equation. In addition a comparison of equations (1), (4) and (6) indicates that liquid assets are not only significant but also improve the performance of the whole equation. An alternative specification with $d(L) = d_1L + d_2L^2$ or $d(L) = d_2L^2 + d_3L^3$ - equations (8) and (9) respectively - shows that exactly the same problem emerges, that is, the introduction of $r_{Lt-2}$ destroys the specification of the equation. Finally we examined the possibility that the disturbance lies in the specification of the $z(L)$ polynomial. However the source of error does not lie even there. We only present two of those equations indicatively that support this argument - equations (4) and (5). In sum, all attempts to obtain a sensible equation when $r_{Lt-2}$ was introduced have failed.

On these grounds equation (1) was chosen since in
addition to its superiority over equation (3) it also proved to perform better than the $d(L) = d_3 L^3 + d_4 L^4$ - which indicated no significant interest rate effect.

(E) Our imports function turns out to be a very simple one as can be seen from table III.6. The concept of long-run resources does not seem to work. Thus whenever liquid assets were introduced - e.g. equation (5) - they appeared with wrong sign. Neither the concept of expected or long-run income seems to be applicable - the coefficient of $IM_{t-2}$ in equation (3) has also the wrong sign.

Due to great difficulties in constructing a reliable series for the general price index of the rest of the world the hypothesis tested was that an increase in the U.K. general price index would lead to increased imports; equation (2) provides no support for this hypothesis.

On the positive side only income and import credit appear to be significant; in addition support is also provided for the lagged adjustment hypothesis.

(F) The theoretical model of the demand for money as postulated in chapter II includes a number of alternative hypotheses. Here we attempt to find out which of these hypotheses, if any, is supported by the empirical evidence.
Table III.6

Import Functions

A.R.T.S.L.S.-estimates

<table>
<thead>
<tr>
<th></th>
<th>Const.</th>
<th>$Y_t$</th>
<th>$Y_t^d$</th>
<th>$P_t$</th>
<th>$IC_t$</th>
<th>$IM_{t-1}$</th>
<th>$IM_{t-2}$</th>
<th>$L_{t-1}/P_t$</th>
<th>$p$</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>-0.6013</td>
<td>0.1144</td>
<td></td>
<td></td>
<td>1.1695</td>
<td>0.7768</td>
<td></td>
<td></td>
<td></td>
<td>0.0845</td>
</tr>
<tr>
<td>t</td>
<td>1.80</td>
<td>2.25</td>
<td></td>
<td></td>
<td>3.25</td>
<td>9.47</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>-0.6013</td>
<td>0.1142</td>
<td>-0.0035</td>
<td>0.05</td>
<td>1.1711</td>
<td>0.7789</td>
<td></td>
<td></td>
<td></td>
<td>0.0855</td>
</tr>
<tr>
<td>t</td>
<td>1.78</td>
<td>2.21</td>
<td></td>
<td></td>
<td>0.05</td>
<td>3.20</td>
<td>8.34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>-0.5485</td>
<td>0.1041</td>
<td></td>
<td></td>
<td>1.2642</td>
<td>0.6297</td>
<td>0.1877</td>
<td></td>
<td></td>
<td>0.0855</td>
</tr>
<tr>
<td>t</td>
<td>1.63</td>
<td>2.01</td>
<td></td>
<td></td>
<td>3.43</td>
<td>4.37</td>
<td>1.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>-0.6647</td>
<td>0.1866</td>
<td></td>
<td></td>
<td>1.1021</td>
<td>0.6445</td>
<td></td>
<td></td>
<td></td>
<td>0.0834</td>
</tr>
<tr>
<td>t</td>
<td>2.17</td>
<td>2.67</td>
<td></td>
<td></td>
<td>3.09</td>
<td>5.44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>-0.5311</td>
<td>0.1067</td>
<td></td>
<td></td>
<td>1.1025</td>
<td>0.7278</td>
<td>0.3170</td>
<td>-0.0121</td>
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<td>0.0849</td>
</tr>
<tr>
<td>t</td>
<td>1.35</td>
<td>1.92</td>
<td></td>
<td></td>
<td>3.12</td>
<td>4.65</td>
<td>1.97</td>
<td>1.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In this model expectations (as specified in equation (4) of II.3a) are thought to be determined by the following rational lag functions

\[ l(L) = \frac{b(L)}{w(L)}; \quad m(L) = \frac{c(L)}{w(L)}; \quad n(L) = \frac{d(L)}{w(L)} \]

We experimented with various degrees of the polynomials \( b(L), c(L), d(L) \) and \( w(L) \) - some of those results appearing in table III.7 - but we found no support for the hypothesis that expectations work in addition to a partial adjustment model. Thus we treated each one separately with the hope that the "appropriate" pattern of expectations would entail a different reduced form from the one that is obtained from the partial adjustment model. Unfortunately, as it turns out, this was not the case; the "best" hypothesis about expectational variables was obtained from a reduced form that was statistically indistinguishable from that of the partial adjustment model. In particular, expectations were found to perform "best" when the polynomials assumed the following values

\[ b(L) = b_0, \quad c(L) = c_0, \quad d(L) = d_0, \quad w(L) = 1 - w_1L \]

These values imply an exponential pattern for each one of the expected variables. Thus the demand for money responds to permanent income which is best described as a weighted average of current and past incomes with the weights declining exponentially. This interpretation fits nicely with those of other studies in this field.
### Table III.7

**Demand for Money Functions**

**A.R.T.S.L.S.-estimates**

<table>
<thead>
<tr>
<th></th>
<th>Const.</th>
<th>$Y_t$</th>
<th>$Y_{t-1}$</th>
<th>$r_{st}$</th>
<th>$r_{st-1}$</th>
<th>$P_t$</th>
<th>$P_{t-1}$</th>
<th>$M_{t-1}$</th>
<th>$M_{t-2}$</th>
<th>$p$</th>
<th>SEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>-0.5790</td>
<td>-0.1849</td>
<td>0.2627</td>
<td>-0.1075</td>
<td>0.0592</td>
<td>1.9010</td>
<td>-0.6731</td>
<td>0.9014</td>
<td>0.0060</td>
<td>0.1723</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>0.98</td>
<td>0.90</td>
<td>1.56</td>
<td>3.51</td>
<td>1.88</td>
<td>3.18</td>
<td>0.93</td>
<td>8.87</td>
<td>0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>-0.6978</td>
<td>0.1769</td>
<td>-0.0995</td>
<td>0.0484</td>
<td>1.7623</td>
<td>0.8192</td>
<td>0.0048</td>
<td>8.26</td>
<td>0.39</td>
<td>0.1749</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>1.56</td>
<td>2.53</td>
<td>3.46</td>
<td>1.59</td>
<td>4.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>-1.2993</td>
<td>0.2008</td>
<td>-0.0557</td>
<td>2.3049</td>
<td></td>
<td>0.7248</td>
<td>0.0054</td>
<td>10.07</td>
<td>0.20</td>
<td>0.1809</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>2.35</td>
<td>2.59</td>
<td>3.80</td>
<td>5.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>-0.9800</td>
<td>0.1967</td>
<td>-0.0964</td>
<td>0.0457</td>
<td>1.7876</td>
<td>0.8148</td>
<td></td>
<td></td>
<td></td>
<td>0.1709</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>2.11</td>
<td>2.48</td>
<td>3.29</td>
<td>1.49</td>
<td>4.05</td>
<td>11.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>-1.1301</td>
<td>0.1755</td>
<td>-0.0536</td>
<td>2.2402</td>
<td></td>
<td>0.7454</td>
<td></td>
<td></td>
<td></td>
<td>0.1789</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>2.25</td>
<td>2.49</td>
<td>3.76</td>
<td>5.65</td>
<td></td>
<td>11.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Similarly the pattern of the weights attached to the expected rate of interest is also exponential. This pattern, as it is widely known, is consistent with Cagan's adaptive expectations; that is, expectations about future interest rates are amended or adapted in proportion to past forecasting errors. Lastly, individuals respond to a weighted average price level in which they attach more weight to the recent experience.

This is the interpretation of the results if it is assumed that the reduced form is obtained from a model where only expectations are at work. A quite different interpretation pertains if the reduced form is assumed to be derived from a partial adjustment model. In this case the underlying structural equations are (1), (2a) and (3) of II.3a with $P^e_t = P_t$ in (1).

This specification implies that the demand for money responds to current, rather than permanent, income and to current or normal rate of interest. As it is well known, in the Keynesian demand for money each individual decides to hold either money or bonds according to whether the current rate of interest is considered to be below or above to what he thinks to be the long-run normal level (denoted by $r^*$). This hypothesis can be represented as

$$r^e_t = r_t + c (r^* - r_t)$$

That is, when the current level of interest is above the normal level the rate would be expected to fall,
and when it is below the normal level, it would be expected to rise. This formulation can also be written as

\[ r_t^e = c r^* + (1 - c) r_t \]

On the assumption that the long-run normal rate is a constant, the expected rate is positively related to the current and thus the previous relationship is written as (9)

\[ r_t^e = e + j r_t \]

Thus the partial adjustment model is also consistent with the "normal backwordation hypothesis" of Keynes.

Although there is no way to choose between the two alternative hypotheses - expectations and partial adjustment - one can claim, on the assumption that reliability could be attached to this reduced form, that probabilistically a partial adjustment model is more likely to be the relevant one in practice; this is so since for the expectations model to hold the weights attached to each one of the three expected variables must be the same. This is a serious limitation since there is no a priori reason why should the weights be the same. On these grounds a partial adjustment model seems more plausible especially since the limitations

(9) Such an approach was adopted by John Wood (1964)
in its interpretation are more easy to swallow.\(^{(10)}\)

If we accept this interpretation then our results imply the following elasticities

<table>
<thead>
<tr>
<th>Elasticities</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r_g )</td>
<td>-0.042</td>
<td>-0.168</td>
</tr>
<tr>
<td>( y )</td>
<td>0.184</td>
<td>0.722</td>
</tr>
<tr>
<td>( p )</td>
<td>0.239</td>
<td>0.940</td>
</tr>
</tbody>
</table>

A number of implications can then be drawn: (a) Money appears as a "necessity" rather than as a "luxury" good as

\(^{(10)}\) Laidler and Parkin (1970) in their study of the demand for money provide also an intuitive interpretation of their results. In this they favour the expectations model. However, though a plausible criterion was used, small reliability can be attached to their results since the reduced forms of the two submodels, the only estimates given (no estimates are reported for their general model), are not well determined - none of the interest rate coefficients, current or lagged, appears to be significant.

On the other hand our interpretation seems to be in accordance with Goodhart's (1970) interpretation, and especially with that of Price (1972) who succeeded (because of disaggregation?) in isolating for the personal sector a general model as the one specified in chapter II.
suggested by Friedman. From another viewpoint economies of scale, as suggested by the inventory approach of the transactions demand for money (Baumol (1952), Tobin (1956)), do not seem implausible. (b) Forcing the same response to changes in output and prices seems a mistake. (c) The long-run price elasticity seems to be unity, and (d) A small but statistically significant interest rate elasticity is found, thus only rejecting the crude version of the quantity theory approach.

(G) We turn now to the supply of money equation where three points are worth mentioning: (a) The short term rate of interest, although appears with the wrong sign - positive - is insignificant. This is not surprising recalling the discussion about the supply of money in chapter II. We stressed there that the present formulation makes more sense for the post 1971 period when the holdings of earning assets by the banks varied significantly in response to interest rates.

(b) The discount rate too enters with the correct sign but is also insignificant. Nevertheless a significant coefficient would imply that the authorities in the U.K. tried to control the supply of money by manipulating the discount rate. But obviously, as it is very well known, the authorities have used the
discount rate to influence short-term capital movements rather than the supply of money. In this sense the insig-
ificance of the discount rate is not disturbing.

(c) The supply of money does not respond to a full extent to current changes in the monetary base. If this were the case it would imply that the banks are trying to get full advantage of every single increase in the monetary base\(^{(11)}\) by increasing their lending and through the latter their deposits and hence the supply of money. Similarly, however, any current decrease in the monetary base will force banks to decrease the money supply\(^{(12)}\).

But such behaviour, implying a myopic response of the banks, would result in instability in the banking system. Thus a more plausible hypothesis is that the banks only partly respond to what they regard as a permanent change in the monetary base rather than to current changes in it.

In passing through we note that the equation for the monetary base is very well determined, fully justifying our treatment of it as expressed in chapter II.

(H) The last comment regards the equation for the term structure of interest rates. This equation also is the result of experimenting with various specifications of the polynomials of the rational lag function which

---

\(^{(11)}\), \(^{(12)}\) The comparison concerns the present formulation of the equation with an equation exactly similar but excluding \(B_{t-1}\).
for purposes of space are not reported here. At the present of particular is the pattern of expectations that emerges from past experience of the rate of interest. The underlying rational lag function implies an inverted V-type for the formation of expectations.\(^{(13)}\) This pattern is based on a synthesis of two widely held views. The first is the "normal level hypothesis" advanced by Keynes, according to which investors have in mind a normal level of long term interest rates based on past experience. Current rates are expected to move towards this normal rate. For example, when current rates are higher than 'normal' investors expect interest rates to fall, and vice-versa.\(^{(14)}\) A quite different hypothesis has been advanced by Duesenberry (1958), who argues that expectations may be extrapolative. "On a priori grounds there is no reason why the (Keynesian) argument should not be turned just the other way ... It would not ... be surprising if it turned out that a rise in rates led to an expectation of a further rise and vice-versa".\(^{(15)}\) However, Duesenberry goes on to

\[ r_t^* = (1-a)r_t + a \frac{(1-b)r_{t-1}}{1 - bL} \]

on the assumption that the 'normal' rate can be approximated by an exponential function.

\(^{(13)}\) It is interesting that the same pattern we established elsewhere, (1977).

\(^{(14)}\) This hypothesis can be presented as

\(^{(15)}\) This hypothesis can be expressed as follows
say that both hypotheses may prove to be correct in practice and that therefore one ought to take both elements into account. "It is almost certainly true that most persons who take an interest in security prices will be influenced by both types of consideration ..." This means, in other words, that expectations contain both extrapolative and regressive elements.

A combination of these two elements provides an inverted V-type, since because of the significance of the extrapolative element the weights rise at a decreasing rate, in the initial stages, then reach a peak, and finally the weights decline toward zero because of the significance of the regressive element. \(^{(16)}\) The justification of this V-type, as de Leeuw (1965) has pointed out is that both elements affect expectations of capital gains. That is, "when long term rates are above 'normal', capital gains are expected, the long rate tends to fall relative to the short rate and the differential between long and short rates is narrowed; at the same time, when

\[
\hat{r}_t^e = r_t + c(r_t - r_{t-1})
\]

or on the assumption that the lagged interest rate is replaced by a geometric average of recent past rates, thus allowing the model to discount the last period's level if it proved to be a false signal as

\[
\hat{r}_t^e = (1+c)r_t - c \frac{(1-d)r_{t-1}}{1 - dL}
\]

(16) The synthesis produces the following equation
Long term rates are rising, capital losses are expected, the long rate tends to rise relative to the short rate and the differential is widened.

\[ r_t^e = r_t + c \left[ r_t - \frac{(1-d)r_{t-1}}{1-dL} \right] + a \left[ \frac{(1-b)r_{t-1}}{1-bL} - r_t \right] \]

which can be simplified as

\[ r_t^e = b(L)r_{t-1} \]

using a rational lag function. The advantage of this formulation is that it does not restrict the extrapolative and regressive elements to follow a geometric pattern, thus providing a more general model.
III.3 The Dynamic Properties of the Model

In this section we investigate the dynamic performance of the model (1) both over the sample period, 1963-1975, and beyond the sample period. This is accomplished by comparing the actual time paths of the endogenous variables with those implied by the model. Such comparison involves ex post forecasting which basically can be dealt with in three ways. The first is based on the structural equations and is a partial analysis in the sense that it does not use the full model and therefore it does not provide evidence on the effectiveness of the model as a whole but for each structural equation separately. To provide forecasts of the "dependent" (left hand) variables it needs information on all "independent" or explanatory variables, both endogenous and predetermined.

The second method is based on the reduced form and is usually called the total method. The full model constitutes a system of simultaneous equations in all the current endogenous variables whose forecasts are now obtained by feeding information only on the predetermined variables.

(1) Although the question of stability or instability of the model conceptually belongs to the dynamic properties of the model and therefore ought to be treated here we postpone its investigation until the next chapter.
The third method is based on the final form\(^{(2)}\) and provides forecasts of the current endogenous variables by using the observed values of the exogenous variables and the initial only values of the lagged endogenous variables. That is, in subsequent periods the method allows the model to draw upon its own past forecasts to provide values of the lagged endogenous variables. As Goldberger (1959) points out this method "may be considered as the strictest test of an econometric model over a series of years in that it is based upon the minimum requisite information".\(^{(3)}\) This method not only tests how well a model performs for individual equations but also how it functions as a complete system.

Using this last method we have subjected the model into dynamic simulations to derive the time paths of all current endogenous variables over the sample period 1963-1975.\(^{(4)}\) These appear in charts 1-11.

Our only excuse is that the technique used to test for the stability of the model rests on policy simulations and the implied dynamic multipliers.

(2) The "final form" must be distinguished from the "reduced form". The former is an equation that expresses each endogenous variable in terms of exogenous and lagged values of itself only; the latter is an equation that expresses each endogenous variable in terms of all predetermined.

(3) Goldberger (1959, p.51)

(4) The simulation program we have used is called "HAVOC" and was written by M. Desai, L.S.E.
Chart 1

Dynamic Simulations
Income (Y)
- Actual
- Predicted

Year: 1963-1976
Chart 2

Dynamic Simulations

Consumption for non durables, \( (C^n) \)

- - Actual

- - - - Predicted
Chart 3

Dynamic Simulations

Consumption for durables, \( (C^d) \)

- Actual
- Predicted
Chart 4
Dynamic Simulations
Non residential fixed investment, (I)
- Actual
- Predicted
Chart 5
Dynamic Simulations
Investment in dwellings, \( (I^d) \)
- Actual
- Predicted
Chart 7

Dynamic Simulations

Imports (IM)

- Actual
- Predicted
Chart 8

Dynamic Simulations

Short term rate of interest, ($r_s$)

- Actual
- Predicted

1963 64 65 66 67 68 69 70 71 72 73 74 75 76
Chart 9

Dynamic Simulations

Long term rate of interest, \( r_L \)

- Actual
- Predicted


%
Chart 9

Dynamic Simulations

Long term rate of interest, ($r_L$)

- Actual
- Predicted
Chart 10
Dynamic Simulations
Money stock, (M)
--- Actual
--- Predicted
As one can see for himself some of the equations perform very well indeed. Overall the model seems to be able to generate closely enough the actual path of the endogenous variables (5) subjected

Next the model is/into forecasting to see how it performs outside the sample period. Thus we made ex post forecasting for the first three quarters of 1976 by the structural method. The results are presented in table III.8. One can immediately see that the predictive power of the durables equation, real disposable income, non residential fixed investment, investment in dwellings, inventory investment, demand for money, and long term rate of interest equation, is very good. The $X^2$-test for post sample parameter stability for all the above equations is satisfied at the conventional 5% level - which turns out to be 7.88. The $X^2$-test for the nondurables equation is satisfied at the 1% level. Only three equations do not seem to perform well outside the sample period: the imports function, the supply of money, and the monetary base. The result is rather surprising for the last two equations given their overall good performance for the 1963-1975 period.

Forecasting for only three periods, nevertheless, should

(5) A measure that is sometimes used to judge this closeness is the Root Mean Square Error (RMSE). Nevertheless there is no way to test whether this magnitude is large or small. It makes more sense to use it if one wishes to compare, as in the case of Andersen (1970), the performance of two models.
Table III.8

Ex post Forecasting

for 1976, I, II, III

Structural Method

<table>
<thead>
<tr>
<th></th>
<th>$C^n_t$</th>
<th></th>
<th>$C^d_t$</th>
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<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>I</td>
</tr>
<tr>
<td>Actuals</td>
<td>8.085</td>
<td>8.070</td>
<td>8.125</td>
<td>0.791</td>
</tr>
<tr>
<td>Forecasts</td>
<td>7.926</td>
<td>7.941</td>
<td>7.965</td>
<td>0.782</td>
</tr>
<tr>
<td>F. Error</td>
<td>0.159</td>
<td>0.129</td>
<td>0.160</td>
<td>0.009</td>
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<tr>
<td>$X^2(3)$</td>
<td>7.96</td>
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<td>3.29</td>
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<td>Forecasts</td>
<td>10.280</td>
<td>10.189</td>
<td>10.164</td>
<td>2.039</td>
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<tr>
<td>F. Error</td>
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<td>-0.405</td>
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<td>0.462</td>
<td>0.038</td>
</tr>
<tr>
<td>Forecasts</td>
<td>0.463</td>
<td>0.466</td>
<td>0.451</td>
<td>0.133</td>
</tr>
<tr>
<td>F. Error</td>
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<td>-0.011</td>
<td>0.011</td>
<td>-0.095</td>
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<td>1.30</td>
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<td>1.31</td>
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<table>
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<th>$M^d_t$</th>
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<tr>
<td>F. Error</td>
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<td>0.266</td>
<td>0.060</td>
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<td>$X^2(3)$</td>
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<th>I</th>
<th>II</th>
<th>III</th>
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<tr>
<td>F. Error</td>
<td>-0.772</td>
<td>-0.699</td>
<td>-0.348</td>
<td>0.358</td>
<td>0.232</td>
<td>0.342</td>
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<td>$X^2(3)$</td>
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### $B_t$

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<td>18.310</td>
<td>19.260</td>
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<td>Forecasts</td>
<td>18.662</td>
<td>19.009</td>
<td>19.602</td>
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<td>F. Error</td>
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<td>-0.699</td>
<td>-0.348</td>
</tr>
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<td>$X^2(3)$</td>
<td>42.31</td>
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### $r_{Lt}$

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<td>14.841</td>
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<td>14.550</td>
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<td>F. Error</td>
<td>-1.081</td>
<td>-0.290</td>
<td>-0.370</td>
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<tr>
<td>$X^2(3)$</td>
<td>7.58</td>
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Table III.9

Ex post Forecasting
for 1976, I, II, III

Final Method

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<th>C^n</th>
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<th>C^d</th>
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<td>III</td>
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<td>II</td>
<td>III</td>
</tr>
<tr>
<td>Actuals</td>
<td>8.085</td>
<td>8.070</td>
<td>8.125</td>
<td>0.791</td>
<td>0.742</td>
<td>0.803</td>
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<td>Forecasts</td>
<td>7.848</td>
<td>7.894</td>
<td>7.928</td>
<td>0.808</td>
<td>0.856</td>
<td>0.872</td>
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<td>F. Error</td>
<td>0.237</td>
<td>0.176</td>
<td>0.197</td>
<td>-0.017</td>
<td>-0.114</td>
<td>-0.069</td>
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<table>
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<tr>
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<td>III</td>
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<td>II</td>
<td>III</td>
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<tr>
<td>Actuals</td>
<td>1.950</td>
<td>1.888</td>
<td>1.974</td>
<td>0.477</td>
<td>0.455</td>
<td>0.462</td>
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<tr>
<td>Forecasts</td>
<td>2.093</td>
<td>2.054</td>
<td>2.193</td>
<td>0.466</td>
<td>0.474</td>
<td>0.475</td>
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<td>F. Error</td>
<td>-0.143</td>
<td>-0.166</td>
<td>-0.219</td>
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<td>-0.019</td>
<td>-0.013</td>
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<th></th>
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<th>IM_t</th>
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<td>III</td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>Actuals</td>
<td>0.038</td>
<td>-0.118</td>
<td>-0.030</td>
<td>3.366</td>
<td>3.635</td>
<td>3.657</td>
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<td>Forecasts</td>
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<td>0.238</td>
<td>0.139</td>
<td>3.489</td>
<td>3.529</td>
<td>3.554</td>
</tr>
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<td>-0.169</td>
<td>-0.123</td>
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<td>0.103</td>
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<table>
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<th></th>
<th>B_t</th>
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<td>II</td>
<td>III</td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>F. Error</td>
<td>-0.804</td>
<td>-1.117</td>
<td>-0.974</td>
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<td>0.367</td>
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<td>II</td>
<td>III</td>
<td>I</td>
<td>II</td>
<td>III</td>
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<td>F. Error</td>
<td>0.179</td>
<td>0.031</td>
<td>0.030</td>
<td>0.058</td>
<td>-0.586</td>
<td>-0.377</td>
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<table>
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<th>$r_{st}$</th>
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<th>$r_{Lt}$</th>
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<td>I</td>
<td>II</td>
<td>III</td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>F. Error</td>
<td>2.255</td>
<td>3.296</td>
<td>3.230</td>
<td>-0.043</td>
<td>-0.197</td>
<td>-0.362</td>
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</tbody>
</table>
not be an adequate criterion for rejecting these equations because these observations might be after all abnormal.

Table III.9 presents dynamic ex post forecasting for the first three quarters of 1976. Even on dynamic predictions the model seems to perform satisfactorily.
Chapter IV

Policy Implications

IV.1. Introduction

In chapter II we concluded that a number of factors determine the significance of a rule. These were the importance of money in explaining business cycles and the associated lags in its effects. In the first section of this chapter we attempt, given the model, to evaluate these factors and thus through those to assess the case for or against a rule. In the second section we attempt a more direct test. This takes two forms which are rather complementary to each other. The first compares the actual behaviour of the economy with the behaviour that would have resulted had the authorities followed a rule. The second compares the behaviour of the economy that results from a vigorous discretionary stabilization policy with that of a rule.
In this model monetary policy—i.e., changes in the supply of money—is considered to be effected by changes in the authorities' instruments which affect the monetary base, with the latter assumed to affect the stock of money. The instruments through which the authorities can induce a change in monetary policy are considered to be open market operations, represented by the security portfolio of the Bank of England, and the discount rate.

The effectiveness of monetary policy can be judged by means of policy simulations—examining, that is, the behaviour of the economy had a different policy been followed. In this instance the policy analysis is conducted by considering a change in the monetary base brought about by open market operations. Yet, examining the path of an endogenous variable, e.g., Y, from one position of static equilibrium to another after a once and for all change in open market operations is of no general relevance. The reason is that we expect the monetary authorities to react to changes in economic conditions by continuously changing the path of open market operations. This means that a new change in open market operations would occur before the dynamic response to the first change has worked itself out. Recognising this important point the question we are asking is this. What portion of the dynamic changes that continuously occur in Y can be attributed to any one particular open market change that we choose arbitrary? In other words, suppose we superimpose a permanent change in open market operations on top
of their actual time path. How will Y now deviate from the time path it would otherwise have followed? The calculation of time paths follows a £1 billion increase in open market purchases initiated in the first quarter of 1963 - the beginning of the sample period - and sustained thereafter. The time path of all the rest exogenous and policy control variables are considered to remain unchanged - that is they assume their actual values. In this way we examine the behaviour of the economy under the ceteris paribus assumption. Comparing the thus obtained time path of the endogenous variables with those that were obtained from the model before the £1 billion increase in open market purchases we calculate dynamic multipliers\(^{(1)}\) which indicate the response of an endogenous variable to a change in a policy instrument after each elapse of time. These multipliers appear in table IV.1. Their usefulness is considered from three points of view: (a) they provide evidence on the stability or instability of the model; (b) they provide evidence on the various lags - intermediate and outside lag; (c) they provide evidence of the importance or unimportance of money.

With respect to the stability of the model one can immediately see from column 1 of table IV.1, that the system is dynamically stable - an exogenous shock that permanently disturbs the original path would have been

\(^{(1)}\) In particular, the dynamic multipliers are computed as the differences between the control and policy simulations. The control solution is obtained by assigning the actual values to all exogenous variables. The experimental solution is obtained by assigning to all but one exogenous variables their actual values and to the last a specified increase on top of the actual values.
### Table IV.1

**Dynamic Multipliers**

Dynamic effects on some endogenous variables of £1 billion increase in SP<sub>t</sub>  
*(Initial Conditions 1963 I)*

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Y&lt;sub&gt;d&lt;/sub&gt; - Y&lt;sub&gt;s&lt;/sub&gt;</th>
<th>B&lt;sub&gt;d&lt;/sub&gt; - B&lt;sub&gt;s&lt;/sub&gt;</th>
<th>M&lt;sub&gt;d&lt;/sub&gt; - M&lt;sub&gt;s&lt;/sub&gt;</th>
<th>(r&lt;sub&gt;s&lt;/sub&gt;)&lt;sub&gt;d&lt;/sub&gt; - (r&lt;sub&gt;s&lt;/sub&gt;)&lt;sub&gt;s&lt;/sub&gt;</th>
<th>(r&lt;sub&gt;L&lt;/sub&gt;)&lt;sub&gt;d&lt;/sub&gt; - (r&lt;sub&gt;L&lt;/sub&gt;)&lt;sub&gt;s&lt;/sub&gt;</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>0.011</td>
<td>0.105</td>
<td>0.121</td>
<td>-2.189</td>
<td>-0.231</td>
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<td>2</td>
<td>0.024</td>
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<td>0.209</td>
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<td>-0.501</td>
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<td>3</td>
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absorbed after a period of 9 years. Nonetheless 98.3 percent of the whole adjustment would have been accomplished within 7 quarters and the remaining 1.7 percent needs more than 7 years to die out. It is interesting also that in the 8th quarter we have a small overshooting of the final path which is ultimately reached through an oscillatory process.

A measure of the intermediate lag - the time lag between the change in policy and the emergence of changed financial conditions facing the banking system, as measured by changes in the monetary base - is provided by examining the dynamic multipliers of the monetary base. As can be seen from column (2) of table IV.1, 83 percent of the whole adjustment has been completed within one year, with 37.5 percent of the total effect coming in the same quarter, 60 percent within the first two quarters and 74 percent within three quarters. Thus a change in monetary policy induced by open market operations is felt very quickly in the banking sector and hence open market operations ought to be considered as an effective instrument of monetary control. This comes as a surprise since the authorities(2) do not believe that open market operations could be relied upon to effect a change in the monetary base with any degree of precision either in time or in size.

In practice dynamic multipliers have been calculated with respect to money or the monetary base. Keeping in line with this tradition, mainly for purposes of comparison, we -

(2) See, e.g., the Hodge Memorial Lecture delivered by the Governor of the Bank of England (1971).
have calculated dynamic multipliers with respect to the monetary base which appear in table IV.2. The monetary base is of course an endogenous variable in our model, and thus no multiplier as such exists. However, one can calculate arithmetic multipliers by dividing, e.g., the income multiplier of open market operations by the monetary base multiplier of open market operations.

The income multiplier of the monetary base provides an estimate of the joint lag — intermediate and outside. Thus it takes six quarters for 96 percent of the total effect on income to work out with almost a quarter of the total appearing within the same quarter and 63 percent coming in the first year.

The various components of income however are affected differently by monetary policy. Table IV.3. shows the percentage to equilibrium covered in each quarter for income and some of its components. One can immediately see that the most quickly affected component of income is investment in dwellings. Thus within the first quarter 94 percent of the total effect has already been worked out and after a year more than 97 percent. Changes in inventories is the component of income with the second shorter lag. The effect builds up very fast — in less than a year the total effect has already been felt — but then greatly fluctuates around its final equilibrium. Thus in the seventh quarter the effect overshoots its final equilibrium by more than a half. The next component with the shortest lag is consumption for durables. The effect builds up gradually with little variation
Table IV.2

Dynamic Multipliers

Dynamic effects on some endogenous variables of £1 billion increase in £P_t
(Initial Conditions 1963 I)

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Y_d - Y_s</th>
<th>Cum.</th>
<th>C^n_d - C^n_s</th>
<th>C^n_d - C^n_s</th>
<th>I_d - I_s</th>
<th>I_d - I_s</th>
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<td></td>
<td>_B_d - B_s</td>
<td></td>
<td>_B_d - B_s</td>
<td>_B_d - B_s</td>
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<td>0.105</td>
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<td>0.010</td>
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<td>0.012</td>
<td>0.012</td>
<td>0.060</td>
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<td>0.709</td>
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Table IV.3

Percentages of the total effect of the long run equilibrium

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<th>Quarter</th>
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<th>$C^d_t$</th>
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<th>$I^d_t$</th>
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around its final equilibrium. One can see that it takes a year for 44 percent of the total effect to be felt in the economy. Investment and consumption for non-durables have the longest lags with only 21 and 24 percent of the total effect having been worked out within one year respectively.

The above results tend to confirm two major concerns about monetary policy. First that the housing industry probably bears the brunt of monetary policy actions. Second, that the lag in effect is probably quite long for consumption for non-durables and business investment. This is rather unfortunate, because these two components are the ones which the monetary authorities would like to affect quickly.

In conclusion our estimate of the lag in the effect of monetary policy in the U.K. is of approximately 2 years time. This is twice as long as the St. Louis estimate for the U.S. economy - the full effect of monetary policy in this model is felt within a year. Our estimate of the lag on the other hand compares well with the estimate of the FMP - model - University of Pennsylvania model - for the U.S. economy, although in the latter 80 percent of the total effect is felt within the first year. Finally our estimate is a bit smaller then that implied by the FRB-MIT model for the U.S. economy. (3)

As far as the ultimate size of the effect of a monetary change is concerned our model suggests that it is quite

(3) All of our comparisons are concerned with the U.S. economy. This is unfortunate but we are not familiar with any estimate of the lag for the U.K. economy.
high-higher than the estimate of the FRB-MIT model but less nevertheless than that implied by the St. Louis or the FMP model.

The next question to be dealt with is how our model accounts for these lags. The answer lies in the behaviour of the interest rates, so it is necessary to examine their behaviour. As a starting point one should notice that all models agree that the initial impact on interest rates is to reduce both the short and the long rate. In our model the permanent increase by £1 billion in open market purchases results in a permanent decrease in the short term rate of interest by 2.016 and by 0.904 in the long term rate of interest - table IV.1. The striking thing about the short term interest rate is its behaviour in the first period. It immediately jumps to, and even more it overshoots, its final equilibrium (it is about 1.08 of the long run value). In later periods, the short term rate of interest approaches equilibrium asymptotically. (Its adjustment path is depicted in fig.1.)

This behaviour is more or less in line with that found by Tanner (1969) and suggested by Tucker (1966). As the latter has long before pointed out the explanation for this behaviour of the short-term rate of interest lies in its function as the variable that clears the money market. In addition, the great movements of the short-term rate of interest can be accounted for by the lag in the demand for money which independently contributes to the variation of the short rate. These substantial changes in
Figure 1

Time Path of Interest Rate Adjustment

Figure 2
the rate of interest affect the level of aggregate demand through their effects on the various forms of expenditure. In this context even though there might exist long lags in the various expenditure functions the lag in the demand for money counteracts these lags providing a short lag in the effect of monetary policy.

Although our model provides support for such a behaviour in the rate of interest we are not in agreement with the above conclusion of Tanner and Tucker about the lag in the effect of monetary policy. The main reason lies in the distinction between short and long rates and in the specification of our expenditure functions which are assumed to be primarily affected by the long rather than the short rate. In our formulation of the term structure of interest rates the effect on the long rate builds up gradually. As it turns out from table IV.1. and is depicted in fig.2 it takes more than a year before a small overshooting occurs and then the final equilibrium is not to be reached before another two years have elapsed. On these grounds the lag in the effect of monetary policy turns out to be in our case of approximately two years.

Now what do all these amount to in terms of the conduct of monetary policy? Two major points seem to emerge. First, although the lag in the effect is something less than two years discretionary monetary policy might not turn to be

(4) In Tanner's and Tucker's model there is no distinction between short and long rate.
destabilizing if it is undertaken moderately early in a cyclical phase since almost fifty percent of the total effect is felt in nine months. Second, although money is important it could not be considered as the predominant factor explaining business cycles. On these grounds one does not expect simple rules to perform satisfactorily.

An attempt to establish more specific statements for or against simple rules rather than general comments as put forward above is a very difficult matter. The main reason is that more specific statements require more strict and severe assumptions and hence loss of generality. For example a clear cut case against a specific rule might be established only at the cost of so many assumptions that practically make it a special case and therefore it becomes logically invalid to derive conclusions about simple rules in general from such evidence alone. One can always say with strong persuasive power that what has been established is that this particular case is not to be preferred while nothing is said about alternative rules. We are aware of this problem of sacrificing a general point of little importance for something less general but of greater importance; we feel, however, that at this stage more insight is to be gained by attempting a direct test and evaluation of the two alternative policies - discretion versus rules - even at such a cost.
IV.3 Rules versus Discretion: A Direct Test

The conduct of monetary policy is never a simple matter. And it is even more difficult to evaluate different policy prescriptions. It must be stressed that an evaluation of two alternative policies depends on the assumption "that had a different policy been followed in practice, the structure would have remained the same." But even if this assumption is satisfied an evaluation of two alternative policies is still a difficult matter; for one thing there is no way to test - using the previous experience - which one is the best. The trouble lies in that previous experience is the result of the specific policies that were pursued in the past.

To illustrate this point, what we have called the "control solution"(5) is not a situation that can meaningfully be compared with, for example, the "rule solution".(6) Theoretically a control solution must be one that is independent of any government intervention. Only then the comparison of the control solution with the rule solution would provide a true test for the performance of the latter. Thus, an ideal and objective comparison is not possible. Nevertheless, the comparison is meaningful and constructive when one is content with less strict propositions, like whether

(5) Control solution is the result of simulating the economy by assigning to all exogenous and policy control variables their actual values.
(6) The rule solution differs from the control solution in that the values for one policy control variable are arbitrarily chosen so as to satisfy a rule.
a specific rule would have produced better results compared with the actual situation for which we cannot trace its causes. Indeed the actual situation might be the result of discretionary policy or the result of another rule or the result of no intervention at all or finally the result of any possible combination among them. In fact our first test is of this kind. It compares the actual behaviour of the economy or rather the behaviour implied by the model by plugging in the actual values - what we call the control solution - with the behaviour that would have resulted had the authorities followed a rule - what we call the rule solution.

But this is not enough. What one needs is an objective or a priori criterion according to which it can be decided whether the control or the rule solution is to be preferred. The role for such a priori criterion could be played by an ideal or desired state. This desired state mainly depends on the governments' objectives. Possible candidates could be price stability, full-employment, boost of economic growth, income distribution etc. In theory unless one knows all these objectives and the weights attached to each one of them it is impossible to judge and evaluate two alternative policies. The situation might become even more difficult to appraise if one considers a long period of time during which the objectives change or at least the weights attached to them change. This is very likely to happen since within a long period the various governments might have pursued quite different programs and objectives.

Thus as a broad principle one can say that detailed
identification of the government's objectives implies shaky conclusions - in the sense that an evaluation of two alternative policies is not possible if the objectives vary over time. Alternatively the more crude one considers the objectives to be the greater the likelihood that these objectives would hold for a longer period of time.

On these grounds we assume that among the many objectives that a government might have one that must surely hold for every government is the stabilization of economic activity. This means that although we assign to the government two objectives - full employment and price stability - we do not attempt to disentangle, for the reason given above, the broader objective of a stable economic activity into its components. In practice of course the authorities might not attempt to stabilize the level of economic activity as such but the inflation rate and the level of employment separately. Given however that each one of them varies with the level of economic activity and particularly in such a way so that a trade off exists, at least in the short-run, it makes sense to speak about stabilization of the economic activity instead of stabilization of the price level and the employment rate separately.

In very broad terms one can say that the trend of economic activity could be considered from the point of view of stabilization as the desired state. One might, in addition, dare say that, above the TT line in fig.3, the situation is one of rising prices and unemployment but the dominant problem is that of inflation. On the other hand, the area below the
TT line might again be associated with rising prices and unemployment but the main problem could be considered to be that of unemployment. The situation on the line is a desired state in that each point is associated with a given price rise and a given unemployment rate. These points could be regarded as equilibrium points in the sense that each one of them represents an inflation rate that is fully expected and a natural rate of unemployment—that is an unemployment level that is only due to friction. If such an interpretation is too much to ask one can interpret this situation as the least harmful from all possible alternatives. The rationale behind this point is the following. If it is reasonable to assume that the inflation rate rises, on average, as we move along the upward phase of the cycle while the unemployment rate declines on average, the opposite happening on the downswing, then it makes sense to assume that somewhere between the peak and the trough there exists a situation that according to some objective could be considered as the least harmful.

Therefore in sum the test for or against simple rules consists in comparing the deviations of the control solution from the trend with the deviations of the rule solution from the trend and examining which deviations could be regarded on average as the minimum.

The problem however of evaluating the case of rules is difficult to formulate even at this stage. There are another two questions involved. The first is to select the monetary aggregate for which to formulate the rule. There is no simple
answer here. Arguments could be put forward against or in favour of formulating a rule for the monetary base, for a narrow or a wider definition of the money stock. The point is that without examining every single case one cannot speak of a rule in general and conclude that simple rules ought to be avoided or preferred. The trouble lies in that while one rule might produce a better situation another rule might produce a worse one.

In our case it is not at all simple to device tests for each possible monetary aggregate. Thus we have to select only one monetary aggregate and we do not conceal that our choice is to some extent arbitrary. The rule is to be formed for the monetary base. Our only excuse is that we regard it as simpler for the authorities to establish a rule for the monetary base rather than for the supply of money. The reason is that the leakages over the control of the base are supposed to be fewer than the leakages that exist in the control of the stock of money, however narrowly defined. Thus we believe that we are not committing a great error when arguing that if the rule for the monetary base is to be rejected, then we can reasonably assume that the rule for the stock of money should also be rejected. (7) In other words, we believe that in a sense we are justified in saying that from all possible monetary aggregates for which a rule could be formed, the easiest to achieve and establish, on the part of the authorities, is the monetary base. We recognize however that this is not a particularly strong

(7) This seems to be a principle with which even Friedman agrees. Friedman (1960).
proposition so that one could alternatively regard the test as simply a test for or against the rule of the monetary base.

Having selected the monetary aggregate for which to formulate a rule there remains the problem of choosing among alternative rules. For example one can speak of a 3 or 5 percent increase in the monetary base. If it is established that the 3 percent rule should be rejected on the grounds that it worsens the situation one can simply say that this was the case because the correct or optimum rule should have been a 5 percent rule.

The problem is not so difficult to get round to as it might first appear. We have already said that the first test consists in comparing the control solution - ie. the actual situation - with the rule solution. In the former the monetary base fluctuates over a trend. Thus the obvious rule for the monetary base is the trend values. This is so since the question we are asking is this: Given the actual values of the base during the period 1963-75 what values the base ought to have assumed so that it rather had a constant percentage increase from quarter to quarter than a fluctuation. Thus the rule is easily found by regressing the monetary base on time only. It turns out that the appropriate rule is a 6.7 percent increase.

Now it is very important to note that from all possible rules this is the best - the optimum from one point of view - that can be formulated. Suppose for example that instead an 8 percent rule was adopted. In this case it would have turned out that the economy would have circulated more money, on
average, than it actually had. In this instance the comparison between the control and the rule solution would have been biased since the ceteris paribus assumption would not have been held any longer (more money circulates on average in the economy). On the other hand if a smaller than 6.7 percent rule had been assumed the experiment would have been conducted with less on average money in the economy. Thus this rule is the best - the optimum - since in both solutions we have on average the same quantity of money.

Now in our model the monetary base is an endogenous variable. This means that the authorities would have to manipulate their instruments if the base is to be set at the desired values. Thus if the rule of 6.7 percent for the monetary base had to be followed for the period 1963-75 then additional open market operations would have had to be undertaken for each quarter than had actually been undertaken. The ceteris paribus assumption entails the following question: What should have been the size of open market operations for each period so that the base would have followed the rule. The answer is provided by solving the equation for the base for the security portfolio and then setting for every variable the actual values while for the base the values of the trend. The thus obtained values for the security portfolio constitute the values that ceteris paribus had to be assumed had a rule been followed.

It must be stressed that although the authorities might attempt to set a 6.7 percent rule for the base the economy might react to such a behaviour so that it does not experi-
ence a 6.7 percent increase but in some cases a greater and in others a smaller rate.

On these grounds the rule solution is obtained by simulating the economy with all exogenous and policy control variables assigned their actual values with the exception of the security portfolio for which we set the values needed for the monetary base to follow the rule of 6.7 percent. On the other hand the control solution is obtained by assigning to all exogenous variables, including the security portfolio, their actual values.

The results of these policy simulations are graphed in fig. 4. The overall picture that emerges is against simple rules. Thus one can immediately see that in 40 out of the 52 quarters examined the deviations from the trend would have been increased had a rule been followed. This could be interpreted as an indication that had a rule been adopted, the economy, as represented by our model, would have been even more destabilized compared with what has actually been. (8) How aggravated the situation becomes from a policy of a rule is even clearer if one considers the average deviation from the trend, calculated in absolute terms. This turns out to be £379m. for the rule and £229m. for the actual case. This could be interpreted that the economy would have deviated by an average of £379 from its desired or equilibrium path or simply from its trend had a rule been

(8) Strictly speaking this is not correct. What we call the actual situation is the one implied by our model by giving the exogenous variables their actual values.
followed while it actually deviated on average by only £229m. Thus on both occasions and strength the economy would have been worse from the point of view of stability in the case of rules.

One can go one step further in the evaluation of the two policies by examining the behaviour of the economy in the case of a rule and in the case where a vigorous discretionary stabilization policy is undertaken. This test improves our judgment about the two policies since it overcomes a problem raised earlier in this chapter. The problem was that the actual behaviour of the economy could have been the result of various policies and that therefore by comparing the control with the rule solution one was not sure whether one was disregarding the case of simple rules while in fact the control solution was itself the result of a better rule. Although this is an unlikely situation its possibility must not be disregarded without any consideration.

As every test, this new one solves some problems by creating others. We can overcome the problem raised above by only making strong assumptions about the behaviour of the authorities in undertaking vigorous discretionary stabilization policy. The question is one of time - when to interfere - and one of quantity - by how much. And we must, if we want to device a test, provide answers to these problems. We do so by assuming the validity of some new criteria although there is no way to know whether these new assumptions are to be satisfied in practice or not. Nevertheless the temptation is very strong since the stronger a conclusion
is the greater the number of cases which support it, in particular when each one of them comes from a different direction, that is when each one of them starts from another set of assumptions. In other words when it becomes very difficult to test the validity of the underlying assumptions one can start the analysis from another set of assumptions and test whether he comes to the same conclusion. Such overwhelming evidence makes a conclusion stronger.

The problem of when and by how much the authorities should interfere is taken care of by assuming that the equation for the monetary base - as analysed in chapter II, that is as a reaction function - can be expected to remain a good approximation to reality. There is no way to test whether this is so. The only thing we know is that from a statistical point of view the equation performs well. But we do not know whether the objectives of the authorities and the implicit trade offs are in fact the ones we have assumed. As in every test however this is an assumption that we have to accept.

Nevertheless the question of the validity of this assumption weakens and loses some of its importance when we sidestep the question of the direct objectives - full employment and price stability - by considering again the case of stabilizing the level of economic activity. That is we make once more the assumption that the authorities attempt to set the level of economic activity on its trend, so that deviation from it and thus the associated cycles are eliminated. This is what we call discretionary stabilization
policy. The authorities' target is a final objective such as income which they attempt to set by manipulating their instruments in such a way so that any deviation of the current value of income from its desired value, that is thought to exist, is assumed to be covered by a change in the instruments. In the policy of a rule on the other hand the final objective is the same but now the authorities manipulate their instruments to effect a specified change in an intermediate target - such as the stock of money - in the first place rather than in a final target. It should be stressed however that the authorities' decision to do so does not relate to the fact that corrective procedure can be more easily undertaken for an intermediate rather than a final target on the basis that information for the former is more readily available in addition to also being more reliable than the information for the latter. The main question is not therefore one of targets and indicators but rather the validity of the proposition that there is a mechanism which secures that whenever the intermediate target is achieved the final target is also achieved. In the monetarist approach the role of this mechanism is played by the quantity theory of money.

In order to achieve the desired change in the level of economic activity, represented by the trend values of income, the authorities must manipulate their security portfolio in much the same way as we assumed them to do when they wanted to set the base on the trend. In this instance too the question is what should have been the size of open
market operations for each period so that income would have assumed its trend values. The answer is provided, as in the case of a rule, by solving the equation of the monetary base for the security portfolio. On this occasion, however, we assign to every variable, including the base, its actual values while we assign to income its trend values. The thus obtained values of the security portfolio constitute the values that ceteris paribus have to be assumed had the authorities undertaken an active discretionary stabilization policy.

It must be remembered that the authorities might not succeed in stabilizing the level of economic activity and thus it is expected that the economy would grow following again a cyclical path. In those terms the discretionary solution is obtained by simulating the economy with all exogenous and policy control variables assigned their actual values with the exception of the security portfolio for which we set the values needed for the level of economic activity to follow its trend.

The test of rules versus discretion in this case consists in comparing the deviations of the rule solution from the trend with the deviations of the discretionary solution from the trend and examining which deviations could be regarded on average as the minimum.

The results of these policy simulations are graphed in fig. 5. The overall picture is much the same as the one that emerged in the previous test. Here an active discretionary stabilization policy is more successful than a rule.
in 42 out of 52 quarters. And the average deviation from the trend is £220 m for the former and £379 m for the latter. Thus Discretion is to be preferred over Rules.
IV.4 Summary and Conclusions

The present thesis has attempted to evaluate two broad principles upon which stabilization of the U.K. economy can be pursued. One of the purposes of chapter I has been to show that whether Rules or Discretion should be used depends on whether one's view of the working of the economy is in line with the new quantity theory of money. In addition, it has been shown that an evaluation of the two policies is only possible through a model that captures the whole of the economy — that is, a general equilibrium analysis is needed rather than a partial one. In this context the main problem which one is faced with when attempting to evaluate Rules versus Discretion is to provide a structure that is not biased towards either a Keynesian or a monetarist viewpoint. The reason is that each camp has developed its own thinking regarding both the working of the economy and the methodology upon which to test such working. Thus, one reasonably wonders whether an evaluation of the two policies is possible without introducing a bias towards one camp or the other. In other words, the question is whether we are allowed to test monetarist propositions through a Keynesian framework. The answer is given in chapter I where we have shown that at a theoretical level a common structure can be found which captures most of the differences between the two schools of thought; at an empirical level small scale models can
be thought of as the least biased towards either viewpoint.

On these grounds a model was specified (chapter II) in such a way as to allow for the different hypotheses which underlie both camps to be tested. The model was then estimated, evaluated and subjected to simulations in order to test its performance. In this model monetary policy is thought to be transmitted through two main channels: interest rates and wealth. In particular, non-durables are influenced through liquid assets. The short term rate of interest does not seem to be important. Durables are influenced by the long term *term* rate of interest and the availability of credit. Investment in dwellings is affected by changes in the short term rate of interest. Investment in plant and equipment is affected by the cost of capital. Changes in inventories are affected by the long term rate of interest and liquid assets. Import credit affects imports. The supply of money is determined partly exogenous and partly endogenous by the monetary base the rediscount rate, prices and income. The long term rate of interest is influenced by expectations of its own rate and expectations about the general economic conditions reflected in changes in the level of economic activity and changes in the price level. Finally the monetary base is determined through a reaction function of the authorities' behaviour and their constraint to provide finance to the government's budget deficit.
The model was then used for policy simulations to test whether Rules or Discretion produces a better stabilization of the economy as this is represented by the model. In terms of these tests it has been suggested that discretionary stabilization should be preferred to rules. Such preference is justified on the grounds that among the factors that contribute to the cyclical behaviour of the economy money is only one of them with changes in autonomous expenditure and expectations about future developments being equally, if not more, important. A successful stabilization policy, therefore, should attempt to control these factors as well as money. Thus by only controlling money stabilization could not be so successful. Professor Sayers, an advocate of discretion, has put it like this: "the essence of central banking is discretionary control of the monetary system" and concluded that "we are doomed to disappointment if we look for rules applicable to all times and places. We have central banks for the very reason that there are no such rules".

Judging now discretionary stabilization policy on its own, our results seem to support the view that it is quite effective. The dynamic multipliers we have calculated indicate that monetary policy is a strong weapon the effects of which are distributed over two years but with a sizeable effect occurring within the first 6 to 9 months. In addition it seems that the brunt of monetary policy is borne primarily by the housing market with
changes in inventories and consumer durables bearing the second and third largest effect respectively. The biggest lag is for non durables and investment in plant and equipment. Thus, if the primary concern of the authorities is in these two components of aggregate demand, other policies might also be used if a quicker effect is needed.

Although our study points to discretionary policy it does not deal with the question of which are the best instruments through which it can be applied. It could be that interest rates or the money stock have the greatest effect. In this context Arestis (1976) has shown that interest rates are the optimal instruments through which discretionary monetary policy should be applied in the case of the U.K. economy.

It is reasonable to ask how well documented is the preference of Discretion over Rules in our study. One cannot conceal that stabilization here is taken to mean elimination of the deviations of the level of economic activity from its trend. Obviously as it was discussed in this chapter the authorities might attempt to stabilize the level of employment and the inflation rate separately. Such treatment, however, would have required a number of equations that would have determined these two variables. In this context the simplicity of our model would have been lost and with it the unbiasedness to a Keynesian and monetarist viewpoint. In addition, a sufficient explanation of the general price level seems
to us a very difficult problem in itself. It is not our purpose here to discuss the theories of inflation, but we cannot help saying that none of the existing approaches satisfies us. Thus we thought it best not to disentangle the objective of stabilizing the level of economic activity into its components, output (employment) and prices.

The next question is whether the authorities are free to pursue a policy of discretionary stabilization. For example the authorities might be preoccupied with the balance of payments. Or they might not be able to alter interest rates because these are strongly influenced by the Euro-dollar market which in its turn might be influenced by the U.S. monetary policy. One should therefore explore this situation in future work. Our study has absolutely nothing to say on this point. This problem requires a detailed analysis of the authorities' objectives, the weights attached to each one of them, and the instruments they have used and believe that they can use. Although this problem is very important the significance of our study, we believe, lies in helping the authorities to reconsider their objectives or at least the weights attached to them.
APPENDIX

Definition and Sources of Variables

\[ Y_t = \text{Gross domestic product at 1970 factor cost prices.} \]
\[ \text{Economic Trends}^{(1)}. \]
\[ C^n_t = \text{Consumer's expenditure for non-durables at 1970 prices. Total less durables. Economic Trends.}^{(1)} \]
\[ C^d_t = \text{Consumer's expenditure for durables at 1970 prices. Durable household goods and cars and motor cycles. Economic Trends}^{(1)}. \]
\[ Y^d_t = \text{Disposable income at 1970 prices. Economic Trends}^{(1)}. \]
\[ I^d_t = \text{Fixed investment in dwellings at 1970 prices. Economic Trends}^{(1)}. \]
\[ I_t = \text{Gross domestic fixed capital formation at 1970 prices. Total less investment in dwellings, Economic Trends}^{(1)}. \]
\[ \Delta H_t = \text{Stockbuilding at 1970 prices. The sum of the value of the physical increase in stocks of materials and fuels, of finished goods, and the change in work in progress. Economic Trends}^{(1)}. \]
\[ G_t = \text{Government expenditure at 1970 prices. Economic Trends}^{(1)}. \]
\[ X_t = \text{Exports of goods and services at 1970 prices. Economic Trends}^{(1)}. \]
\[ IM_t = \text{Imports of goods and services at 1970 prices. Economic Trends}^{(1)}. \]
\[ E_t = \text{Residual error in the income identity.} \]

(1) Annual Supplement 1975 and later issues. Variables are seasonally adjusted.
\[ P_t = \text{G.D.P. price deflator. Economic Trends.} \]

\[ L_{t-1} = \text{Selected liquid assets of the personal sector, defined as national savings, tax reserve certificates, local authority temporary debt, deposits with banking sector, building societies, finance houses. Financial Statistics, table 90, various issues.} \]

\[ L_{ct-1} = \text{Selected liquid assets of industrial and commercial companies. Economic Trends, table 60.} \]

\[ BA_t = \text{Bank advances to the personal sector. Financial Statistics, table 90, various issues.} \]

\[ BA_{ct} = \text{Bank advances to industrial and commercial companies. Economic Trends, table 128, various issues.} \]

\[ BAB_t = \text{Bank advances to builders. Monthly Digest of Statistics, various issues.} \]

\[ \Delta HP_t = \text{Hire purchase credit; changes in debt outstanding. Economic Trends, table 12.} \]

\[ IC_t = \text{Imprt credit; Economic Trends.} \]

\[ r_{st} = \text{Interest rate on three months local authority temporary debt. Economic Trends, table 64.} \]

\[ r_{Lt} = 2\frac{1}{2} \text{Consols yield. Economic Trends, table 64.} \]

\[ r_{dt} = \text{Minimum lending rate. Economic Trends.} \]

\[ M_1 = \text{Money stock defined as currency held by the public plus current accounts. BEQB.} \]

\[ B_t = \text{Base money, defined as currency held by the public plus bank reserves. BEQB.} \]

\[ SP_t = \text{Bank's security portfolio. BEQB.} \]

\[ BR_t = \text{Public sector borrowing requirement. Economic Trends, table 52.} \]
Abbreviations

AER = American Economic Review.
BNOL = Banca Nazionale del Lavoro Quarterly Review.
CMC = Commission on Money and Credit.
EJ = Economic Journal.
FRB = Federal Reserve Bank...
IER = International Economic Review.
JF = Journal of Finance.
JMCB = Journal of Money Credit and Banking.
JPE = Journal of Political Economy.
QJE = Quarterly Journal of Economics.
RES = Review of Economic Studies.
RE & Stats. = Review of Economic and Statistics.
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