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MONETARY AGGREGATES AND ECONOMIC ACTIVITY: EVIDENCE FROM FIVE INDUSTRIAL COUNTRIES

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MONETARY AGGREGATES AND ECONOMIC ACTIVITY: EVIDENCE FROM FIVE INDUSTRIAL COUNTRIES*

Introduction

Since the early 1970s a number of industrialised countries have pursued a strategy of money supply targeting as the primary focus of monetary policy. Essentially such a strategy has involved the setting of policy instruments to attain an intermediate target (the rate of growth of one or more of the monetary aggregates) with the ultimate aim of influencing the rate of growth of nominal income, particularly inflation, and perhaps affecting real economic variables also (Friedman 1975, OECD 1979, Saving 1967). As a result, the post-war Keynesian monetary approach based on interest rate stabilisation objectives, which allowed the money supply to be demand-determined, has generally been abandoned.

The major reasons behind the switch to monetary targeting are now well-known (Friedman 1982a, Dennis 1982). These included: i) the acceleration of inflation in the early 1970s and the difficulty of targeting on interest rates in such circumstances, ii) the considerable empirical support then prevailing for the key monetarist proposition

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of a stable demand for money[1] (Laidler 1981), iii) the expectation, with the advent of floating exchange rates, that small, open economies would be able to conduct an independent monetary policy and iv) growing dissatisfaction with the results of Keynesian demand-management (fine-tuning) policies.

More recently, however, some departures from this central theme have reflected new controversy over the appropriateness of strict monetary targeting in certain countries at the present time. For example, in September 1982, the Federal Reserve Board announced that it would for the time being pay less attention to M_1 and would instead focus more on the broader monetary aggregates (M_2 and M_3). In 1982 also, Canada discontinued its M_1 target while the United Kingdom, in dropping its exclusive attention on a Sterling M_3 target, announced that it would in future monitor a range of aggregates as well as the exchange rate. The reasons behind these general modifications of policy are numerous. Policies may have been influenced by the deep recession in world demand and accompanying high unemployment since the second oil crisis of 1979 and by the threat to international financial stability arising from the debt-servicing problems of many developing nations. More particularly, against a background of high and volatile interest rates, the demand for money in recent years has shown considerable instability in certain countries, not least the United States. The evolution of financial innovation, together with shifts in the demand for funds on precautionary grounds, have contributed to this instability. In consequence, monetary targeting procedures have become subjects of considerable debate, although the modifications that have occurred are no more than a partial retreat in a few countries. Thus, although the underlying foundations of a targeting strategy are

[1] The fact that since the early 1970s considerable instability has appeared in demand-for-money equations in both the United States and the United Kingdom has, as noted below, only very recently diminished the enthusiasm of governments and monetary authorities for a targets strategy. See Duprey 1980, Radecki 1981 for a summary of recent US results and Artis and Lewis 1981, Dennis 1981 for a similar treatment of UK studies.

slightly less secure, the advantages of such a strategy are still seen to be strong.

Within an intermediate targets strategy the optimal choice of the target monetary aggregate is typically made on the basis of three criteria (Andersen and Karnovsky 1977, Brittain 1981, Davis 1979, Friedman 1982b). Firstly, a monetary aggregate must be closely and stably related to the final goals of policy – usually summarised as the level or rate of growth of nominal income. This is the most important criterion and explains the considerable discussion in monetary analysis of the transmission mechanism between the money supply and nominal income (Laidler 1978). The second criterion concerns the strength and stability of the link between the spectrum of monetary instruments and the chosen monetary aggregate.[2] (This also implies the need for the intermediate targets to be exogenous to non-policy developments or at least capable of having such factors reliably offset by actions of the monetary authorities.) Thirdly, for a monetary aggregate to be a feasible policy target, reliable information regarding its time path is required. Data on such an aggregate should, therefore, be accurate, frequently published and available with a short time-lag only.[3]

The purpose of the present paper is limited. In view of the renewed debate on targeting and especially on the choice of target aggregates, it would seem useful to have a new look at the long-term relationships between nominal income and particular monetary aggregates across a selected group of countries. Hence the paper presents evidence on the first criterion above, that is the strength of

[2] Andersen and Karnovsky (1977) conveniently combine these two by arguing that the aggregate that minimises the combination of control and projection errors is the most appropriate intermediate target of monetary policy.

[3] Other possible criteria for the choice of a monetary target have been proposed. These have included the extent to which a given aggregate is "understood" by the general public, which should allow a monetary target to have an "announcement effect", and the inclusion in the chosen aggregate of the flow of funds to the sensitive housing market (Davis 1979). However, those criteria noted in the text are the widely accepted ones.

the links between nominal income and a wide range of concepts of money and credit using data for the United States, the United Kingdom, Germany, France and Italy. The tests are extended by the addition of autonomous expenditure variables to the estimating equations. This is done to allow estimation of a formal reduced-form equation derived from a conventional model of an open economy, as the omission of such alternative arguments in the determination of nominal income would lead to biased coefficients on the monetary aggregates. However, it must be emphasised that the tests in this paper should not be viewed as a re-run of the familiar St. Louis equations.[4] Thus there is little inference drawn in the paper on the relative rôle of monetary and autonomous spending variables in the determination of fluctuations in nominal income.

The major aims of the study are therefore twofold:

(a) to investigate the relationships between nominal income and alternative monetary aggregates in individual countries;

(b) to observe whether there are any cross-country patterns in the money supply/nominal income relationships for certain common definitions of money such as narrow money, broad money or credit.

It is in the second respect, perhaps, that the paper is of main interest in the ongoing debate concerning the choice of the target aggregate. Few attempts have been made to provide a cross-country survey of a wide range of aggregates in this way. The inevitable cost is some absence of sophistication in the econometric evidence. Without doubt, a larger number of more complex specifications and tests could have been undertaken for the individual countries covered.

The main cross-country themes that are apparent from the regression results presented in this paper may be briefly

[4] See, for example, for the United States, Andersen and Jordan 1968, Carlson 1978 and Meyer and Varvares 1981, for the United Kingdom, Matthews and Ormerod 1978 and for Germany, Läufer 1977.

summarised. Firstly, it is clear that the broadest concepts of liquidity or total credit, in those countries for which data are published, are closely related to nominal income. Secondly, and in contrast, credit from the banking system alone has a much less close relationship with nominal income for all countries except Germany and Italy. Thirdly, with respect to the conventional monetary aggregates, a broad measure (M_3) is generally more closely related to nominal income than a narrow definition of money (M_1), although the United Kingdom is an exception to this general result. Finally, the relationship between the monetary base and nominal income is well-defined for the United States and United Kingdom, although slightly less so in the case of Italy. Turning to the velocity graphs, a common theme is that the velocity of M_1 has trended upwards over the observation period in all countries except Italy. In contrast, the velocity of broader concepts of money has generally fallen, with the exceptions of the United Kingdom, where the velocity of all aggregates has risen over the data period, and the United States, where the velocity trends for all broad concepts of money, and also for the Debt Proxy and Total Credit, have been effectively flat. Any international variations in results are likely to reflect many complex factors, but particularly institutional differences in payment systems and the extent of financial innovation, and also variations in the rates of financial saving and investment.

It must be emphasised that these results are based on behaviour over a long-run period. They are derived from a study of annual data over, approximately, twenty-year periods. The possibility that short-run, reversible fluctuations in the nominal income/money relationships may have occurred which are not tracked in this study does not invalidate conclusions with respect to such secular behaviour. The results do, however, reflect any permanent movement in velocity relationships that may have occurred over the data period. However, any fundamental shifts in the relationships between monetary aggregates and nominal income that, for regulatory or structural reasons, may be evolving at present are not necessarily picked up in a historical study of this type.

In addition, the results in this paper stand on their own as evidence on the first, and most important, criterion governing the choice of targets. However, any unambiguous, broadly-based conclusions would also require evidence on the relative controllability of the aggregates in question. Therefore, this paper's concentration on the strength of the links between money and nominal income should not be taken to mean that the other criteria – especially controllability – are unimportant.

I.
The model

The reduced-form estimating equation for income is derived from a conventional macro-economic model of an open economy with a government sector (e.g. Coghlan 1980, Modigliani and Papademos 1980). All variables are in nominal terms:

$$Y_t = C_t + I_t + G_t + X_t - MP_t \quad (1)$$
$$C_t = a_o + a_1(Y_t - T_t) \quad (2)$$
$$I_t = b_o + b_1 r_t \quad (3)$$
$$T_t = t_1 Y_t \quad (4)$$
$$MP_t = c_o + c_1 Y_t \quad (5)$$

where Y, C, I, T, MP and r are income, consumption, investment, taxation, imports and the rate of interest respectively and are determined endogenously in the model. Government spending (G) and exports (X) are predetermined variables:

$$G_t = \bar{G} \quad (6)$$
$$X_t = \bar{X} \quad (7)$$

Equations (1) to (7) represent the non-monetary or real side of the model (although all variables are specified in nominal terms). The condition that withdrawals must equal injections in equilibrium is satisfied when the economy is located on the IS curve, extended to include the government and external sectors.

The monetary sector is defined in terms of a simple LM curve:

$$MD_t = l_o Y_t + l_1 r_t \quad (8)$$

$$MS_t = \bar{M} \quad (9)$$

$$MD_t = MS_t \quad (10)$$

with MD representing the demand for money, determined endogenously within the model, and MS the money supply which is assumed to be exogenous. The expected signs of the coefficients in these equations are a_o, a_1, b_o, t_1, c_o, c_1, $l_o > 0$ and b_1, $l_1 < 0$ while t is a time subscript.

Solving Equations (1) to (7) for the rate of interest:

$$r_t = \frac{-(a_o + b_o - c_o + \bar{G} + \bar{X})}{b_1} + \frac{(1 - a_1(1-t_1) + c_1)Y_t}{b_1} \quad (11)$$

Assuming the money market is in equilibrium (such that Equation (10) holds and the economy is on the LM curve), Equations (8) to (10) may also be solved for the rate of interest:

$$r_t = \frac{\bar{M}}{l_1} - \frac{l_o}{l_1} Y_t \quad (12)$$

Full equilibrium in this two-sector model requires simultaneous solution of (11) and (12) to leave a reduced-form equation for nominal income:

$$Y_t = \alpha_o + \alpha_1 \bar{M} + \alpha_2(\bar{X} + \bar{G}) \quad (13)$$

where $\alpha_o = \frac{l_1}{l_1[1 - a_1(1-t_1) + c_1] + b_1 l_o} \cdot [a_o + b_o - c_o]$

$$\alpha_1 = \frac{b_1}{l_1[1 - a_1(1-t_1) + c_1] + b_1 l_o}$$

$$\alpha_2 = \frac{l_1}{l_1[1 - a_1(1-t_1) + c_1] + b_1 l_o}$$

While exports and government spending in Equation (13) may be a satisfactory definition of autonomous expenditure (with imports and taxation withdrawn from the reduced form), an alternative

estimating equation was specified which included a measure of the government fiscal deficit:

$$Y_t=\beta_0+\beta_1\bar{M}+\beta_2\bar{X}+\beta_3(\bar{G}-\bar{T}) \qquad (14)$$

Equation (14) may be derived from the above model by assuming that although tax revenue (T) does, in practice, depend on income, G–T may be treated as an exogenous variable given that governments may design fiscal policy and adjust tax yields to achieve a desired level of G−T. In this form, the specification follows more closely the St. Louis version in such a way that Equation (14) could be used to measure the comparative rôles of fiscal and monetary policies in the determination of nominal income.[5]

Some points may be made concerning the applicability of this model to the main objective of the paper. Firstly, although the model has a Keynesian flavour, Milton Friedman (1970, 1971) argued persuasively that such a conventional two-sector model can accommodate a number of theoretical positions, with the size and stability of the coefficients (in both the structural model and the reduced form) and the lag structure distinguishing between the alternative theoretical viewpoints. Secondly, the model may be applied to all conventional definitions of the money stock measured on the liabilities side of banks' balance sheets. However, some points need to be noted if equations such as (13) and (14) are to be used for other monetary aggregates. For example, the monetary variable included in Equation (13) may be the monetary base (MB) given a stable relationship between it and the money supply in the form of:

$$MS_t=d_0+d_1MB_t \qquad (15)$$

[5] The underlying coefficients (β_i) will differ slightly from those (α_i) in Equation (13). The use of a full-employment budget deficit measure rather than the unadjusted concept is preferable on exogeneity grounds. When included in a set of tests for the United States, this measure was more significant than the unadjusted measure, although the significance, size and relative rankings of the monetary aggregates were little different. In consequence of this last result, the unadjusted deficit was used in all the preliminary tests in this work.

In this case the included variables in Equations (13) and (14) remain the same, although the underlying coefficients alter slightly in magnitude but not in sign. Use of the reduced-form Equations (13) and (14) for much wider liquidity concepts (which would include short-term financial assets, such as three-month bills, and deposits at non-bank financial intermediaries) or for the volume of bank credit advanced to the private sector requires some respecification of the monetary sector. Equations (8) and (9) would need to specify demand and supply functions for, on the one hand, the broader monetary aggregates and, on the other hand, credit, with the corresponding sectoral equilibrium (Equation (10)) being redefined accordingly (Modigliani and Papademos 1980).

However, such problems for alternative monetary aggregates become relevant only if structural model estimation is attempted. The reduced-form approach in Equations (13) and (14) has the advantage, therefore, of being able to encompass a wide range of monetary aggregates and to include a variety of lagged effects, though at the cost of not identifying the transmission mechanisms in its various forms from money to nominal income. As one drawback of reduced-form estimation, this lack of structural and allocative detail is well-known. However, the approach remains useful insofar as attention is confined to the overall stability of the money supply/income relationships.

Thirdly, the assumption that the money supply is exogenous, while being common practice in such empirical studies, suppresses any discussion of the second criterion, that is the strength of the links between policy instruments and the monetary aggregates. Nevertheless, these two criteria are independent of one another and may be considered so in empirical testing, although a more comprehensive comparison of target aggregates would require that the assumption of an exogenous money supply be relaxed.

Fourthly, Equation (13) demonstrates that the values of the multipliers linking both the money supply and exports plus government spending to nominal income depend on the sizes of the underlying parameters. This obvious point is particularly interesting

in the case of l_1 which measures the influence of changes in the rate of interest on the demand for money. If l_1 is expected, a priori, to be higher for a narrow definition of money, owing to the possibility that money-holders will substitute between non-interest-bearing current accounts and interest-bearing time deposits when interest rates change, than for a broad definition of money, within which such substitution would occur, this will lead to variations in the expected value of α_1 and β_1 in Equations (13) and (14) respectively.

Finally, the reduced-form equations specified above may be complemented by an equation that estimates the division of any nominal income (Y) change into fluctuations in real income and in the price level. This use of an aggregate supply equation is not common in studies of this type. However, it does serve a useful purpose, particularly as the aggregate supply curve is a theoretical construct accepted by a wide range of schools of thought.

To do this, the following equation was estimated (Gordon 1981):

$$\dot{P}_t=\lambda_o\hat{Y}_t+\lambda_1\dot{P}^e_{t-1}+\lambda_2(y_{t-1}-y^*_{t-1}) \qquad (16)$$

in which $\dot{P}$ is the rate of inflation (with the superscript e representing expectations), y and y^* are the actual and trend levels of real output respectively and $\hat{Y}$ is the deviation of the rate of increase of nominal income from the trend rate of increase of real output. All coefficients are expected to be positive with $0\leq\lambda_o,\lambda_1\leq 1$.

The equation is essentially a modified Phillips curve where the rate of price inflation depends on the level of excess demand as well as the change in nominal income relative to trend output growth. Inflation is assumed to rise, given the state of inflationary expectations, when output is above its trend level and/or when nominal income is growing at a rate greater than the trend rate of real growth.

The main problem in the estimation of Equation (16) is the non-observability of expected inflation. Two alternatives are used here. Firstly, the actual inflation rate (with a one-period lag) is used as a proxy for expected inflation so that the short-run price effect of fluctuations in the rate of change of nominal income adjusted for the

rate of change of trend output is estimated by λ_o and the long-run effect by $\lambda_o/1-\lambda_1$. However, it is important to note that, given this long-run effect, the real income or output effect of a change in nominal income is $1-\lambda_o/1-\lambda_1$, so that if $\lambda_o+\lambda_1=1$, this output effect is zero. This corresponds to the long-run vertical Phillips curve and implies that only at the equilibrium "natural" level of unemployment will price increases be stable. Secondly, the expected inflation rate may be proxied by the actual growth rate of various monetary aggregates with the short-run (λ_o) and long-run ($\lambda_o/1-\lambda_1$) effects on the rate of inflation of a change in nominal income growth above trend being estimated in this case on the assumption that, in the long run, the rate of increase of the money supply is equal to the rate of price inflation.

II.
Earlier studies

A large amount of empirical evidence has been published in recent years on the relationships between monetary aggregates and nominal income in the countries included in this study. Such evidence covers tests of demand-for-money functions, of the relative sizes of monetary and autonomous expenditure multipliers and of the relative rôles of monetary and fiscal policy in the determination of nominal income. In contrast, country studies of the predictive power of *alternative* monetary aggregates with respect to nominal income have, generally, appeared only more recently.[6] In this section, a brief survey of such studies is made, on a country-by-country basis, to enable the results presented later in the paper to be

[6] Prior to the widespread adoption of monetary aggregates targeting in the mid-1970s, it was much more common to publish evidence on the relative explanatory power of a given monetary aggregate and a given interest rate in the determination of nominal income (e.g. Keran 1970, Holbrook and Shapiro 1970, Zecher 1970, Tanner 1972). The discussion of which concept of money to use as a target amongst the available alternatives has therefore occurred much more recently.

considered in relation to earlier work. Little attempt is made to include studies other than those which are broadly of the same genre as the tests reported in the main section of this paper.

Considering first the United States, many early studies (including Hamburger 1970, Levin 1974 and Schadrack 1974) found that bank credit was a more significant determinant of nominal income than any of the conventional monetary aggregates. However, in more recent work certain common findings, which differ significantly from these earlier studies, have become established.[7] The most stable relationships have generally been found for very broad aggregates such as the Debt Proxy (a measure of the financial claims of the non-financial private sector) and Total Credit[8] (Friedman 1981a, b, 1982a, c, Cagan 1982, Davis 1979, Islam 1982). Alternatively, in regressions that have not included such wide-ranging concepts, it is usual to find that a narrow definition of money such as old M_1 or the more recently defined M_{1A} and M_{1B} (which has now in turn been renamed M_1) have the closest fit with respect to nominal income (Carlson and Hein 1980, Cullison 1982, Davis 1979–80, Dewald 1982, Gambs 1980, Hafer 1981, Higgins and Roley 1979, OECD 1982). In some studies, however, the monetary base is only marginally inferior to M_1 in stability terms, as for example in Fellner's study (1982) of the stability of the velocities of circulation of the two aggregates.

In contrast to these conclusions, Berkman (1980) in a wide-ranging study of the stability of all old and new monetary aggregates vis-à-vis nominal income found that there was little to choose between them, a result echoed for a smaller set of aggregates by Brittain (1981). However, Berkman did find that the specification of the new monetary aggregates should help the attainment of a target

[7] Despite the almost universal use of quarterly data for such studies, other elements of the estimating equations (such as the data period, the other included variables and the lag structure) have varied, explaining many of the apparent contradictions from these studies.

[8] Total Credit is broader than the bank credit aggregate that performed well in earlier studies, and is defined in Table 1.

level of nominal income because, as a set, such aggregates yielded more close-fitting results than did the old aggregates.

On the basis of this single criterion, therefore, it would appear that the US authorities should focus on a narrow monetary aggregate and/or a broad measure of Total Credit or private-sector debt. The performance of the intermediate aggregates is inferior, while that of the monetary base is highly volatile.

In the United Kingdom, in contrast to the large amount of money-demand evidence, few reduced-form studies linking nominal income to alternative monetary aggregates have been published and such evidence as is available exhibits certain inconsistencies. Artis and Nobay (1969) found that a broad definition of money outperformed narrow money as a determinant of nominal income (as did a measure of bank credit), although in all cases fiscal policy measures were considerably more significant. In a study of money multipliers alone, Goodhart and Crockett (1970) concluded that M_3 provided the best fit vis-à-vis nominal income, followed by M_2[9] and lastly M_1. This superiority of M_3 over M_1 was confirmed by Matthews (1978), who also found that the monetary base was the least significant determinant of nominal income amongst these aggregates. However, more recent studies (Friedman 1982c, OECD 1982) indicate the superiority of M_1 over M_3, although Friedman's results were very sensitive to the type of test undertaken. This conclusion in favour of a narrow monetary aggregate is consistent both with conventional wisdom from demand-for-money equations (Artis and Lewis 1981) and with the results reported in the next section. Finally, Darby and Lothian (1982) reject Sterling M_3 as a monetary target, because of the distortions in it that appeared towards the end of the 1970s, and note that the monetary base is now the most stable aggregate with respect to nominal income.

As with the United Kingdom, early econometric evidence for Germany showed little consistent pattern. Using data to the end of 1969, Willms (1972) found that M_1 and the monetary base were both

[9] M_2 was abandoned at the end of 1971. See also Table 4, Footnote 1.

superior to other targets including bank credit, bank lending rates and the liquidity ratio as determinants of fluctuations in nominal income. However, more recent work has suggested that M_1 is, in fact, an inferior target in this sense. In Willms' later study (1977) both M_2 and bank credit outperform M_1 and the monetary base, a result consistent with Brittain's conclusion (1981) that both the total stock of credit and broad money fit more closely in a regression equation for GNP than does M_1. Comparing M_1 and M_2 only, an OECD study (1982) confirmed the greater explanatory power of the broader aggregate. Both Forster (1981) and Islam (1982) conclude that the most stable link between nominal income and money exists when the Central Bank Money Stock is used, although in the Forster study M_3 (with a one-year lag) and in Islam's work two measures of credit also perform satisfactorily. Finally, and in contrast to some of these studies, Friedman (1982c) found that M_1 was, on balance, more stably related to nominal income than M_2, although a measure of total non-financial debt also performed well. It is apparent from these studies that the ranking of alternative targets of monetary policy is very sensitive to the data period and, in Friedman's (1982c) work, to the type of test undertaken; the former point was confirmed by Islam, who found that M_3 and the monetary base were also particularly sensitive to the choice of lag structure. Notwithstanding this, there has been growing evidence, in recent years at least, that the traditional monetary aggregates, such as M_1 and M_2, have been inferior targets in comparison to the Central Bank Money Stock and credit aggregates. The superiority of the Central Bank Money Stock is, in fact, now established in official monetary opinion. For example, "the main reason why the Central Bank Money Stock has proved useful as a target variable is that its relationship to the nominal gross national product is fairly stable over lengthy periods ... The Central Bank Money Stock also compares very favourably with other monetary aggregates in the usual econometric stability tests" (Schlesinger 1982).

There are relatively few studies for France on the comparative performance of the monetary aggregates in the determination of

nominal income. However, a recent study by the OECD (1982) found that neither M_1 nor M_2 were significant arguments in such equations. This result is broadly consistent with that of Dewald and Marchon (1978), who found that when exports were included in their reduced-form equation for nominal income, M_1 became insignificant. In contrast, earlier work (David 1972, 1975) indicated that the "masse monétaire" definition of the money supply (close to the conventional M_2 concept) was a significant determinant of industrial production in nominal terms, while both Melitz (1976) and Boughton (1979) found that the "masse monétaire" generated a more stable demand function for money than did M_1. The only tentative conclusions that may be drawn from these studies of France are, therefore, that a broad definition of money is likely to be more closely related to nominal income, although the overall rôle of monetary aggregates in such equations is very uncertain.

There is clear evidence of a significant rôle for M_1 in the determination of nominal income in Italy. While the OECD (1982) found little to choose between it and M_2, Brittain (1981) derived results showing that M_1 outperformed M_2, the monetary base and bank credit as arguments in a reduced-form equation. Dewald and Marchon (1978) confirmed the significance of M_1, although they also reported an alternative experiment using M_2 and found "a marginally improved fit but qualitatively the same results as with M_1" (page 205). Spinnelli and Verga (1982) obtained significant results for the monetary base in a reduced-form equation, although the degree of significance of this variable and its comparative performance vis-à-vis a measure of fiscal policy were very sensitive to the lag structure. Finally, Penati and Tullio (1982), in a paper focusing on the flow variable Total Domestic Credit (TDC), found that conventional aggregates, in particular M_2, were more closely related to nominal income than was TDC. On the basis of these tests, M_1 appears to be the best target aggregate, with M_2 and the monetary base only slightly inferior alternatives.

Overall, this survey of empirical evidence reveals little cross-country pattern of results. This is likely to reflect in part variations in

institutional structure (including the relative rôles of interest rates and quantitative controls in the operation of policy) and different definitions of the various monetary aggregates, themselves. Nonetheless, it is the objective of the next section to present results, however disparate, of similar empirical tests from these five countries on a consistent comparative basis. This both has information value in its own right, and may allow a judgement to be made of the consistency of some of the previously published work with the most recent experience.

III.
Reduced-form estimates

In this section, estimates of Equations (13) and (14) are discussed for the United States, the United Kingdom, Germany, France and Italy. Annual data are used for the tests over, where possible, a time-period stretching back to 1960.[10] The use of annual figures allows the identification of broad trends in the movements of nominal income and money, while, in addition, certain of the series used are not available in seasonally adjusted quarterly form. Most crucially, however, given that money supply targets are generally specified on an annual basis, the use of quarterly data may lead to wrong or inappropriate conclusions being drawn (Hamburger 1982). The possibility that monetary growth affects nominal income with a lag is tested for by the inclusion of the change in the money stock lagged by one and two years respectively in alternative estimating equations. In addition, the contemporaneous change in the money stock is included alongside this variable with a one-year lag in a separate set of equations. A dummy variable is included to capture

[10] For certain aggregates such long data runs are unavailable. The exact observation periods used are defined in the tables.

any effects on the nominal income/money (velocity) relationship of the introduction of money supply targets in each country. It is expected to have a positive sign, owing to the effect of targets on the rate of financial innovation in those monetary assets outside the target aggregate and to the attempt by economic agents to make more efficient use of existing monetary assets (Akhtar 1981). All equations are fitted in first difference form to minimise the existence of serial correlation of the residuals and multicollinearity. The use of first differences rather than percentage changes is one factor explaining the high R^2 in the results.

For each country, this section includes the best results obtained from various alternative equations for each aggregate. The significance of individual monetary variables is indicated by "t" statistics and "beta" coefficients, while the overall goodness of fit of each equation is indicated by the adjusted R^2 and the percentage standard error. All other results are reported in detail in the annex and the reader is referred to these for a fuller picture of the empirical tests.

For each country, in turn, the results are preceded by the description in tabular form of the various definitions of money used in this study. This provides information on the structure of the constituent financial assets and on the relationships between different aggregates in any one country. The section also includes a composite table for all countries of the coefficients of variation of the income velocity of alternative monetary and credit aggregates using actual and de-trended data (Table 3) and graphs of the velocity of each monetary and credit aggregate in the five countries under study. Each of the graphs is drawn on a semi-logarithmic scale.

A. United States

Eight aggregates were included in the reduced-form tests for the United States. These aggregates are defined in Table 1. Four conventional monetary aggregates are used (M_1, M_2, M_3 and Liquidity) corresponding to the new definitions of money introduced

Table 1

United States – Money supply definitions

Item	M_1	M_2	M_3	L[1]
Currency in circulation	X	X	X	X
Travellers' cheques of non-bank issuers	X	X	X	X
At commercial banks				
– Demand deposits (except those due to domestic banks, US Government, foreign banks and official institutions)	X	X	X	X
– NOW accounts	X	X	X	X
– ATS accounts	X	X	X	X
At thrift institutions				
– Demand deposits (at mutual savings banks)	X	X	X	X
– NOW accounts	X	X	X	X
– ATS accounts	X	X	X	X
– Credit union share draft balances	X	X	X	X
At commercial banks				
– Overnight RPs		X	X	X
– Small (<$100,000) time deposits		X	X	X
– Savings deposits		X	X	X
At thrift institutions				
– Savings deposits (at mutual savings banks and savings and loan associations)		X	X	X
– Small (<$100,000) time deposits		X	X	X
Other				
– Overnight Euro-dollar deposits of US non-bank residents at Caribbean branches of member banks		X	X	X
– Money-market mutual fund shares		X	X	X
At commercial banks				
– Large (≥$100,000) time deposits, including large negotiable CDs			X	X
– Term RPs			X	X
At thrift institutions				
– Large (≥$100,000) time deposits			X	X
– Term RPs at savings and loan associations			X	X
Term Euro-dollars held by non-bank US residents at Caribbean branches of member banks				X
Bankers' acceptances				X
Commercial paper				X
Treasury bills and other liquid Treasury securities				X
US savings bonds				X
Consolidation component[2]		X	X	X

Bank credit (BC) = Loans and investments of commercial banks.
Total Credit (TC) = Total credit-market debt owed by non-financial, domestic sectors.
Debt Proxy (DP) = Total of credit-market instruments, deposits and currency held by private, non-financial, domestic sectors.
Monetary base (MB) = Currency held outside the Treasury, Federal Reserve banks and the vaults of depository institutions.
+ Reserve balances at Federal Reserve banks (current).
+ Vault cash used to satisfy reserve requirements at all depository institutions (held 2 weeks earlier).
+ Surplus vault cash at depository institutions.

[1] Liquid assets. [2] Consolidation component: less cash items in the process of collection, interbank deposits, the Federal Reserve float and estimated proportion of demand deposits used by thrift institutions to service their chequable deposits.

by the Federal Reserve Board in early 1980 (Simpson 1980).[11] Essentially, the new definitions take into account recent financial developments, including the introduction of new monetary assets, in particular certain categories of interest-bearing transactions balances, and the changing characteristics of standard monetary and non-monetary assets. Therefore, new M_1 includes, in addition to the components of the previous M_1 definition, such interest-bearing assets as negotiable order of withdrawal (NOW) accounts, automatic transfer system (ATS) accounts and credit union share drafts. In addition, the group of institutions whose liabilities are included in this narrow definition of money was extended to include all depository institutions, not simply commercial banks. The new definition of M_2 – closest, if anything, to the old M_3 concept – adds to M_1 savings deposits and small time deposits at all depository institutions, overnight repurchase agreements (RPs) at commercial banks, certain overnight Euro-dollar deposits held by residents and money-market mutual fund shares. M_3 is only slightly greater than M_2 in quantitative terms, as it simply adds large time deposits and term RPs to the M_2 definition. Finally, the broadest new concept (Liquidity) is intended to answer the criticism that no official US aggregate includes near-money liquid assets. In specifying Liquidity to include M_3, term Euro-dollars held by US residents, bankers' acceptances, commercial paper, savings bonds and liquid Treasury securities (including short-term bills), this definition of money is much wider than any concept based exclusively on the balance sheets of banks and other financial institutions.

Three concepts of credit were included in the tests, all of which, unlike the components of the traditional money supply definitions, are measured from the assets side. Bank credit (BC) is defined as the loans and investments of commercial banks, while Total Credit (TC) is the total credit-market debt owed by non-financial domestic

[11] At that time two M_1 series were defined, namely M_{1A} which equalled the old M_1 definition (i.e. currency in circulation plus demand deposits at commercial banks, net of those demand deposits due to foreign commercial banks and official institutions) and M_{1B}. In December 1981 M_{1A} was discontinued and M_{1B} renamed M_1.

sectors, including the US Government. A third credit concept used is the total of credit-market instruments, deposits and currency held by private, domestic non-financial sectors and is known as the Debt Proxy (DP).[12] Finally, the monetary base (MB), defined as currency held by the non-bank private sector, reserve balances of Federal Reserve banks and vault cash, is included in the tests.

Table 2 presents the "best" estimates for each monetary aggregate, drawn from the basic equations:

$$\Delta Y_t = \alpha_o + \alpha_1 \Delta M_t + \alpha_2 \Delta (X+G)_t \quad (17)$$

$$\Delta Y_t = \beta_o + \beta_1 \Delta M_t + \beta_2 \Delta X_t + \beta_3 \Delta (G-T)_t \quad (18)$$

and their variations. In this and succeeding tables, t-statistics are shown in parentheses, while the second part of each table includes the associated "beta" coefficients. For all the US aggregates, the equations including exports plus government spending as the autonomous variable (that is, those based on Equation (17) rather than (18)) provided more satisfactory results. The explanatory power of the "best" equations was raised by the inclusion of both contemporaneous changes in the money stock and those with a one-period lag. In addition, the dummy variables for the introduction of monetary targets in 1975, although only significant in the M_1 and monetary base equations, add to the overall explanatory power in the equations for M_3, bank credit and the Debt Proxy also.

The lag structure of the reduced-form results suggests that the traditional monetary aggregates have their greatest impact on nominal income with a lag of one year. The contemporaneous coefficient in the Liquidity equation is significant but, as in the equations for M_1, M_2 and M_3, the main impact of the change in Liquidity occurs after one year.

Similarly, the effect of a change in the monetary base on nominal income is negative in the current year with a positive and significant

[12] This concept is included in Friedman's work (1981a, b, 1982a) under the heading of Total Net Assets or Net Financial Assets. As the Debt Proxy, it has been widely canvassed as an aggregate for targeting purposes, most notably by Henry Kaufman of Salomon Brothers of New York.

Table 2

Reduced-form estimates for each monetary aggregate – United States.[1]

Monetary variable	ΔM_t	ΔM_{t-1}	$\Delta M_t xD^*$	$\Delta M_{t-1} xD^*$	$\Delta(X+G)$	$\bar{R}^2$	% S.E.[+]	D.W.
M_1	2.319 (2.62)	4.264 (3.75)		0.172 (2.83)	0.572 (2.22)	0.949	14.96	1.124
M_2	0.251 (1.30)	1.016 (4.72)			0.990 (4.04)	0.935	17.03	2.300
M_3	0.236 (1.43)	1.059 (5.31)		0.022 (1.34)	0.257 (0.96)	0.955	14.01	1.665
L	0.370 (2.15)	1.071 (4.30)			−0.794 (−2.75)	0.974	10.75	2.128
Bank credit	1.381 (3.57)	−0.430 (−0.45)	0.112 (1.68)	0.103 (1.27)	1.512 (1.29)	0.812	29.08	1.675
Total Credit	0.628 (4.35)	0.057 (0.24)			−0.073 (−0.18)	0.977	9.78	2.323
Debt Proxy	0.853 (4.41)	0.190 (0.72)		0.085 (1.33)	−0.406 (−1.14)	0.951	14.38	1.662
MB	−1.255 (−0.48)	22.953 (7.53)	−0.576 (−2.91)	0.401 (2.07)	−0.012 (−0.03)	0.949	15.93	0.939

[1] Time periods: for M_1, Total Credit and Debt Proxy regressions 1961–80,
for all other regressions 1961–81.

[*] D=0 up to 1974.
D=1 from 1975 onwards.

[+] Standard error divided by the mean of the dependent variable.

Beta coefficients[1]

	Monetary aggregate			Autonomous expenditure
	t	t−1	sum	
M_1	0.258	0.462	0.720	0.218
M_2	0.145	0.539	0.684	0.339
M_3	0.177	0.710	0.887	0.088
L	0.345	0.908	1.253	−0.272
Bank credit	0.610	−0.194	0.416	0.517
Total Credit	0.955	−0.083	0.872	−0.028
Debt Proxy	0.880	0.195	1.075	−0.155
MB	−0.052	0.988	0.936	−0.004

[1] By converting the absolute values of the regression coefficients into relative form, beta coefficients indicate the relative importance of each variable in the overall regression.

impact coming through after a twelve-month period. In contrast, the three credit/debt aggregates exhibit a powerful current-period effect on nominal income which falls to zero after one year. This difference in lag structure for the monetary and credit aggregates may suggest that credit is demand-determined, while the monetary aggregates are under the control of the authorities and so affect nominal income with the lag associated with the monetarist view. If so, the monetary aggregates are better suited to the rôle of target aggregates, whereas the credit equations are misspecified and subject to simultaneous equations bias.

In general, the explanatory power of the autonomous expenditure variables in these equations is very limited. When included separately, the export variable was frequently insignificant, while the government's financial deficit often had a theoretically unsatisfactory positive sign. In addition, the coefficient on the combined exports and government spending variable is positive and significant in the M_1 and M_2 equations alone, while in the equations for Liquidity, Total Credit, the Debt Proxy and the monetary base it appears with a negative sign. The clear implication of these results is that autonomous expenditure has played a much less dominant rôle in the determination of fluctuations in nominal income than have monetary variables, a conclusion consistent with much of the evidence from US reduced-form studies of this type published in the last twenty years.

It is apparent from Table 2 that the broadest aggregates, in particular Total Credit and Liquidity, were most closely related to nominal income over the observation period. However, of the two, Liquidity would seem to be the optimal choice for targeting purposes owing to the well-determined lag structure in that equation and the uncertainty over the endogeneity of the credit measures noted above.

All the remaining aggregates, with the exception of the bank credit variable, perform in fairly similar fashion vis-à-vis nominal income. Of these, M_3 is marginally the most significant (its explanatory power is, in fact, similar to that of the Debt Proxy),

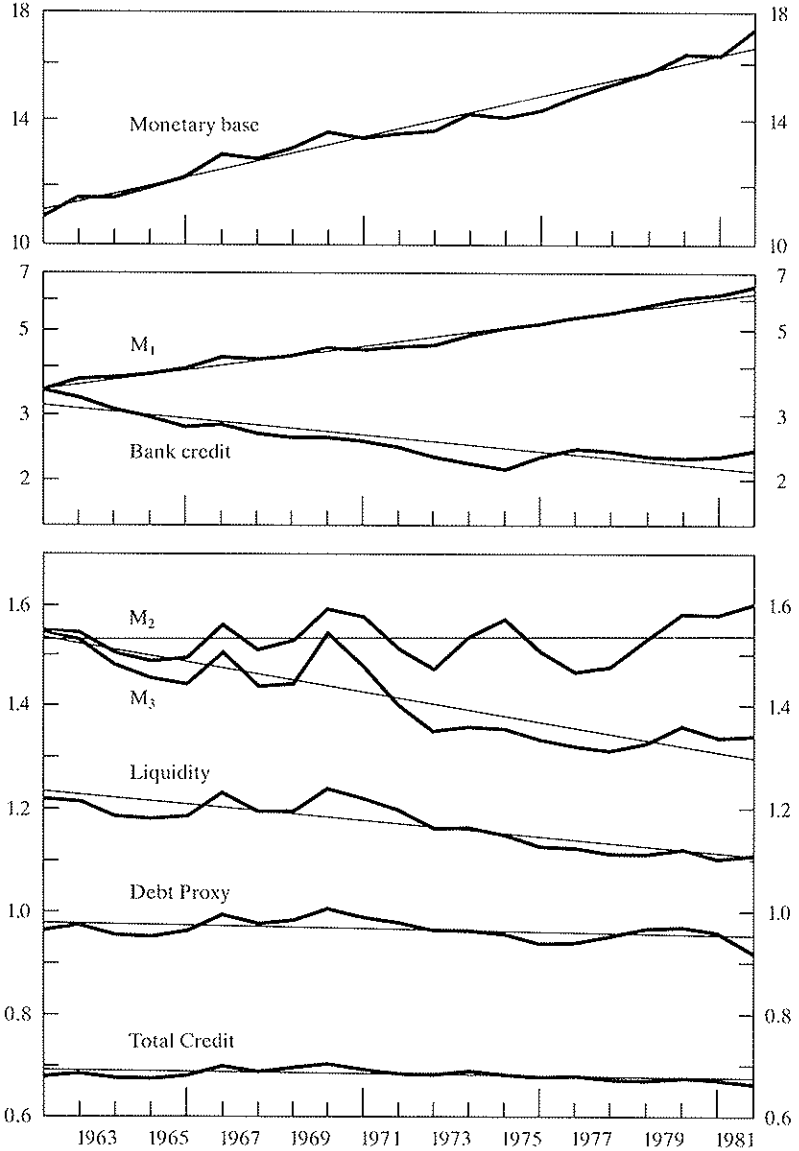
followed by M_1 and then the monetary base. However, the equations for the latter two definitions of money are adversely affected by evidence of autocorrelation of the residuals. M_2 is slightly less significant than these other conventional monetary aggregates. Finally, the least significant aggregate is bank credit, which, when coupled with doubts over its joint dependence with nominal income, indicates that this aggregate is not suitable as a monetary target in the United States. In no way, however, is the least significant of these aggregates inferior in anything other than relative terms. All aggregates are highly significant and the results provide powerful support for the rôle of monetary variables in the determination of nominal income.

The introduction of dummy variables provides mixed evidence of a shift in velocity in response to the introduction of money supply targets. While that on M_1 is significant, the evidence from the monetary base equation is for an upward movement in velocity after one year to offset a reduction in the current period. The dummy variables in all other equations are insignificant.

However, by referring to the graphs, a slightly different interpretation of the post-1975 period may be proposed. These graphs provide some visual support for the possibility that the velocity of M_1, bank credit and the monetary base increased significantly after 1975 (Ott 1982). This is confirmed by the positive significance of a dummy variable in velocity equations for M_1 and bank credit, in which a time-trend is included.[13] In addition, in velocity equations for Liquidity, Total Credit and the Debt Proxy this dummy variable is negative and significant, indicating

[13] In switching from a reduced-form equation for nominal income as in Table 2 to a velocity function, the autonomous expenditure variable is ignored and a unit coefficient is effectively imposed on the monetary aggregates in the reduced-form equations. In the US equations, few differences will exist between the reduced-form estimates and those derived from the velocity equations due to the minor rôle of autonomous expenditure in the reduced-form results. However, for countries where autonomous expenditure is more significant, more substantial differences will emerge.

United States: Income velocity



downward shifts in the velocity of these aggregates in the period following the introduction of money supply targets. Given that the aggregates chosen by the US authorities for targeting purposes at this time were M_1 and M_2, these results support the view that higher velocity has offset, in part, the tight control of the target aggregates, allowing nominal income to grow faster than predicted on the basis of the velocity trends up to 1975. In addition, the fall in the velocity of circulation of the wider aggregates provides tentative evidence in favour of "Goodhart's Law", that growth of the target aggregates is distorted and that of broader concepts of money is artificially raised as a result of the adherence to a restrictive target path for narrow money (Akhtar 1981).

Table 3
Coefficients of variation of income velocity of alternative aggregates

	USA	UK	Germany	France	Italy
Actual data					
M_1	19.604	15.546	4.871	13.450	16.584
M_2	2.648		7.571	11.088	11.800
M_3	5.588	9.524[1]	10.925	10.061	13.240
Liquidity	3.478	10.429[2]			
		9.649[3]			
Credit 1	14.959[4]		13.017[5]	30.327[6]	5.126[4]
Credit 2	1.406[7]		15.648[8]	31.465[9]	8.456[10]
Debt Proxy	1.757				
Monetary base	13.276	22.641			5.847
CBMS			2.425		
De-trended data					
M_1	3.174	3.591	4.833	5.061	8.662
M_2	2.539		3.725	3.701	5.045
M_3	2.601	7.360[1]	3.333	2.657	3.576
Liquidity	1.863	7.046[2]			
		7.170[3]			
Credit 1	7.352[4]		3.607[5]	12.537[6]	3.315[4]
Credit 2	1.247[7]		3.292[8]	13.409[9]	5.718[10]
Debt Proxy	1.640				
Monetary base	2.086	6.058			5.845
CBMS			2.362		

[1] Sterling M_3. [2] PSL_1. [3] PSL_2. [4] Bank credit. [5] Bank credit (including securities) to domestic enterprises and individuals. [6] Concours à l'économie (inscrit dans les contreparties de M_3). [7] Total Credit. [8] Bank credit (including securities) to domestic non-banks. [9] Concours à l'économie de caractère bancaire. [10] Stock concept derived from Total Domestic Credit flow.

More generally, the graphs illustrate the considerable stability of velocity relationships over the long period for all US aggregates. In particular, the minor variations in the velocities of Liquidity, Total Credit and Debt Proxy are remarkable, with coefficients of variation for de-trended data lying between 1.2 and 1.9 for these aggregates (Table 3). These results strengthen the preference, on this stability criterion, for the use of one of these aggregates as the monetary target in the United States.

B. United Kingdom

For the United Kingdom, five monetary aggregates were included in the various tests, namely M_1, Sterling M_3 (£M_3), PSL_1, PSL_2 and the monetary base (MB). In addition, two other variables – DCE and bank credit to the private sector (which are published in flow form and so did not need to be first-differenced) – were included in tests of Equations (17) and (18). The definitions of these concepts of money and credit are set out in Table 4 (see also Bank of England 1982).

In addition to a dummy variable to allow for any shift in the money/income relationship following the introduction of money supply targets at the end of 1976, a further possible structural shift in the relationship was investigated. The reform of the control arrangements in the UK monetary system (Competition and Credit Control – CCC) in 1971 is generally believed, alongside the desire of the government of that time to expand the growth rate of the British economy, to have led to the observed rapid expansion of the money supply in 1972–74. A dramatic fall in the income velocity of, in particular, M_3[14] and the collapse in the predictability of money demand equations followed (e.g. Haache 1974, Artis and Lewis 1976). Therefore, the effects of Competition and Credit Control on

[14] Sterling M_3 was introduced in 1976. The difference between the two series is the exclusion from Sterling M_3 of foreign currency deposits held by residents. Quantitatively the series are very similar, with the average discrepancy being around 10 per cent.

Table 4

United Kingdom – Money supply definitions[1]

Item	M_1	£M_3	M_3	"Money"	PSL_1	PSL_2	MB
Currency held by the non-bank public	X	X	X	X	X	X	X
In the banking sector[2]							
Non-interest-bearing sterling sight deposits of the private sector[3]	X	X	X	X	X	X	
Interest-bearing sterling sight deposits of the private sector	X	X	X	X	X	X	
Sterling time deposits of the private sector[4]		X	X				
Sterling deposits of the public sector[4]		X	X				
Foreign currency deposits of UK residents			X				
Sterling time deposits of the private sector with less than two years to maturity[4]				X	X	X	
Treasury bills held by the private sector					X	X	
Bank bills held by the private sector					X	X	
Deposits of private sector at local authorities					X	X	
Deposits of private sector at finance houses					X	X	
Certificates of tax deposit held by private sector					X	X	
Less:							
Holdings of money-market instruments of finance houses					X	X	
Holdings of money of finance houses					X	X	
Private-sector assets							
Shares and deposits at building societies[5]						X	
Deposits at trustee savings banks						X	
Deposits at National Savings Banks						X	
National savings securities						X	
Less:							
Savings institutions' holdings of money and other money-market instruments						X	
Building societies' deposits with other savings institutions						X	
Building societies' holdings of CDs						X	
Currency held by banks							X
Balances of banks at Bank of England							X

Credit = Sterling lending to the United Kingdom private sector by UK banks.
DCE = Increase in Sterling M_3 adjusted for external and foreign currency flows and the increase in non-deposit liabilities. (Or bank and overseas lending to the public sector plus sterling bank lending to the private and overseas sector plus increases in the public's holdings of notes and coin.)

[1] A new concept of the money supply labelled M_2 (the original M_2 definition was abandoned at the end of 1971) was introduced in 1982 adding private-sector interest-bearing deposits to the non-interest-bearing component of M_1. Currently, the series for M_2 goes back to November 1981 only. [2] The banking sector comprises all recognised banks and licensed deposit-takers (LDTs), the national girobank, listed banks in the Channel Islands and Isle of Man which have opted to comply with the new monetary control arrangements, the trustee savings banks and the banking department of the Bank of England. [3] 60 per cent. of net (sterling) transit items deducted from non-interest-bearing deposits. [4] Including CDs. [5] Excluding S.A.Y.E. deposits and term shares of over one year to maturity.

the income/money relationship were tested for in this study by the inclusion of a second shift dummy.

The results of the UK reduced-form tests are set out in Table 5. The specification of autonomous expenditure as exports plus government spending performed better for all concepts of the money stock, although in the DCE and credit equations the alternative specification of separate estimation of exports and the Public Sector Borrowing Requirement (PSBR)[15] produced better results.

The CCC dummy is significant in all equations except that for credit. The negative coefficient on the dummy variable indicates that there was a fall in the velocity of circulation for all concepts of money between 1972 and 1974, especially for Sterling M_3 and PSL_1, a result that is apparent from the velocity graph. However, the rebound of velocity after 1974 was sharp. Given, therefore, that velocity was on an exaggerated upward trend in the immediate aftermath of the monetary explosion of 1972–74, it is not unexpected that the dummy variable for the introduction of monetary targets in 1976 performs much less well. For all the broad aggregates, the growth of velocity slackened after 1976 as the long-term trends were re-established. A different interpretation may be possible, however, for M_1. The significantly negative dummy variable in the M_1 equation suggests a new fall in the velocity of narrow money following the introduction of a Sterling M_3 target in 1976. If this monetary target was successful in restricting the rate of growth of nominal income after 1976, the evidence that the velocity of M_1 fell in this period leads one to conclude that the growth of the non-targeted narrow money outstripped that of Sterling M_3 after 1976.

According to the results in Table 5, changes in the money stock have their major effects on nominal income within the current period (none of the lagged money stock or credit concepts contributed significantly to fluctuations in nominal income).

[15] As a positive PSBR indicates a public-sector deficit, the expected sign on this variable is positive.

Table 5

Reduced-form estimates for each monetary aggregate – United Kingdom.[1]

Monetary variable	ΔM	ΔMxD1*	ΔMxD2*	ΔX	ΔPSBR	Δ(X+G)	$\bar{R}^2$	% S.E.	D.W.
M_1	2.622 (14.77)	−0.716 (−2.03)	−0.116 (−3.09)			1.218 (29.78)	0.992	7.09	2.597
£M_3	1.318 (2.84)	−0.823 (−2.24)				1.121 (4.91)	0.923	23.28	1.327
PSL_1	1.067 (2.47)	−0.721 (−2.08)				1.209 (5.30)	0.919	24.25	1.402
PSL_2	0.940 (5.36)	−0.480 (−3.14)				0.943 (6.01)	0.957	16.74	1.351
Credit	0.569 (1.73)	−0.594 (−1.49)		2.663 (6.43)	1.414 (3.51)		0.873	31.55	2.585
DCE	1.039 (2.57)	−0.909 (−2.48)	−0.346 (−1.10)	2.264 (5.73)	1.019 (2.63)		0.904	26.62	2.569
MB	9.845 (8.08)	−4.093 (−2.69)	−0.174 (−1.07)			0.993 (9.72)	0.979	13.06	2.156

[1] Observation periods: MB 1962–80.
All other aggregates 1964–80.

* D1=CCC dummy variable.
D2=Monetary targets dummy variable.

Beta coefficients

	Monetary aggregate	Autonomous expenditure
M_1	0.397	0.729
£M_3	0.403	0.673
PSL_1	0.356	0.724
PSL_2	0.459	0.565
Credit	0.250	1.055
DCE	0.560	0.844
MB	0.465	0.591

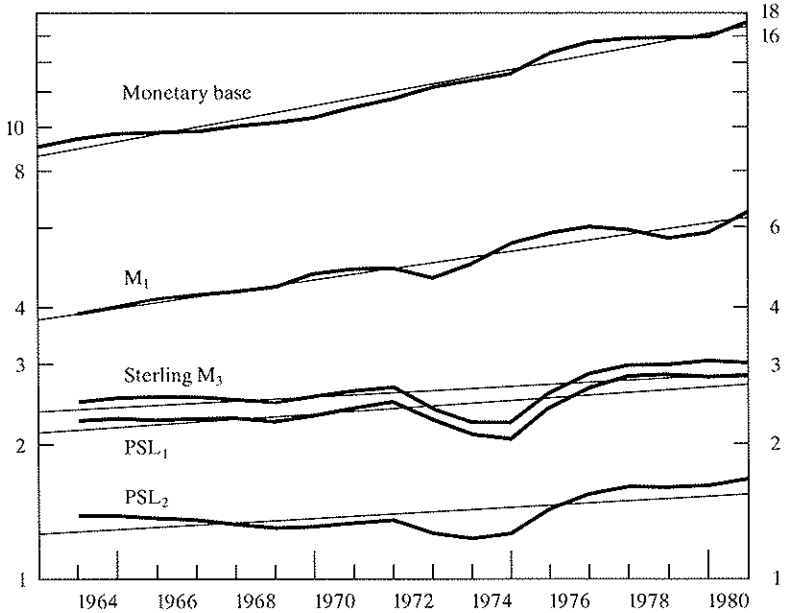
Therefore, the conclusions on the rankings of these monetary aggregates as targets are drawn purely from contemporaneous results. The most significant monetary aggregates vis-à-vis nominal income are M_1 and the monetary base. M_1 also has a much lower coefficient of variation of velocity, using de-trended data, than any other aggregate. Of the broader aggregates, PSL_2 is the most closely related to nominal income, followed by Sterling M_3 and PSL_1.

Finally, despite carrying a high beta coefficient, DCE performs relatively poorly as a determinant of fluctuations in nominal income. The explanatory power of the DCE equation is low relative to those for the conventional monetary aggregates, while that of bank credit is worse still, indicating that, as in the US case, bank credit is an inappropriate target for monetary policy in the United Kingdom. These poor results for DCE and credit may be explained by these flows effectively being residuals, given targets for Sterling M_3 and the PSBR, so that a reduced-form equation is unlikely to yield significant results in these cases.

Two other points should be noted from the results. Firstly, the explanatory power of autonomous expenditure relative to money is much higher in these equations than in the US results. For all equations, the significance of the spending variable(s) is greater than that of the monetary aggregate. In addition, the high t-statistic on exports when the variable appears separately in the credit and DCE equations confirms the expected rôle of this variable in the determination of nominal income in an open economy such as the United Kingdom. The magnitudes of these coefficients are generally in line with the expected size of the multipliers, with that on exports plus government spending (taxation being endogenous) being greater than one, and with that on exports, when the PSBR is included with taxes exogenous, being greater than two. On this basis, additional support is given to the M_1 equation and also to the equations for credit and DCE in which autonomous expenditure clearly dominates the monetary variables. Secondly, there is a suggestion of autocorrelation in the residuals in all the equations in Table 4, except that for the monetary base, suggesting that the basic equation may require some respecification.

The conclusions of these reduced-form tests on UK data may be summarised. Firstly, on the basis of the estimated influence of money on income, the monetary authorities should target, as a first choice, M_1, with the monetary base being only slightly inferior. This broad conclusion is consistent with other recent studies for the United Kingdom, in particular those of Friedman (1982c), the

United Kingdom: Income velocity



OECD (1982) and Darby and Lothian (1982), and also with demand-for-money evidence. However, in assessing the relationship between M_1 and nominal income, it should be noted that, in the UK system, M_1 is typically assumed to be demand-determined, so that, in terms of the ability of the authorities to control this variable, it may be a less satisfactory target aggregate than the monetary base. As another alternative, the authorities might move to the other end of the liquidity spectrum and adopt the broadest available aggregate, in this case PSL_2, as the target. The intermediate aggregates (Sterling M_3 and PSL_1) do not recommend themselves, while both DCE and bank credit appear to be poor targets. Secondly, the velocity of circulation of all aggregates shifted downwards in the wake of CCC. Thirdly, apart from M_1, the velocity of which was influenced both by CCC and by the introduction of money supply

targets, the effects on the income/money supply relationship of the adoption of Sterling M_3 as a target in 1976 were not apparent, although they were probably concealed by the adjustment phase following the end of the monetary explosion in 1974.

C. Germany

For Germany, six monetary and credit aggregates were included in the empirical tests. Their definitions are set out in Table 6. Three conventional monetary aggregates (M_1, M_2 and M_3) were used and two concepts of credit. The narrower credit aggregate includes all credit extended by the banking system to domestic individuals and enterprises, while the broader aggregate includes, in addition, credit extended to public authorities. These two concepts are referred to as Credit 1 and Credit 2 respectively. The Central Bank Money Stock (CBMS), which is used by the Bundesbank as its monetary target, includes currency held by domestic non-banks and required minimum reserves on domestic bank liabilities adjusted for changes in reserve requirements since January 1974. Specified in this form, CBMS closely resembles in concept the broad money stock (M_3). In particular, the CBMS includes reserves held against all types of banks' domestic liabilities according to a weighting scheme determined by the reserve ratios operating in 1974. Although M_3 includes these same component liabilities with unit weights, the result is that M_3 and the CBMS, although greatly different in magnitude, grow at similar rates. Further, this resemblance between M_3 and CBMS should reduce the tendency to compare the CBMS, in conceptual terms, with the monetary base (MB). In quantitative terms, the MB and CBMS are similar, as the former simply adds free liquid reserves (which are usually low in Germany) to the CBMS. However, conceptually the two aggregates are very different, as the MB is a reflection of the original stimulus of policy while the CBMS represents money creation that has already occurred. As a result, like the conventional monetary aggregates, it is an "intermediate" monetary variable (see Bockelmann 1979, Schlesinger 1982). Owing

Table 6
Germany – Money supply definitions[1]

Item	M_1	M_2	M_3	CBMS
Currency held outside banks[2,3]	X	X	X	X
At banks				
Sight deposits and deposits up to one month's maturity of non-bank residents and public authorities	X	X	X	
At central banks				
Sight deposits and deposits up to one month's maturity of non-bank residents	X	X	X	
At banks				
Time deposits of between one month and four years to maturity of non-bank residents		X	X	
At banks				
Savings deposits of resident individuals at statutory notice			X	
Minimum reserves on domestic liabilities[4]				X

Credit 1: Total credit extended by the banking system to domestic enterprises and individuals (including securities).
Credit 2: Total credit extended by the banking system to all domestic non-banks including public authorities (including securities).

[1] In domestic and foreign currency. [2] Banks includes commercial banks, central giro institutions, savings banks, central institutions of credit co-operatives, credit co-operatives, mortgage banks, instalment sales financial institutions, banks with special functions, postal giro and postal savings bank offices. This is the banking sector. [3] Including currency held abroad. [4] Adjusted from January 1974 base for reserve requirement changes.

to the shortness of the available data period and its limited rôle in German monetary policy, the monetary base is excluded from these tests.

The best estimates for each aggregate are set out in Table 7. For all aggregates, the exports plus government spending specification of autonomous expenditure provided the best results. Exports were typically positively-signed and significant when included individually but the government's financial deficit was always insignificantly different from zero in the reduced-form equations. Exports plus government spending were a significant determinant of fluctuations in nominal income for all aggregates except for the two concepts of credit, although the positive sign was retained in both these cases.

The inclusion of a dummy variable for the introduction of money supply targets in 1975 was generally unsuccessful. There was little

Table 7

Reduced-form estimates for each monetary aggregate – Germany[1]

Monetary variable	ΔM_t	ΔM_{t-1}	$\Delta M_t xD^*$	$\Delta(X+G)$	$\bar{R}^2$	% S.E.	D.W.
M_1	1.579 (2.38)	2.007 (2.24)		0.774 (3.88)	0.748	24.647	1.029
M_2	1.578 (4.95)		0.128 (2.19)	0.822 (4.20)	0.734	26.860	1.608
M_3	0.389 (0.97)	1.003 (2.02)		0.523 (2.26)	0.724	25.368	1.321
CBMS	6.562 (8.04)			0.608 (3.94)	0.820	19.960	1.428
Credit 1	1.023 (7.01)			0.283 (1.30)	0.822	22.171	1.269
Credit 2	0.741 (6.80)			0.377 (1.78)	0.809	22.662	0.933

[1] Time periods: 1962–80 except M1: 1963–80

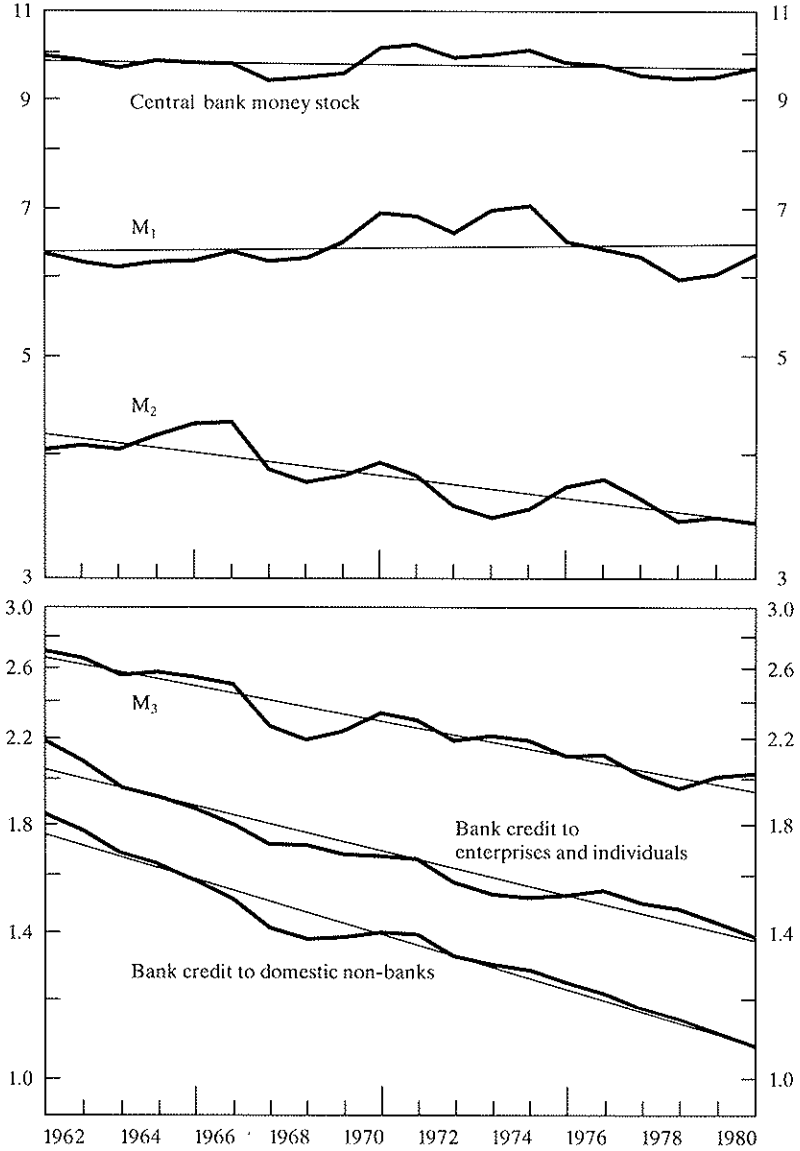
* D=0 up to 1974
D=1 1975 onwards.

Beta coefficients[1]

	Monetary aggregate			Autonomous expenditure
	t	t−1	sum	
M_1	0.344	0.438	0.782	0.556
M_2	0.680			0.585
M_3	0.203	0.531	0.734	0.372
CBMS	0.661			0.432
Credit 1	0.941			0.201
Credit 2	0.882			0.268

pattern to the coefficients on the dummy variable across the aggregates and it appeared in the best equation for M_2 alone, which is not the target aggregate in Germany. The upward shift in the velocity of M_2 in 1975 indicated by this result is shown in the graph. However, the result may be partly coincidental, given that this shift followed a sharp fall in velocity between 1970 and 1973 and may therefore have been part of a normal cyclical correction in velocity rather than a result of the introduction of targets per se. According to the graph, the velocity of the Central Bank Money Stock, far from

Germany: Income velocity



increasing after the adoption of monetary targets, actually fell between 1975 and 1979. It may be concluded, tentatively, therefore that fluctuations in the money/income relationship for alternative aggregates in Germany were not influenced in a predictable way by the introduction of money supply targets and on the contrary were affected by other exogenous factors.

The explanatory power of the M_1 and M_3 equations was raised by the inclusion of both contemporaneous and one-year lagged changes. M_3 has its main impact on nominal income after a twelve-month period, while that of M_1 is spread relatively equally over the current period and one year ahead. Reference to the results contained in the annex confirms that for all other aggregates a significant positive impact on nominal income is recorded in the current period, with the effect in the succeeding period being statistically insignificant or, in the case of the second credit definition, negative, to offset in part the expansionary contemporaneous influence. For these other aggregates, therefore, the best estimates included current changes in the monetary aggregates only.

With such diverse results on the effect of the dummy variable and the lag structure, the procedure of ranking the aggregates in terms of their influence on nominal income is complicated. In addition, there is tentative evidence of misspecification in the low Durbin-Watson statistics and the coefficients of less than unity on autonomous expenditure. The most significant aggregate (in terms of a t-statistic) and the equation with the lowest percentage standard error is the Central Bank Money Stock. Moreover, it has the lowest recorded variability of velocity in terms of both actual and de-trended data. However, the two credit measures also perform well and dominate autonomous expenditure in the determination of nominal income to a greater extent than does the Central Bank Money Stock. Once the trend is removed, the variability of M_3 velocity is lower than that of M_2 and much below that of M_1 although, in terms of significance in Table 7, these conventional monetary aggregates perform in a very similar fashion.

Taking into account the time-lag before changes in M_3 and, to a lesser extent, M_1 influence nominal income, it seems that the most appropriate aggregate for targeting purposes is the Central Bank Money Stock followed by Credit 1, Credit 2 and finally the conventional monetary aggregates. This finding is consistent both with the current design of German monetary policy and with other recent evidence of this type for Germany.

D. France

Five monetary and credit aggregates were included in the reduced-form tests for France and they are defined in Table 8. Three conventional money supply concepts are officially defined in France, namely M_1 (Disponibilités Monétaires), M_2 (Masse Monétaire) and M_3 (Ensemble des Liquidités). These are augmented in this study by two measures of credit. Credit 1 is the asset counterpart of the M_2

Table 8

France – Money supply definitions[1]

Item	M_1	M_2	M_3
Currency held outside the banks[2]	X	X	X
At banks, postal cheque offices and "public accountants"			
Sight deposits of enterprises and individuals (resident and non-resident), including local government, but excluding central government	X	X	X
At banks			
Passbook deposits of individuals		X	X
Savings deposits for housing loans of resident individuals		X	X
Time deposits[3]		X	X
Cash certificates issued by banks[4]		X	X
Passbook deposits and savings deposits for housing loans of individuals at savings banks			X[5]
Two and five-year bonds issued by regional savings and provident funds and held by individuals and enterprises			X[5]
Treasury certificates held by individuals and enterprises			X[5]
Government bills issued by auction and held on current account by certain non-bank institutions			X[5]

Credit 1 = Concours à l'économie (Contreparties de la Masse Monétaire – M_2).
Credit 2 = Concours à l'économie de caractère bancaire.

[1] Domestic and foreign currency. [2] Excluding notes (not coin) held by banking system. [3] And with "public accountants". [4] Except those issued by the National Agricultural Credit Bank and taken up by regional agricultural credit banks. [5] In French francs only.

concept of money and is officially labelled concours à l'économie. It includes credit to non-residents as well as to the domestic economy. The second definition of credit – concours à l'économie de caractère bancaire – adds the asset counterpart of all non-monetary liabilities of French banks (Ressources non-monétaires) to the Credit 1 concept. The best results for each aggregate are set out in Table 9.

For each aggregate in Table 9, the equation including exports plus government spending as the autonomous expenditure variable is preferred owing to the significance of the coefficients on this variable and the better overall fit that is obtained. Also for all equations, except those for M_2 and M_3, the coefficient on the exports plus government expenditure variable is greater than one, as would

Table 9

Reduced-form estimates for each monetary aggregate – France[1]

Monetary variable	ΔM_t	ΔM_{t-1}	$\Delta M_t xD^*$	$\Delta M_{t-1} xD^*$	$\Delta(X+G)$	$\bar{R}^2$	% S.E.	D.W.
M_1	1.314 (3.29)	1.009 (2.32)		0.086 (2.13)	1.214 (5.73)	0.967	12.358	1.934
M_2	0.645 (2.35)	0.825 (3.00)		0.035 (2.26)	0.711 (3.34)	0.981	9.484	1.906
M_3	0.279 (1.77)	0.911 (4.91)	−0.032 (−3.01)	0.137 (1.60)	0.527 (3.00)	0.989	7.400	2.289
Credit 1	0.605 (1.08)	0.492 (1.18)		0.057 (1.42)	1.170 (2.63)	0.944	16.514	2.246
Credit 2	0.472 (1.35)	0.441 (1.38)			1.144 (2.79)	0.938	17.381	1.848

[1] Observation period: 1963–80.

* D=0 up to 1976
D=1 from 1977 onwards.

Beta coefficients

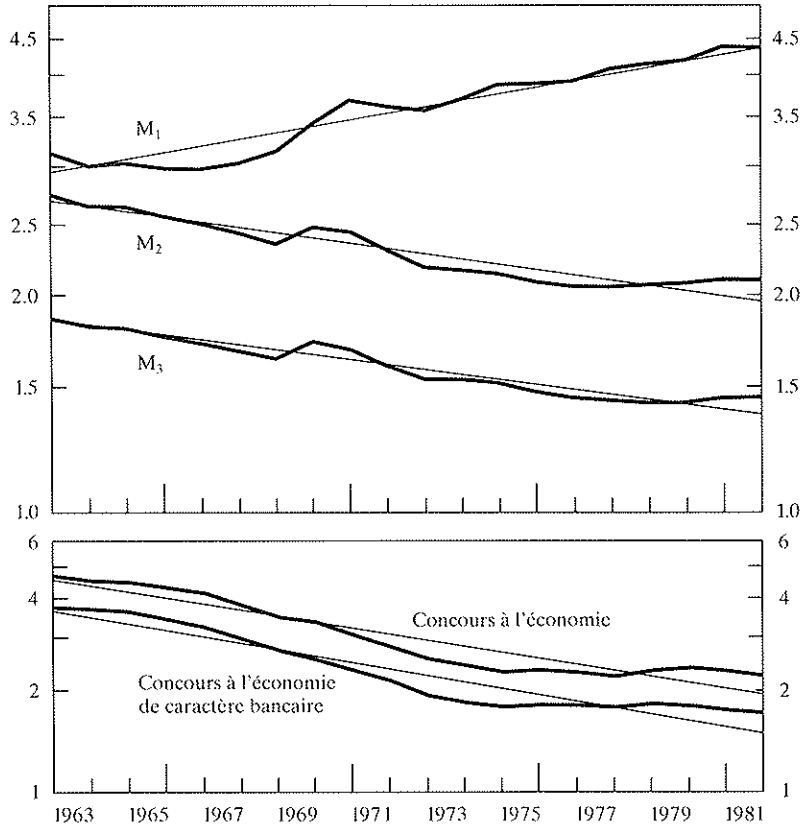
	Monetary aggregate			Autonomous expenditure
	t	t−1	sum	
M_1	0.257	0.191	0.448	0.542
M_2	0.305	0.368	0.673	0.317
M_3	0.200	0.622	0.822	0.235
Credit 1	0.281	0.193	0.474	0.522
Credit 2	0.291	0.230	0.521	0.510

be expected on a priori grounds. Unlike some other countries in this study, however, the specification including exports and the fiscal deficit of the government separately was only marginally inferior, in that exports always entered with the expected positive sign (although only for M_1 was the variable consistently significant), while the fiscal deficit at least appeared with a negative sign almost throughout the tests, albeit without great significance.

Before the results for the monetary aggregates are discussed, certain features of the implementation of monetary policy in France should be noted. The French monetary system is subject to greater quantitative control than is the case in the other countries included in this study. In particular, the emphasis placed on credit ceilings as instruments of policy relative to market-orientated policies through interest rate fluctuations is considerable. As a result, it is to be expected that the reduced-form estimates for credit are much less significant than those for the monetary aggregates, one of which (M_2) is used as an intermediate target. These institutional differences therefore affect the interpretation of the results in Table 9, both absolutely and relative to those for other countries.

The inclusion of a dummy variable with a one-year lag to allow for any shift in the nominal income/money relationship following the introduction of monetary targets in 1976 led to an improvement in the overall significance of all equations except that for the broader definition of credit. There is clear evidence from the graph that the downward trend of the velocity of M_2 was broken around 1977 while the same result is apparent for M_3 velocity one year later. The velocity patterns of the two definitions of credit are very similar, although the more pronounced upward rebound of the velocity of Credit 1 in the late 1970s is likely to explain the appearance of a significant dummy variable in the equation for this credit concept only. For all these concepts of money and credit there was a general levelling-out of income velocities in the mid-1970s. In addition, for M_1 there was a notable change in 1977 from a gently rising velocity trend to a much sharper rate of increase which lasted until 1980. The structural break in the money/income relationships for France in

France: Income velocity



1976 appears, therefore, not to be limited to the target aggregate – Masse Monétaire (M_2) – but is considerably more wide-ranging. For all definitions of money, therefore, the impact of the introduction of targets was partly offset by some upward correction to velocity.

The explanatory power of the reduced-form equations was raised by the inclusion of both contemporaneous and one-year

lagged changes. Table 9 suggests that the broader monetary aggregates (M_2 and M_3) have their primary impact on nominal income with a twelve-month lag, while the main influence in the case of M_1 is concentrated in the current period. This may indicate that in France there is joint dependence between M_1 and income – a commonly held view in the case of narrow monetary aggregates in many countries – while in view of the institutional arrangements, it is more difficult to explain the relationship between the credit aggregates and income.

By all criteria, the monetary aggregate that is most closely related to nominal income in France is M_3, followed fairly closely by M_2. The beta coefficients (including the one-period lag) for these aggregates are much higher than those for the other aggregates, while the coefficients of variation from both actual and de-trended data indicate the same relative stability of M_2 and M_3 vis-à-vis nominal income. Indeed the results for these two monetary aggregates compare very well with any statistical fits obtained for other countries in this study. The equation for M_1 is also well-determined but the absolute rôle of this aggregate in the determination of nominal income is below that of the broader aggregates while it is dominated, in relative terms, by autonomous expenditure. Finally, as predicted earlier, the significance of the credit aggregates, vis-à-vis nominal income is much more uncertain. In addition, the coefficients of variation of velocity of these credit aggregates are much higher than those for the conventional definitions of money.

As a set, the results of these reduced-form tests for France are particularly good. This outcome is remarkable, given the evidence of earlier studies that the rôle of monetary aggregates in the determination of nominal income is uncertain. The results suggest a preference for the use of M_3, and with a little less certainty M_2, as the target of monetary policy on this criterion. The general suggestion of earlier studies that broad money is more closely related to nominal income in France than narrow money is therefore confirmed.

E. Italy

Three concepts of money, two credit measures and the monetary base are used in the reduced-form tests for Italy. These aggregates are defined in Table 10. M_1 corresponds to a conventional definition, being restricted to currency held outside the banking sector and sight deposits (in both domestic and foreign currencies) held in the banking sector and the Treasury, while M_2 includes, in addition, time deposits and lira postal savings bonds. M_3 adds lira Treasury bills to this definition of M_2. Credit is defined as the stock of outstanding claims of commercial and savings banks on the non-bank domestic sector. Total Domestic Credit (TDC), which has been used by the Italian authorities for targeting purposes, includes, in addition to bank credit, loans made by the specialised non-bank private institutions, government and private bond issues and the net indebtedness of the state sector. Although this target is expressed by the authorities in flow form (i.e. the increase in TDC over a twelve-

Table 10

Italy – Money supply definitions

Item	M_1	M_2	M_3	MB
Currency held outside the banking sector[1]	X	X	X	X
With the banking sector and the Treasury held by non-bank domestic sector[2,3]				
– ordinary accounts without overdraft facilities	X	X	X	
– unrestricted special accounts with overdraft facilities	X	X	X	
– restricted special accounts	X	X	X	
Passbook deposits with the banking sector[4]		X	X	
Lira savings bonds issued by the postal administration		X	X	
Lira Treasury bills			X	
Compulsory and excess reserves of the banking sector				X
Non-interest-bearing deposits compulsorily placed by the banking sector at the central bank				X

Credit = Credit extended by the monthly reporting commercial and savings banks and their central institutions to the non-bank domestic sector (including public non-financial enterprises and central government).
Total Domestic Credit (TDC) = Increase in credit (as defined above), loans made by specialised non-bank private institutions to the non-bank domestic sector, government and private bond issues and the net indebtedness of the state sector.

[1] Defined as the Bank of Italy, the Post Office Savings Bank, the commercial and savings banks and their central banking institutions. Currency held by the POSB is not excluded. [2] Excluding central government. [3] In lire and foreign currencies. [4] In lire only.

month period), stock data on this concept are also available, enabling its inclusion in the velocity calculations and graphs in addition to the reduced-form tests. Finally, the monetary base includes currency in circulation, the compulsory and excess reserves of the banks and all non-interest-bearing deposits which the banks have to lodge at the central bank when they exceed their lending ceilings.

The reduced-form results for Italy are set out in Table 11. In common with the results for other countries in this study, the exports plus government spending definition of autonomous expenditure consistently outperforms the separate specification of exports and

Table 11
Reduced-form estimates for each monetary aggregate – Italy[1]

Monetary variable	Constant	ΔM_t	ΔM_{t-1}	ΔM_{t-2}	$\Delta M_t xD^*$	$\Delta M_{t-1}xD^*$	$\Delta M_{t-2}xD^*$	$\Delta(X+G)$	$\bar{R}^2$	% S.E.	D.W.
M_1				1.237 (3.20)				1.528 (4.97)	0.943	26.803	1.957
M_2		−0.853 (−4.01)	1.561 (2.22)	0.515 (0.94)		−0.058 (−1.77)	0.099 (2.86)	0.492 (0.79)	0.981	14.591	1.725
M_3		−1.508 (−2.15)	1.958 (4.28)		−0.100 (−1.22)	−0.070 (−1.55)		2.513 (1.91)	0.957	22.142	1.916
Credit	−3.611.472 (−2.52)	2.376 (5.41)	1.652 (3.96)			−0.180 (−2.42)		−0.317 (−0.82)	0.980	11.130	1.504
TDC	−4,261.359 (−2.72)	−0.910 (−3.22)	2.418 (4.87)	1.256 (3.59)	0.050 (1.56)		0.036 (1.16)	−3.220 (−3.59)	0.977	13.593	1.947
MB			−3.176 (−2.04)	7.955 (5.29)			0.529 (1.51)	1.462 (3.58)	0.967	17.404	1.928

[1] Observation periods: M_1 1961–80, M_2 1963–80, M_3 1962–80, Credit 1969–80, TDC and MB 1965–80.
* D=0 up to 1973
D=1 from 1974 onwards.

Beta coefficients

	Monetary aggregate				Autonomous expenditure
	t	t−1	t−2	sum	
M_1			0.379	0.379	0.597
M_2	−0.626	1.082	0.300	0.756	0.192
M_3	−1.375	1.560		0.185	0.981
Credit	0.749	0.438		1.187	−0.120
TDC	−0.906	2.074	0.938	2.106	−1.240
MB		−0.292	0.690	0.398	0.566

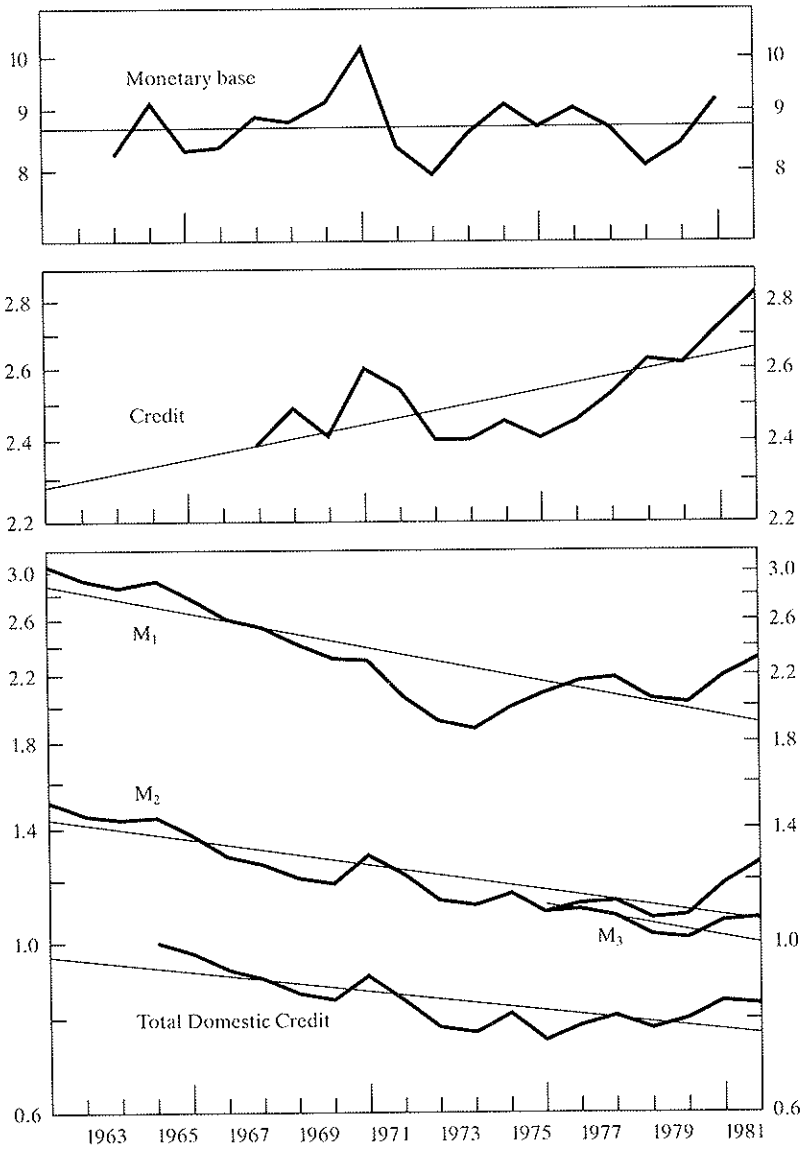
the government's fiscal deficit. In general, however, neither version of autonomous expenditure generates particularly good results. When included separately, exports were rarely significant and frequently took a theoretically unsatisfactory negative sign, while the fiscal deficit often had the wrong sign also. The composite exports plus government spending variable performed slightly better, being positive and significant in all the equations that included M_1 and for many of the monetary base equations. However, the highly unstable nature of the coefficients on autonomous expenditure in Table 11 suggests some misspecification of the M_2, M_3, credit and TDC equations. In the M_1 and monetary base equations, autonomous expenditure conforms to a priori expectations with a coefficient exceeding unity, although that in the M_3 equation at 2.5 is too high.

The time period over which changes in the alternative money and credit aggregates influence nominal income in Italy appears to be longer and the lag structure more complex than for other countries. Changes in M_1 have a significant effect on income only after two years, a result that could not be improved by the inclusion of other lags or of a dummy variable to reflect the introduction of money supply targets. Similarly, the monetary base affects nominal income most significantly after two years and in this case the coefficient on the monetary base lagged by one period is even negative. This result may illustrate the nature of the monetary base as a policy instrument, in such a way that a two-year lag before the final goal of policy – nominal income – is affected is plausible. When entered contemporaneously, M_2, M_3 and TDC have negative signs and it is only after one year that significant impacts on nominal income (and ones that are quantitatively greater) are recorded. In the case of TDC this impulse also carries over into a further year. These lagged effects of TDC on nominal income are unusual for this type of variable in this study. The customary contemporaneous effect of changes in credit variables on income is, however, obtained in the bank credit equation in Table 11, although there is also a smaller but still significant effect after one year.

The effects of the introduction of a monetary targets strategy in 1974 on the income/money relationships were investigated through the inclusion of a set of dummy variables. Owing in part to the complex and variable lag structure, the results for these dummy variables were neither clear nor consistent across the aggregates, although for all aggregates except M_1 the overall fits of the equations were improved by their inclusion. A consideration of the velocity graphs provides further information. For M_1 there was a sharp and sustained upward movement in velocity beginning in 1974, reversing a previously well-established trend. This conclusion is confirmed by a highly significant coefficient on the dummy variable when included in a time-trend equation for the velocity of M_1. (The absence of a significant dummy in the reduced-form equation that includes M_1 may be due to the timing of the velocity shift in 1974 compared to the result that M_1 affects income with a two-year lag.) For M_2 and M_3, velocity rose in 1974 but these movements were much less sharp and were reversed in the following year. The velocities of bank credit and the monetary base rose in that year too. However, for credit this upward movement was not so noticeable, given the offsetting fall in velocity in 1975 and the observation that a much more pronounced, secular rise in velocity began some two years after monetary targets were introduced. In the case of the monetary base, the upward movement of velocity in 1974 was considerable but it had begun a year earlier and, given the general lack of trend and high volatility of this velocity, any effect of the policy change in 1974 is impossible to isolate. Any discussion of these velocity graphs would not be complete without noting that, for all aggregates, there was a sharp upward movement in velocity at the end of the 1970s, suggesting that some new, fundamental instability of this relationship may be developing.

In contrast to the other countries in this study, the optimal target for Italy in terms of the influence on money income alone is bank credit. Of all the aggregates this has the highest significance in the reduced-form equations, coupled with the lowest de-trended coefficient of variation of velocity. The preference for this credit

Italy: Income velocity



aggregate is strengthened by the relative shortness of the lag between changes in credit and in nominal income, although the possibilities of misspecification of the equation (due to the negative, but insignificant, coefficient on autonomous expenditure) and of reverse causation cannot be dismissed. The results for Total Domestic Credit are only marginally inferior and, on the basis of the estimates in Table 11, Total Domestic Credit seems a suitable choice of monetary target in Italy. The results for M_2 and M_3, considering the graphs also, are similar, with both aggregates having their main impacts on nominal income with a one-year lag. The difference in goodness of fit of the equations for these variables is not great and is largely explained by the higher significance of the contemporaneous, negative M_2 variable and the inclusion of the dummy variable with a two-year lag in that equation. In addition, the de-trended velocity of M_3 is more stable than that for M_2. The relationship between the monetary base and income is highly volatile, despite a significant coefficient on the base when it enters with a two-year lag, and M_1, while generating a reasonable fit and a superior specification, is marred by its velocity moving cumulatively away from trend from 1967 to 1974 before its sharp upward correction. Consideration of the beta coefficients indicates that for both M_1 and the monetary base (and also M_3) much of the explanatory power of the overall equation is due to the exports plus autonomous spending variable. The absence of almost any trend in the velocity of the monetary base is illustrated by the near equality of the coefficients of variation of this velocity using de-trended and actual data, while the velocity of circulation of M_1 is by far the most variable on the basis of this summary statistic.

Overall, the reduced-form equations fit well and are not impaired by autocorrelation. However, the variation and complexity of the lag structures and the fluctuating rôle of autonomous expenditure lead to some uncertainty in the conclusions derived from the reduced-form tests and the velocity graphs. It is notable that the derivation of the most powerful links between money and income when the bank credit aggregate and Total Domestic Credit

are used is unusual in this sample of countries, while the rejection of M_1 and the monetary base as targets is inconsistent with some earlier studies for Italy. Some uncertainty must therefore remain over the choice of the target aggregate in Italy.

IV.
International themes

To facilitate a discussion of cross-country themes from the reduced-form tests, Table 12 sets out the approximate ranking of the money and credit aggregates, for each country, in terms of their rôle in the determination of nominal income fluctuations. At first glance, few patterns consistent across all countries emerge. However, certain points may still be drawn from these rankings and the results themselves.

Firstly, there is fairly strong evidence that, where reliable data are available for testing, the very broad aggregates, including all concepts of bank liabilities or assets, certain other liquid assets and deposits at non-bank financial institutions, are closely related to nominal income and therefore on this criterion would correspond to suitable targets of monetary policy. This result is overwhelmingly true for the concepts of Total Credit, Liquidity and the Debt Proxy in the United States, for Total Domestic Credit in Italy and, with only a little less certainty, for PSL_2 in the United Kingdom.[16] No aggregates of equivalent breadth to these are readily available for the other two countries in the sample. Secondly, and in sharp contrast to this, a narrower version of credit – including loans made by commercial banks only – gives by far the poorest results for the United States, the United Kingdom and France. The superiority of

[16] The poorer results for PSL_1 for the United Kingdom do not contradict this conclusion, as, in quantitative terms, PSL_1 is only slightly larger than Sterling M_3 and on average is only just over 50 per cent. of the size of PSL_2, given that the latter includes the very large sum of deposits at building societies, trustee savings banks and the National Savings Bank.

Table 12
Approximate ranking of monetary aggregates on closeness of fit criterion

United States	United Kingdom	Germany	France	Italy
Total Credit/ Liquidity	M_1	CBMS	M_3	Credit
M_3/Debt Proxy	Monetary base	Credit 1	M_2	Total Domestic Credit
M_1	PSL_2	Credit 2	M_1	M_2
Monetary base	£M_3	$M_3/M_2/M_1$	Credit 2	Monetary base
M_2	PSL_1		Credit 1	M_3
Bank credit	DCE			M_1
	Credit			

this credit aggregate in the case of Italy and the relatively good performances of two concepts of bank credit in Germany represent exceptions to this result. On balance, however, bank credit is far inferior to more comprehensive measures of credit or liquidity as a potential monetary target. This result could have been anticipated, however, given the likelihood that borrowers may switch from bank loans to other forms of credit in the face of restrictions on the former. This close substitutability between different forms of credit (except insofar as credit markets may be imperfect or segmented) contrasts with the situation with respect to Liquidity and Total Credit where, by definition, alternative liquid assets or credit lines are unavailable.

Thirdly, considering the conventional monetary aggregates alone, the broadest of these (M_3) appears to be most closely related to nominal income across the countries in the sample, a result that applies also to the Central Bank Money Stock in Germany (which, as argued earlier, is similar in concept to M_3). In contrast, M_1 generally performs least satisfactorily in this sense. The main exception to this conclusion is the United Kingdom. As argued in the last section, however, the empirical superiority of M_1 over Sterling M_3 in the United Kingdom is now well-established, with the inferiority of the latter being partly attributable to the frequent distortions of this aggregate since 1971. In other countries, however,

the poor results for M_1 are rather unexpected. This evidence casts doubt on the view that a narrow concept of money, restricted to money's function as a medium of exchange (that is, the holding of transactions balances), is likely to be closely related to nominal income, whereas a more hybrid concept of money is not.

Finally, the results for the monetary base are fairly good for the United Kingdom, the United States and Italy. To specify any link between nominal income and the monetary base (or any concept of banks' reserves) involves a second link between the base and conventional definitions of the money stock as well as between the latter and nominal income. This is made clear in Equation (15). Any instability in such relationship may be due not simply to the variability of velocity but also to fluctuations in the "money supply multiplier" linking the monetary base and the money supply (Fellner 1982). This additional instability as banks' reserve ratios or the currency/deposits ratio of the public vary, would seem to be sufficient to reject the use of the monetary base for target purposes. However, the good results for the monetary base suggest, particularly if controllability is considered also, that some serious reconsideration should be given to this concept as a target of monetary policy.

Table 13 calculates the income velocity for the monetary and credit aggregates used in these tests at three-yearly intervals. The average velocity over the whole period is also shown. A study of this table, alongside the velocity graphs, suggests some other cross-country conclusions with respect to the pure income/money relationships. For all countries except Italy, the trend of M_1 velocity has been upwards in the observation period. In particular, the slope of this upward trend has been very sharp for the United States, the United Kingdom and France. In contrast, the velocity of the broader aggregates has generally been trending downwards over the data periods (see Kaldor 1980, 1982). Exceptionally, the velocity of all UK aggregates has risen significantly since 1963, while the trends of M_2, the Debt Proxy and Total Credit in the United States are virtually flat.

Table 13

Income velocity in five industrialised countries

	1960	1963	1966	1969	1972	1975	1978	1981	Mean*
USA									
MB	11.059	11.700	12.877	13.583	13.648	14.292	15.693	17.311	13.672
M_1	3.479	3.753	4.232	4.465	4.581	5.183	5.788	6.484	4.705
M_2	1.606	1.505	1.560	1.592	1.470	1.507	1.531	1.599	1.535
M_3	1.615	1.481	1.503	1.544	1.348	1.332	1.326	1.338	1.421
L	1.257	1.188	1.230	1.238	1.162	1.128	1.113	1.107	1.173
Bank credit	3.605	3.090	2.823	2.613	2.312	2.303	2.314	2.403	2.638
Total Credit	0.697	0.678	0.682	0.697	0.686	0.686	0.673	0.664	0.685
Debt Proxy	0.983	0.957	0.995	1.007	0.965	0.941	0.966	0.922	0.967
UK									
MB	8.772[2]	9.417	9.802	10.428	12.239	14.580	15.827	17.110[1]	12.132
M_1		3.869	4.254	4.709	4.640	5.764	5.664	6.405[1]	4.996
Sterling M_3		2.476	2.524	2.541	2.392	2.577	2.966	3.012[1]	2.614
PSL_1		2.247	2.280	2.315	2.272	2.411	2.831	2.819[2]	2.418
PSL_2		1.381	1.355	1.315	1.267	1.446	1.605	1.660[1]	1.410
Germany									
CBMS	9.941[3]	9.695	9.757	9.545	9.908	9.796	9.440	9.656[1]	9.759
M_1	6.327[2]	6.128	6.342	6.467	6.610	6.482	5.954	6.291[1]	6.407
M_2	4.168	4.043	4.299	3.810	3.560	3.705	3.430	3.399[1]	3.816
M_3	2.827	2.562	2.495	2.236	2.186	2.108	1.961	2.025[1]	2.308
Credit 1	2.183[2]	1.959	1.796	1.678	1.572	1.527	1.480	1.390[1]	1.688
Credit 2	1.841[2]	1.678	1.515	1.383	1.327	1.246	1.146	1.080[1]	1.394
France									
M_1	3.266[2]	3.003	2.967	3.419	3.580	3.885	4.128	4.358	3.581
M_2	2.884[2]	2.636	2.500	2.469	2.180	2.085	2.061	2.094	2.330
M_3	1.948[2]	1.807	1.721	1.727	1.536	1.480	1.426	1.445	1.615
Credit 1	4.946[2]	4.543	4.119	3.311	2.564	2.348	2.342	2.225	3.185
Credit 2	3.927[2]	3.681	3.227	2.543	1.963	1.836	1.854	1.740	2.509
Italy									
MB		8.252	8.369	9.121	7.935	8.705	8.105	9.188[1]	8.723
M_1	3.141	2.866	2.606	2.307	1.912	2.081	2.044	2.307	2.393
M_2	1.552	1.436	1.291	1.190	1.131	1.093	1.071	1.261	1.253
M_3	1.537	1.431	1.291	1.190	1.131	1.090	1.024	1.071	1.229
Credit			2.389[3]	2.414	2.407	2.412	2.626	2.824	2.527
TDC		1.001[4]	0.923	0.845	0.781	0.749	0.778	0.834	0.844

[1] 1980. [2] 1961. [3] 1967. [4] 1964.

* Calculated from

USA: 1960–81 except Total Credit and Debt Proxy – 1960–80.

UK: 1963–80 except MB – 1961–80.

Germany: 1961–80 except M_2, M_3 – 1960–80.

France: 1961–81.

Italy: 1960-81 except Credit – 1967–81, TDC – 1964–81.

Some reasons may be tentatively advanced for these opposing movements in the velocity of narrow and broad money. The rising trend of M_1 velocity is explained predominantly by the fact that for all countries in the sample (except Italy) interest is not generally paid on demand deposits. Therefore, if nominal rates are considered high enough to make the opportunity cost of holding demand deposits excessive, individuals will economise on such transactions balances and place a greater proportion of their funds in less liquid interest-bearing deposits which appear in M_2 or M_3 only. In Italy, on the other hand, the payment of interest on current accounts has discouraged much of the switching into time deposits, thus contributing to an actual fall in the velocity of M_1 over the observation period.

The statistical treatment of any new accounts generated as a result of financial innovation may also affect velocity. If this innovation takes the form of the creation of new interest-bearing accounts which, although having transactions balances characteristics, are excluded from M_1, the velocity of narrow money is given further upward impetus. Therefore, the widespread development of savings accounts at banks in many of the sample countries over the last twenty years – which pay interest but which also retain much liquidity – has been a key factor in the opposing velocity movements. However, the impact of financial innovation on velocity may go the other way too. Thus, the recent redefinition of the US monetary aggregates, with certain of these new interest-bearing accounts – such as NOW and ATS accounts – being included in M_1, is likely to reduce the velocity of narrow money.

In 1982, such a fall in M_1 velocity occurred. An additional argument that may help to explain this unexpected decline has been the increased holding of precautionary money balances due to uncertainty over the state of the US economy and the stability of the international banking system. This point may be generalised by saying that any significant rise in uncertainty may have a negative impact on the velocity of M_1 owing to increased resources being held in precautionary balances. The relatively steady rise of M_1 velocity

since the beginning of the 1960s in many countries may have reflected the general stability of economic relations before the macro-economic disturbances of the period after 1973 appeared.

Finally, an additional factor explaining the steadier downward velocity trend of the broad aggregates in most countries reflects the desire of individuals to diversify their assets as their stock of wealth increases. There will be an increased demand for a wide variety of financial assets, some of which will only be included in the broader aggregates or the wider measures of liquidity and debt. Aside from interest rate considerations, the attractiveness of holding demand deposits will fall as wealth increases.

V.
Division of changes in income into changes in output and prices

In this final section, estimates of Equation (16) are provided for each of the five countries included in the study. The aim of these estimates is to complement the reduced-form results reported earlier in the paper. Specifically, the reduced-form equations explain shifts in aggregate demand in terms of changes in the money supply and autonomous expenditure. These fluctuations in aggregate demand interact with the aggregate supply curve for each country to predict the effects on output and the price level of any change in nominal income. Therefore, Equation (16) estimates the key parameters of the supply equation to allow the split into price and output changes to be identified. Although providing econometric evidence that is of a completely different type to that derived from the reduced-form tests, the results are complementary and indicate how much of a given change in one of the monetary aggregates (for a particular country) may be expected to be reflected in a rise in inflation and how much in an expansion of real output.

Previous studies suggest that for the United States around one-third of any change in nominal GNP passes through to prices within one year and the remainder to output (e.g. Gordon 1981, 1982a, b),

Table 14

Inflation equations using lagged actual inflation as a measure of expected inflation[1]

Country	$\hat{Y}$	$\dot{P}^{e}_{t-1}$[2]	$LOG(y/y^{*})_{t-1}$	$\bar{R}^2$	S.E.	D.W.
USA	0.292 (3.37)	0.759 (8.43)	0.416 (4.82)	0.893	31.35	1.878
UK	0.933 (5.91)	0.078 (0.50)	0.848 (3.13)	0.898	31.06	1.725
Germany	0.394 (4.80)	0.601 (6.84)	0.233 (2.39)	0.814	58.67	2.084
France	0.639 (5.45)	0.401 (3.42)	0.534 (3.03)	0.908	32.39	1.757
Italy	0.501 (8.42)	0.555 (9.20)	0.263 (3.74)	0.960	20.40	2.070

	Price effects of change in nominal income		Average lag (years)	Mean annual inflation rate	Variability of annual inflation rate[3]
	short-run	long-run			
USA	0.292	1.212	4.149	4.826	2.539
UK	0.933	1.012	1.085	8.184	5.312
Germany	0.394	0.987	2.506	4.200	1.621
France	0.639	1.067	1.669	6.587	2.757
Italy	0.501	1.126	2.247	8.870	5.348

[1] Time periods. US, Italy: 1962–81
UK, France: 1963–80
Germany: 1962–80.

[2] Measured by $\dot{P}_{t-1}$.

[3] Measured by standard deviation.

although a split of 10–90 was found by Okun (1978). In Germany, France and Italy the short-run response of prices is greater (and classified by Gordon as "medium"), while for the United Kingdom most of the rise in demand is reflected in price increases and little in terms of output (Gordon 1982b). There is considerable evidence that, if an economy is already at full employment, the real effects of a rise in nominal demand will disappear over time and, therefore, that there is no long-run trade-off between output and inflation.

In Table 14, the results of estimating Equation (16) using annual data are presented with $\hat{Y}$ being the deviation of the rate of increase of nominal income from the trend rate of increase of real output,

$\dot{P}^e_{t-1}$ the expected inflation rate, lagged one period and proxied by the lagged actual inflation rate[17] and y/y^* the ratio of actual output to its trend level. As argued earlier, the short-run effect of a change in nominal income on inflation is given by the coefficient on $\hat{Y}$, defined as the deviation of the rate of increase of nominal income from the trend rate of increase of output (λ_0) with the long-run effect on inflation being given by $\lambda_0/1-\lambda_1$, where λ_1 is the coefficient on the lagged inflation rate. The equations fit well for all countries and the results are broadly consistent with those in earlier studies.

Substantial cross-country differences exist in the short-run division of a change in nominal income into changes in output and in prices, but these effectively disappear in the long run. The largest short-run effect on output is recorded for the United States, with only 29 per cent. of a change in income being absorbed by inflation, followed by Germany (39 per cent.), Italy (50 per cent.), France (64 per cent.) and the United Kingdom (93 per cent.). Therefore, even the short-run supply curve in the United Kingdom is almost vertical. For all countries, the long-run effect on prices of a change in nominal income is insignificantly different from one. This indicates that, in a steady-state equilibrium, nominal income less the trend rate of growth of output will grow at the same rate as the price level, assuming that the trend rate of real growth is exogenous to changes in demand. Some differences do emerge, however, over the length of time before all real effects of the change in nominal income are dissipated. These are indicated by the average lags, which vary from only just over one year for the United Kingdom to over four years in the case of the United States.

Table 15 reports the results of re-estimating Equation (16) using the rate of change of one measure of the money supply or credit as a

[17] Despite many attempts to derive reliable estimates of expected inflation from distributed lag schemes (of actual inflation) of varying complexity and from sample survey data, there is little consensus over the most appropriate method. In particular, the use of the lagged actual inflation rate, although representing a "naive" model, is not unambiguously inferior to other more sophisticated alternatives. See the survey article by Chan-Lee (1980) and the references included therein.

Table 15

Inflation equations using lagged monetary growth as a measure of expected inflation

Country	$\hat{Y}$	$\dot{P}^e_{t-1}$[1]	$LOG(y/y^*)_{t-1}$	$\bar{R}^2$	% S.E.	D.W.
USA	0.416 (1.95)	0.359 (2.71)	0.332 (1.90)	0.628	59.63	0.872
UK	1.102 (11.27)	−0.105 (−1.12)	0.800 (2.58)	0.913	27.96	1.432
Germany	0.319 (2.94)	0.362 (5.62)	0.381 (3.56)	0.863	67.37	1.741
France	0.836 (7.24)	0.112 (1.73)	0.649 (0.305)	0.877	35.43	1.414
Italy	0.386 (1.54)	0.550 (2.41)	0.039 (0.13)	0.809	42.18	1.364

Country	Price effects of change in nominal income		Average lag (years)
	short-run	long-run[2]	
USA	0.416	0.649	1.560
UK	1.102	0.997	<1
Germany	0.319	0.500	1.567
France	0.836	0.941	1.126
Italy	0.386	0.858	2.222

[1] Measured by M_{t-1}. For USA – Total Credit; UK – M_1; Germany – CBMS; France – M_3; Italy – Credit.

[2] Assuming that in the long run $\dot{P}=\dot{M}$ so that the long-run price effects are calculated by $\frac{\lambda_0}{1-\lambda_1}$.

proxy for expected inflation. The aggregate chosen was that which provided the best results in the reduced-form tests for each country. The purposes of this extra test are twofold. Firstly, the results will allow an estimate to be made of the possible short and long-run direct effects (as opposed to the indirect effects arising from changes in nominal income) on inflation of a change in monetary growth. Secondly, the conclusions on the slope of the aggregate supply curve derived from Table 14 may be considered in the light of this new test.

Certain key differences exist in Table 15 compared to the previous exercise in which the lagged inflation rate was included. The short-run effect on prices of a change in the rate of growth of nominal income is smaller for Germany and Italy and larger for the United States and France when compared to the results in Table 14. In general, however, the quality of results is lower, with some evidence of autocorrelation in four out of the five equations. The equation is clearly misspecified for the United Kingdom owing to the negative coefficient on the monetary growth variable. There is evidence that, when the expected inflation rate is proxied by the rate of increase of monetary growth, changes in nominal income are, even in the long term, partly reflected in changes in real output in the United States and Germany. However, given the overall impression that money supply growth is an inferior proxy for inflationary expectations, the validity of this result is questionable and the implications uncertain.

Conclusions

The evidence presented in this paper on the long-run relationships between nominal income and various monetary and credit aggregates in five countries point to several tentative conclusions, bearing on the choice of aggregates for targeting purposes. Some cross-country patterns were found. For example, the close relationships between the broad credit/debt aggregates and nominal income contrast sharply with the poor performances of the bank credit variables. In addition, the common velocity trends for narrow and broad money were of interest. Considerable confidence may be placed in these and other conclusions for individual countries, given that a large degree of consistency was apparent from the different types of evidence (regression equations, velocity calculations and graphical inspection). While even greater cross-country consistency would have been encouraging, the different institutional frameworks in which monetary policy operates and the variations of the compo-

nents of money supply definitions in the different countries studied, militated against this possibility.

The logical counterpart to the work reported in this paper is a consideration of the degree to which national monetary authorities are able to exercise control over the alternative aggregates in their particular countries. As with the results of the reduced-form tests presented here, such evidence on controllability is of interest in itself, although it is beyond the scope of this paper. However, it is only by combining the two sets of results that more definite conclusions may be drawn with respect to the optimal target aggregate for each country in question.

Annex

The full results of the reduced-form tests for the five countries are set out in this annex. In all cases, the results quoted are those obtained with exports plus government spending as the autonomous expenditure variable. (This procedure is consistent with the "best" results for each aggregate reported in the main part of the paper, except for DCE and credit in the United Kingdom. For these aggregates, the inclusion of dummy variables led to the "best" estimates when autonomous expenditure was specified as exports and the PSBR.) The results are in abbreviated form including the coefficient on the monetary variable(s) in each equation including the t-statistic, the adjusted coefficient of determination and the Durbin-Watson statistic only.

United States

	M_1	M_2	M_3	L	Bank credit	Total Credit	Debt Proxy	MB
ΔM_t	5.283	0.966	0.972	1.049	1.061	0.660	1.007	12.673
	(7.07)	(5.69)	(6.84)	(11.11)	(3.36)	(17.73)	(11.32)	(3.22)
$\bar{R}^2$	0.895	0.865	0.895	0.952	0.780	0.978	0.950	0.765
D.W.	2.058	2.015	2.363	2.493	1.613	0.321	1.601	2.141
ΔM_t	5.280	1.074	0.979	1.059	1.276	0.676	0.979	12.617
	(6.86)	(6.57)	(6.78)	(11.31)	(3.69)	(15.39)	(10.27)	(3.13)
$\Delta M_t xD$	−0.007	−0.064	−0.017	−0.017	0.094	−0.021	0.035	−0.143
	(−0.08)	(−2.15)	(−0.67)	(−1.21)	(1.38)	(−0.69)	(0.86)	(−0.36)
$\bar{R}^2$	0.888	0.887	0.891	0.953	0.785	0.977	0.950	0.753
D.W.	2.047	2.266	2.398	2.582	1.555	2.359	1.730	2.173
ΔM_{t-1}	7.041	1.238	1.362	1.563	−0.727	1.106	1.335	21.959
	(6.77)	(9.26)	(10.72)	(14.40)	(−0.93)	(10.02)	(7.73)	(7.72)
$\bar{R}^2$	0.881	0.932	0.947	0.970	0.698	0.940	0.909	0.913
D.W.	0.841	2.331	1.611	1.996	1.729	2.471	2.309	1.230
ΔM_{t-2}	4.892	1.433	1.815	1.767	−0.230	1.064	1.236	20.930
	(1.68)	(3.97)	(3.89)	(5.18)	(−0.42)	(6.13)	(5.79)	(3.91)
$\bar{R}^2$	0.669	0.791	0.784	0.848	0.670	0.880	0.864	0.780
D.W.	1.325	1.867	1.977	1.854	1.601	1.414	1.804	1.884
ΔM_t	3.086	0.251	0.304	0.370	1.230	0.628	0.844	1.513
	(3.05)	(1.30)	(1.90)	(2.15)	(3.68)	(4.35)	(4.27)	(0.48)
ΔM_{t-1}	3.839	1.016	1.048	1.071	−0.993	0.057	0.247	20.387
	(2.84)	(4.72)	(5.14)	(4.30)	(−1.48)	(0.24)	(0.93)	(5.56)
$\bar{R}^2$	0.927	0.935	0.953	0.974	0.791	0.977	0.946	0.913
D.W.	0.925	2.300	1.688	2.128	2.007	2.323	1.471	1.179

United Kingdom

	M_1	£M_3	PSL_1	PSL_2	Credit	DCE	MB
ΔM_t	2.369	0.635	0.494	0.670	0.081	0.143	9.411
	(11.41)	(1.61)	(1.34)	(3.48)	(0.29)	(0.55)	(6.90)
$\bar{R}^2$	0.987	0.900	0.897	0.933	0.897	0.897	0.972
D.W.	2.490	1.644	1.716	1.642	1.642	1.676	2.407
ΔM_t	2.409	1.318	1.067	0.940	0.125	0.298	9.538
	(11.60)	(2.84)	(2.47)	(5.36)	(0.37)	(0.91)	(8.02)
$\Delta M_t xD1$[1]	−0.521	−0.823	−0.721	−0.480	−0.099	−0.240	−3.800
	(−1.19)	(−2.24)	(−2.08)	(−3.14)	(−0.27)	(−0.87)	(−2.53)
$\bar{R}^2$	0.988	0.923	0.919	0.957	0.886	0.895	0.978
D.W.	2.470	1.327	1.402	1.351	1.351	1.529	2.283
ΔM_t	2.544	0.657	0.524	0.668	0.087	0.133	9.572
	(13.27)	(1.62)	(1.38)	(3.39)	(0.25)	(0.45)	(6.69)
$\Delta M_t xD2$[2]	−0.102	0.036	0.037	0.015	−0.009	0.021	−0.095
	(−2.51)	(0.53)	(0.56)	(0.52)	(−0.03)	(0.10)	(−0.50)
$\bar{R}^2$	0.991	0.894	0.891	0.929	0.892	0.893	0.970
D.W.	2.344	1.831	1.927	1.817	1.769	1.669	2.321
ΔM_t	2.622	1.316	1.073	0.939	0.445	0.615	9.845
	(14.77)	(2.74)	(2.40)	(5.13)	(0.62)	(1.27)	(8.08)
$\Delta M_t xD1$	−0.716	−0.807	−0.705	−0.478	−0.399	−0.504	−4.093
	(−2.03)	(−2.10)	(−1.96)	(−2.95)	(−0.57)	(−1.24)	(−2.69)
$\Delta M_t xD2$	−0.116	0.018	0.023	0.001	−0.311	−0.282	−0.174
	(−3.09)	(0.29)	(0.37)	(0.06)	(−0.50)	(−0.86)	(−1.07)
$\bar{R}^2$	0.992	0.917	0.913	0.954	0.885	0.894	0.979
D.W.	2.597	1.408	1.521	1.365	1.870	1.509	2.156
ΔM_{t-1}	1.818	0.188	−0.407	0.395	−0.236	−0.710	9.865
	(2.44)	(0.28)	(−0.58)	(0.90)	(−0.50)	(−1.85)	(2.71)
$\bar{R}^2$	0.915	0.883	0.890	0.884	0.887	0.915	0.928
D.W.	2.377	1.761	1.825	1.861	1.777	1.755	2.408
ΔM_{t-2}	0.456	0.214	0.390	1.190	0.216	0.297	10.63
	(0.38)	(0.20)	(0.45)	(1.67)	(0.40)	(0.82)	(2.79)
$\bar{R}^2$	0.875	0.873	0.874	0.885	0.875	0.877	0.927
D.W.	1.816	1.725	1.675	1.637	1.646	1.731	1.804
ΔM_t	2.405	0.852	0.977	1.307	0.204	0.099	9.483
	(8.74)	(1.66)	(2.23)	(5.05)	(0.61)	(0.39)	(5.14)
ΔM_{t-1}	−0.090	−0.568	−1.440	−1.360	−0.373	−0.669	−0.182
	(−0.02)	(−0.73)	(−1.86)	(−3.11)	(−0.79)	(−1.74)	(−0.06)
$\bar{R}^2$	0.986	0.891	0.909	0.956	0.889	0.914	0.970
D.W.	2.461	1.710	2.148	2.055	1.850	1.733	2.394

[1] CCC dummy variable. [2] Monetary targets dummy variable.

Germany

	M_1	M_2	M_3	Credit 1	Credit 2	CBMS
ΔM_t	2.620	1.205	1.089	1.023	0.741	6.562
	(5.09)	(3.51)	(5.08)	(7.01)	(6.80)	(8.04)
$\bar{R}^2$	0.696	0.708	0.675	0.822	0.809	0.820
D.W.	1.580	1.795	1.897	1.269	0.933	1.428
ΔM_t	3.140	1.578	1.121	0.993	0.771	6.959
	(4.90)	(4.95)	(4.53)	(6.56)	(6.22)	(7.58)
$\Delta M_t xD$	−0.172	0.128	−0.011	0.018	−0.011	−0.125
	(−1.31)	(2.19)	(−0.28)	(0.85)	(−0.50)	(−0.96)
$\bar{R}^2$	0.705	0.734	0.656	0.814	0.803	0.819
D.W.	2.055	1.608	1.965	1.314	0.980	1.622
ΔM_{t-1}	2.741	0.905	1.424	0.517	0.507	8.468
	(3.91)	(1.65)	(5.80)	(1.55)	(2.37)	(4.92)
$\bar{R}^2$	0.729	0.558	0.737	0.528	0.602	0.669
D.W.	1.125	1.311	1.152	1.410	1.508	1.290
ΔM_{t-2}	0.957	0.286	1.574	0.211	0.370	3.072
	(0.87)	(0.46)	(3.43)	(0.61)	(1.51)	(1.27)
$\bar{R}^2$	0.456	0.460	0.574	0.442	0.507	0.486
D.W.	1.385	1.175	1.224	1.204	1.341	1.333
ΔM_t	1.579	1.210	0.389	1.052	0.999	6.778
	(2.38)	(2.77)	(0.97)	(5.07)	(4.56)	(3.67)
ΔM_{t-1}	2.001	−0.012	1.003	−0.394	−0.546	−0.377
	(2.24)	(−0.02)	(2.02)	(−1.44)	(−2.02)	(−0.14)
$\bar{R}^2$	0.748	0.689	0.724	0.762	0.828	0.792
D.W.	1.029	1.145	1.321	0.884	1.414	1.420

France

	M_1	M_2	M_3	Credit 1	Credit 2
ΔM_t	1.794 (4.65)	1.337 (6.09)	0.925 (6.56)	0.708 (1.71)	0.772 (2.75)
$\bar{R}^2$	0.958	0.970	0.974	0.926	0.939
D.W.	2.265	1.782	2.100	2.349	2.020
ΔM_t	1.844 (4.84)	1.329 (5.92)	0.928 (6.28)	0.707 (1.59)	0.763 (2.63)
$\Delta M_t xD$	0.054 (1.27)	0.011 (0.57)	−0.001 (−0.10)	0.001 (0.01)	0.007 (0.29)
$\bar{R}^2$	0.959	0.969	0.972	0.921	0.936
D.W.	2.222	1.819	2.100	2.352	2.110
ΔM_{t-1}	1.437 (2.54)	1.336 (5.62)	0.953 (6.32)	0.898 (3.34)	0.704 (2.72)
$\bar{R}^2$	0.932	0.968	0.974	0.943	0.936
D.W.	2.693	2.462	2.585	1.930	2.019
ΔM_{t-1}	1.643 (3.27)	1.312 (6.36)	0.912 (6.39)	0.824 (2.93)	0.663 (2.50)
$\Delta M_{t-1} xD$	0.122 (2.44)	0.043 (2.52)	0.022 (1.81)	0.028 (0.93)	0.122 (0.89)
$\bar{R}^2$	0.949	0.977	0.980	0.944	0.941
D.W.	2.585	2.237	2.215	2.089	2.218
ΔM_{t-2}	1.273 (2.02)	1.388 (3.72)	1.007 (4.25)	1.221 (3.09)	1.082 (2.85)
$\bar{R}^2$	0.921	0.948	0.957	0.939	0.934
D.W.	2.482	2.432	2.423	2.095	1.785
ΔM_t	1.544 (3.61)	0.786 (2.61)	0.523 (2.86)	0.078 (0.18)	0.472 (1.35)
ΔM_{t-1}	0.764 (1.64)	0.737 (2.40)	0.547 (2.89)	0.865 (2.60)	0.441 (1.38)
$\bar{R}^2$	0.960	0.971	0.982	0.939	0.938
D.W.	1.948	2.012	2.319	1.929	1.848

Italy

	M_1	M_2	M_3	Credit	TDC	MB
ΔM_t	0.184	−0.535	0.634	2.560	0.366	−2.513
	(0.35)	(−1.42)	(1.53)	(4.00)	(1.43)	(−1.14)
$\bar{R}^2$	0.909	0.920	0.919	0.950	0.909	0.905
D.W.	1.549	1.840	1.614	1.990	1.547	1.753
ΔM_t	−0.009	−0.864	0.626	2.525	0.347	−3.304
	(−0.02)	(−2.26)	(1.01)	(3.61)	(1.18)	(−1.53)
$\Delta M_t xD$	−0.127	−0.234	−0.003	−0.018	−0.009	−0.891
	(−1.01)	(−2.06)	(−0.02)	(−0.17)	(−0.16)	(−1.59)
$\bar{R}^2$	0.909	0.933	0.914	0.945	0.901	0.914
D.W.	1.585	1.941	1.614	2.034	1.564	2.067
ΔM_{t-1}	1.001	1.485	1.092	1.601	1.332	−0.610
	(2.25)	(3.37)	(3.83)	(2.06)	(3.04)	(−0.25)
$\bar{R}^2$	0.929	0.945	0.950	0.897	0.952	0.892
D.W.	2.084	2.121	2.101	1.572	1.437	1.526
ΔM_{t-2}	1.237	1.311	1.127	−1.987	0.824	6.737
	(3.20)	(3.96)	(3.72)	(−1.41)	(2.30)	(4.01)
$\bar{R}^2$	0.943	0.952	0.948	0.861	0.917	0.949
D.W.	1.957	2.240	2.185	2.040	1.943	1.877
ΔM_t	−0.197	−0.905	−0.928	2.531	−0.364	−2.694
	(−0.39)	(−3.61)	(−1.87)	(4.59)	(−1.07)	(−1.06)
ΔM_{t-1}	1.065	1.850	1.730	1.206	1.902	0.342
	(2.19)	(5.19)	(3.99)	(2.54)	(2.76)	(0.13)
$\bar{R}^2$	0.925	0.967	0.956	0.968	0.952	0.893
D.W.	2.188	2.599	2.243	1.982	1.512	1.790

References

M.A. Akhtar (1981): "Why gradualism in monetary policy will not cure the inflation problem", *Federal Reserve Bank of New York Research Paper*, 8109.

L.C. Andersen and J.L. Jordan (1968): "Monetary and fiscal actions: a test of their relative importance in economic stabilisation", *Federal Reserve Bank of St. Louis Review*, November.

L.C. Andersen and D.S. Karnovsky (1977): "Some considerations in the use of monetary aggregates for the implementation of monetary policy", *Federal Reserve Bank of St. Louis Review*, September.

M.J. Artis and M.K. Lewis (1976): "The demand for money in the UK, 1963–73", *Manchester School*, June.

M.J. Artis and M.K. Lewis (1981): "Monetary control in the United Kingdom", Philip Allan, Oxford.

M.J. Artis and A.R. Nobay (1969): "Two aspects of the monetary debate", *National Institute Economic Review*, August.

Bank of England (1982): "Composition of monetary and liquidity aggregates, and associated statistics", *Bank of England Quarterly Bulletin*, December.

N.G. Berkman (1980): "Abandoning monetary aggregates" in *Federal Reserve Bank of Boston Conference Series No.* 23, "Controlling monetary aggregates III".

H. Bockelmann (1979): "Experience of the Deutsche Bundesbank with monetary targets" in J.E. Wadsworth and F.L. de Juvigny (eds.) "New approaches in monetary policy", Sijtheff and Noordhoff, Alphen aan den Rijn.

J.M. Boughton (1979): "The demand for money in major OECD countries", *OECD Economic Outlook Occasional Studies*, January.

B. Brittain (1981): "Choosing between money targets and targets for credit" in B. Griffiths and G.E. Wood (eds.) "Monetary targets", Macmillan, London.

P. Cagan (1982): "The choice among monetary aggregates as targets and guides for monetary policy", *Journal of Money, Credit and Banking*, November (Part 2).

K.M. Carlson (1978): "Does the St. Louis equation believe in fiscal policy?", *Federal Reserve Bank of St. Louis Review*, February.

K.M. Carlson and S.E. Hein (1980): "Monetary aggregates and monetary indicators", *Federal Reserve Bank of St. Louis Review*, November.

J.M. Chan-Lee (1980): "A review of recent work in the area of inflationary expectations", *Weltwirtschaftliches Archiv*, Heft 1.

R.T. Coghlan (1980): "The theory of money and finance", Macmillan, London.

W.E. Cullison (1982): "Money, the monetary base and nominal GNP", *Federal Reserve Bank of Richmond Economic Review*, May/June.

M.R. Darby and J.R. Lothian (1982): "Thatcher's monetary policy is working: No case for reflation", *Journal of Economic Affairs*, October.

J.H. David (1972): "Un modèle de l'économie française inspiré des thèses monétaristes", *Bulletin Trimestriel de la Banque de France*, November.

J.H. David (1975): "A monetarist model for the french economy" in F. Masera, A. Fazio, T. Padoa-Schioppa (eds.) "Econometric research in European central banks", Banca d'Italia.

R.G. Davis (1979): "Broad credit measures as targets for monetary policy", *Federal Reserve Bank of New York Quarterly Review*, Summer.

R.G. Davis (1979–80): "The monetary base as an intermediate target for monetary policy", *Federal Reserve Bank of New York Quarterly Review*, Winter.

G.E.J. Dennis (1981): "Monetary economics", Longman, London.

G.E.J. Dennis (1982): "The rationale of monetary policy" in D.T. Llewellyn, G.E.J. Dennis, M.J.B. Hall and J.G. Nellis, "The framework of UK monetary policy", Heinemann, London.

W.G. Dewald (1982): "Disentangling fiscal and monetary policy", *Federal Reserve Bank of San Francisco Review*, Winter.

W.G. Dewald and M.N. Marchon (1978): "A modified Federal Reserve of St. Louis spending equation for Canada, France, Germany, Italy, the United Kingdom and the United States", *Kredit und Kapital*.

J.N. Duprey (1980): "The search for a stable money demand equation", *Federal Reserve Bank of Minneapolis Quarterly Review*, Summer.

W. Fellner (1982): "Criteria for useful targeting: money versus the base and other variables", *Journal of Money, Credit and Banking*, November (Part 2).

G. Forster (1981): "Der optimale Geldmengenbegriff. Eine theoretische und empirische Analyse für die Bundesrepublik Deutschland", *Untersuchungen über das Spar-, Giro- und Kreditwesen*, Band 109.

B.M. Friedman (1981a): "The relative stabilities of money and credit velocities in the U.S.: Evidence and some speculations", *NBER Working Paper* No. 645.

B.M. Friedman (1981b): "The rôles of money and credit in macroeconomic analysis", *NBER Working Paper* No. 831.

B.M. Friedman (1982a): "Monetary policy with a credit aggregate target", *NBER Working Paper* No. 980.

B.M. Friedman (1982b): "Time to re-examine the monetary targets framework", *New England Economic Review*, March/April.

B.M. Friedman (1982c): "Money, credit and non-financial economic activity: An empirical study of five countries", *NBER Working Paper* No. 1033.

M. Friedman (1970): "A theoretical framework for monetary analysis", *Journal of Political Economy*, March/April.

M. Friedman (1971): "A monetary theory of nominal income", *Journal of Political Economy*, March/April.

M. Friedman (1975): "Unemployment versus inflation? An evaluation of the Phillips curve", *Institute of Economic Affairs*, London.

C.M. Gambs (1980): "Federal reserve intermediate targets: Money or the monetary base?", *Federal Reserve Bank of Kansas City Economic Review*, January.

C.A.E. Goodhart and A.D. Crockett (1970): "The importance of money", *Bank of England Quarterly Bulletin*, June.

R.J. Gordon (1981): "A consistent characterisation of a near-century of price behaviour", *American Economic Review*, May.

R.J. Gordon (1982a): "Wages and prices are not always sticky: A century of evidence for the U.S., U.K. and Japan", *NBER Working Paper*, No. 847.

R.J. Gordon (1982b): "The wage and price adjustment process in six large OECD countries", *Mimeo*, July.

G. Hacche (1974): "The demand for money in the UK: Experience since 1971", *Bank of England Quarterly Bulletin*, September.

R.W. Hafer (1981): "Selecting a monetary indicator: A test of the new monetary aggregates", *Federal Reserve Bank of St. Louis Review*, February.

M.J. Hamburger (1970): "Indicators of monetary policy: The arguments and the evidence", *American Economic Review*, May.

M.J. Hamburger (1982): "Comment on Cagan and Fellner", *Journal of Money, Credit and Banking*, November (Part 2).

B. Higgins and V.V. Roley (1979): "Monetary policy and economic performance: Evidence from single equation models", *Federal Reserve Bank of Kansas City Economic Review*, January.

R. Holbrook and H. Shapiro (1970): "The choice of intermediate economic targets", *American Economic Review*, May.

S. Islam (1982): "Monetary and credit aggregates and economic activity: Evidence from Germany, Japan and the United States", *Federal Reserve Bank of New York Research Paper*, No. 8203.

J.P. Judd and J.L. Scadding (1982): "The search for a stable money demand function: A survey of the post-1973 literature", *Journal of Economic Literature*, September.

N. Kaldor (1980): "Monetarism and UK monetary policy", *Cambridge Journal of Economics*.

N. Kaldor (1982): "The scourge of monetarism", University Press, Oxford.

M.W. Keran (1970): "Selecting a monetary indicator – Evidence from the United States and other developed countries", *Federal Reserve Bank of St. Louis Review*, September.

D.E.W. Laidler (1978): "Money and money income: An essay on the transmission mechanism", *Journal of Monetary Economics*, April.

D.E.W. Laidler (1981): "Monetarism: An interpretation and an assessment", *Economic Journal*, March.

N.K.A. Läufer (1977): "Further evidence on the relative importance of fiscal and monetary actions in the Federal Republic of Germany" in S.F. Frowen, A.S. Courakis and M.H. Miller (eds.) "Monetary policy and economic activity in Germany", Surrey University Press, Guildford.

F.J. Levin (1974): "The selection of a monetary indicator: Some further empirical evidence" in "Monetary aggregates and monetary policy", Federal Reserve Bank of New York.

K.G.P. Matthews (1978): "A monetary model of nominal income determination for the United Kingdom". *Empirical Economics*.

K.G.P. Matthews and P.A. Ormerod (1978): "St. Louis models of the UK economy", *National Institute Economic Review*, May.

J. Melitz (1976): "Inflationary expectations and the French demand for money, 1959–70", *Manchester School*, March.

L.H. Meyer and C. Varvares (1981): "A comparison of the St. Louis model and two variations: Performance and policy implications", *Federal Reserve Bank of St. Louis Review*, December.

F. Modigliani and L. Papademos (1980): "The structure of financial markets and the monetary mechanism" in *Federal Reserve Bank of Boston Conference Series No.* 23, "Controlling monetary aggregates III".

OECD (1979): "Monetary targets and inflation control", *OECD Monetary Studies Series*.

OECD (1982): "Output responsiveness and inflation", *OECD Working Party No. 1 of the Economic Policy Committee*, CPE/WP1(82)6.

A.M. Okun (1978): "Efficient disinflationary policies", *American Economic Review*, May.

M. Ott (1982): "Money, credit and velocity", *Federal Reserve Bank of St. Louis Review*, May.

A. Penati and G. Tullio (1982): "Total Domestic Credit as an intermediate target of monetary policy in Italy", *International Monetary Fund Departmental Memoranda Series* DM/82/57.

D.D. Purvis (1980): "Monetarism – a review", *Canadian Journal of Economics*, February.

L. Radecki (1981): "Structural shift versus specification error in the demand for money", *Federal Reserve Bank of New York Research Paper*, No. 8104.

T.R. Saving (1967): "Monetary policy targets and indicators", *Journal of Political Economy*, August.

F.C. Schadrack (1974): "An empirical approach to the definition of money" in "Monetary aggregates and monetary policy", Federal Reserve Bank of New York.

H. Schlesinger (1982): "The setting of monetary objectives in Germany", Paper presented to the International Conference on Monetary Targeting, Federal Reserve Bank of New York.

T.D. Simpson (1980): "The redefined monetary aggregates", *Federal Reserve Bulletin*, February.

F. Spinelli and G. Verga (1982): "The St. Louis approach, fine tuning and the potency of fiscal policy: Some thoughts", *Review of Economic Conditions in Italy*, February.

J.E. Tanner (1972): "Indicators of monetary policy: An evaluation of five", *Banca Nazionale del Lavoro Quarterly Review*, December.

M. Willms (1972): "An evaluation of monetary indicators in Germany" in the proceedings of the 1st Konstanz Seminar on Monetary Theory and Policy, K. Brunner (ed.) *Kredit und Kapital*, Supplement.

M. Willms (1977): "Monetary indicators in the Federal Republic of Germany" in S.F. Frowen, A.S. Courakis and M.H. Miller (eds.) "Monetary policy and economic activity in Germany", Surrey University Press, Guildford.

R. Zecher (1970): "Implications of four econometric models for the indicators issue", *American Economic Review*, May.