No money, no inflation—the role of money in the economy

In this article,[1] *Mervyn King,* ***Deputy Governor****, examines the apparent contradiction that the acceptance of the idea inflation is a monetary phenomenon has been accompanied by the lack of references to money in the conduct of monetary policy during its most successful period. The disappearance of money from the models used by economists is, however, more apparent than real, with official interest rates playing the leading role as the instrument of policy, with money in the wings off-stage. Nevertheless, there are real dangers in relegating money to this behind-the-scenes role.*

Introduction

Most people think economics is the study of money. But there is a paradox in the role of money in economic policy. It is this: that as price stability has become recognised as the central objective of central banks, the attention actually paid by central banks to money has declined.

It is no accident that during the 'Great Inflation' of the post-war period money, as a causal factor for inflation, was ignored by much of the economic establishment. In the late 1970s, the counter-revolution in economics—the idea that in the long run money affected the price level and not the level of output—returned money to centre stage in economic policy. As Milton Friedman put it, 'inflation is always and everywhere a monetary phenomenon'. If inflation was a monetary phenomenon, then controlling the supply of money was the route to low inflation. Monetary aggregates became central to the conduct of monetary policy. But the passage to low inflation proved painful. Nor did the monetary aggregates respond kindly to the attempts by central banks to control them. As the governor of the Bank of Canada at the time, Gerald Bouey, remarked, 'we didn't abandon the monetary aggregates, they abandoned us'.

So, as central banks became more and more focused on achieving price stability, less and less attention was paid to movements in money. Indeed, the decline of interest in money appeared to go hand in hand with success in maintaining low and stable inflation. How do we explain the apparent contradiction that the acceptance of the idea that inflation is a monetary phenomenon has been accompanied by the lack of any reference to money in the conduct of monetary policy during its most successful period? That paradox is the subject of my talk.

Of course, some central banks, especially the Bundesbank and the Swiss National Bank, always paid a good deal of attention to monetary aggregates. But when the European Central Bank acquired responsibility for monetary policy it adopted a reference value for money growth as only one of its two pillars of monetary policy, with an assessment of the outlook for inflation as the other. And the Swiss National Bank recently replaced its target for the monetary aggregates with one for inflation. In the United States, the Federal Reserve, at its own request, has been relieved of the statutory requirement, imposed in 1978, to report twice a year on its target ranges for the growth of money and credit. As Larry Meyer, a Governor of the Federal Reserve Board explained earlier this year, 'money plays no explicit role in today's consensus macro model, and it plays virtually no role in the conduct of monetary policy.'

The decline and fall of money in policy formation is confirmed by a fall in the number of references to money in the speeches of central bank governors. So much so that over the past two years, Governor Eddie George has made one reference to money in 29 speeches, Chairman Greenspan one in 17,

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Governor Hayami one in 11, and Wim Duisenberg three in 30.

Money and inflation: the evidence

Let me begin by looking at some of the historical evidence. Chart 1, which extends the results of McCandless and Weber (1995), shows the correlation between the growth of the monetary base and inflation over different time horizons for a large sample of 116 countries. Countries with faster growth rates of money experience higher inflation. It is clear from Chart 1 that the correlation between money growth and inflation is greater the longer is the time horizon over which both are measured. In the short run, the correlation between monetary growth and inflation is much less apparent. Understanding why this is so is at the heart of monetary economics and still poses problems for economists trying to understand the impact of money on the economy. I shall return to this later.

Few empirical regularities in economics are so well documented as the co-movement of money and inflation. Chart 2 shows that this relationship is true for broad money as well as the monetary base. The other side of the coin to this close relationship between money and prices is the absence of a long-run relationship between money and output growth, shown in Chart 3. Over the 30-year horizon 1968–98, the correlation coefficient between the growth rates of both narrow and broad money, on the one hand, and inflation, on the other, was 0.99. Correspondingly, the correlation between the growth of narrow money and real output growth was -0.09 and between broad money growth and output was -0.08.

Correlation, of course, is not causation. The essence of monetary theory is trying to understand the structural relationship between money growth, demand, output and price movements. Stable structural relationships can give rise to unstable short-run correlations between any of these variables. It is, therefore, somewhat surprising that some economists have argued that the instability of observed short-run correlations casts doubt on the long-run importance of money growth in the inflationary process. Chart 4 shows the behaviour of the price level in the United Kingdom and its relationship with the ratio of money to real income over the period from 1885 to 1998. Short-run movements in the velocity of money are apparent, as well as the long-run link between money and inflation.

The view that money does not matter has been encouraged by those who point to regressions of inflation and output growth on monetary growth, and find that the influence of money is either insignificant or unstable. But these results tell us little about the significance of money in the transmission mechanism of monetary policy. They are based on what economists call reduced-form equations, the coefficients of which will be complex functions of the true structural parameters of the economy, as well as expectations of future policy responses by the monetary authorities. There is no reason to expect a simple relationship between inflation and output and money growth in reduced-form estimates.

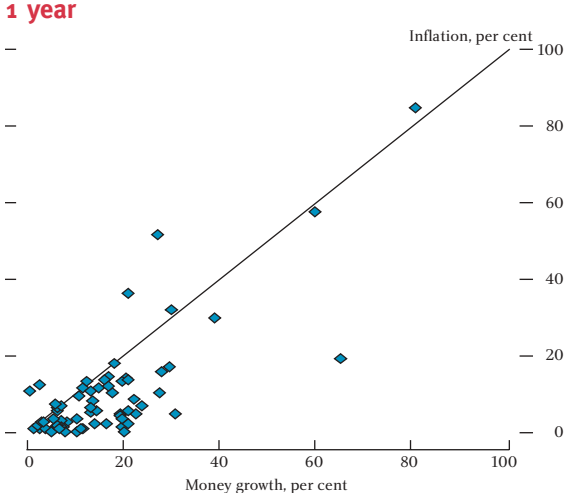
This last point was clearly grasped by Friedman and Schwartz in their classic 1963 study of money in the United States. They took great care to identify periods in which there was an exogenous shock to the money supply, such as moves on to and off the gold standard, and changes in reserve requirements imposed on banks. More recent studies, such as Estrella and Mishkin (1997), Hendry (2001), Gerlach and Svensson (2000) and Stock and Watson (1999) produce conflicting and unstable regression results for the influence of money growth on inflation.

To understand the true role of money, a clear theoretical model is required and that model must allow for the central role of expectations. The key role of expectations is best illustrated by considering extreme cases of high inflation, known as hyperinflations. In hyperinflations the effect of expectations on money and inflation is amplified relative to other influences, such as the business cycle.

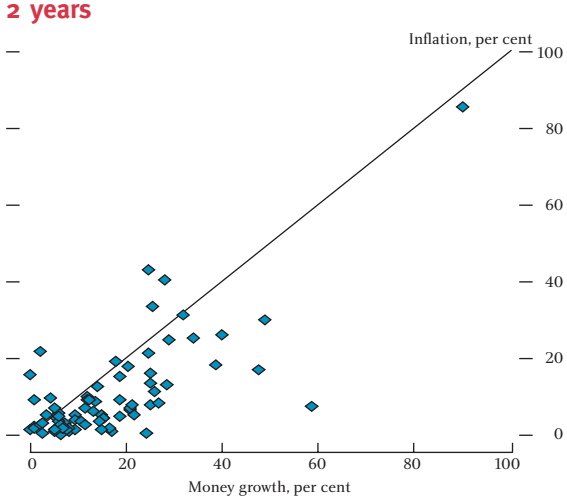
Chart 5 shows the link between money and prices in four hyperinflations. Two of these are drawn from the inter-war period, namely the hyperinflations in Austria and Hungary, and two are post-war hyperinflations, in Argentina and Israel. At their peak, these hyperinflations involved annual inflation rates of 9,244%, 4,300%, 20,266%, and 486% respectively. All four hyperinflations illustrate the importance of expectations. In the case of the two inter-war hyperinflations, large government deficits were monetised, leading to rapid money growth and inflation. The public tried to economise on money holdings, and so real money demand fell. Announcements of credible fiscal stabilisations changed inflation expectations and led extremely quickly to a rapid fall in inflation. Lower

Chart 1
Annual inflation and growth of narrow money at different horizons across countries

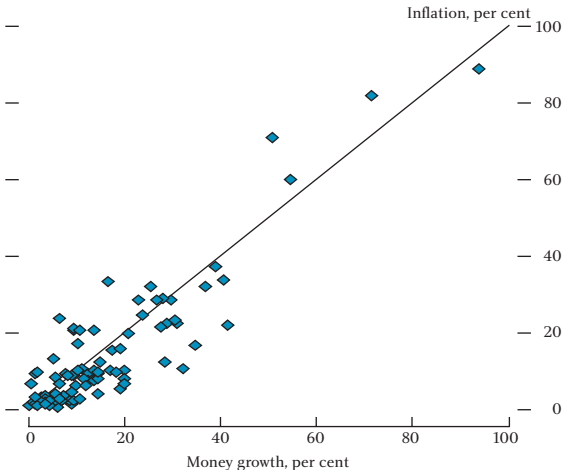
1 year



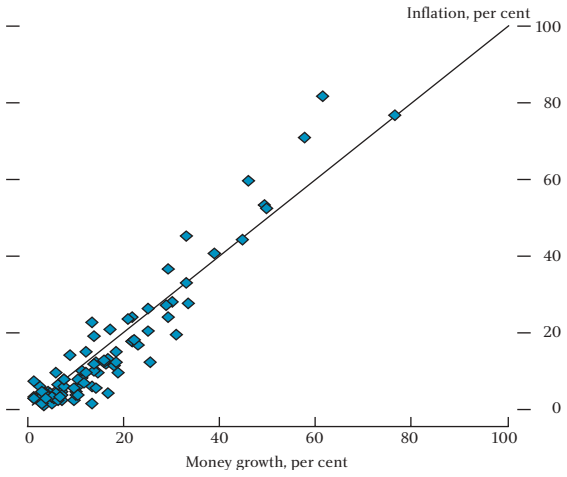
2 years



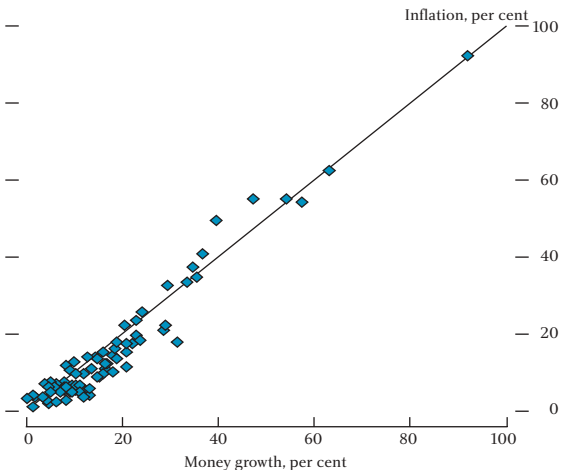
5 years



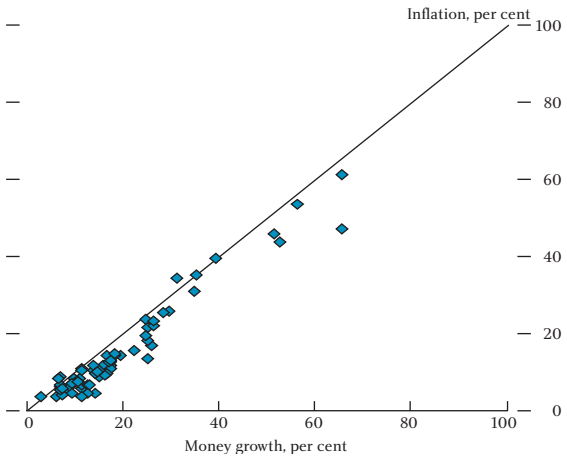
10 years



20 years



30 years

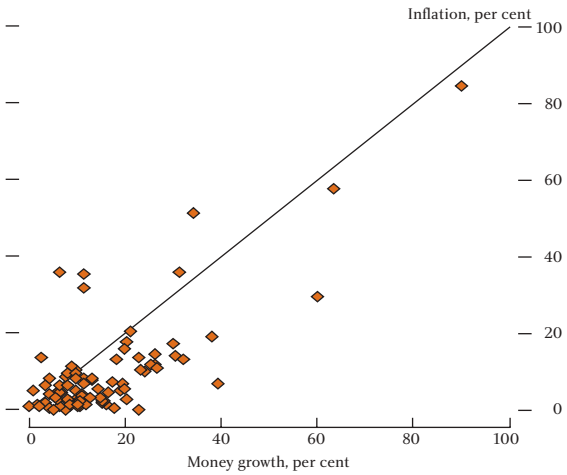


Note: Narrow money is reserve money, which includes currency in circulation (data item 14 in each IFS country table). Inflation is the percentage increase in the consumer price index (item 64). For presentation purposes, countries with average annual money growth or inflation exceeding 100% have not been included in the charts.

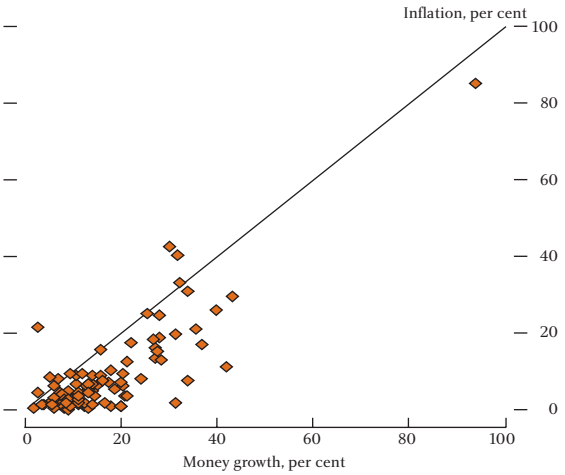
Source: *International Financial Statistics*, International Monetary Fund.

Chart 2
Annual inflation and growth of broad money at different horizons across countries

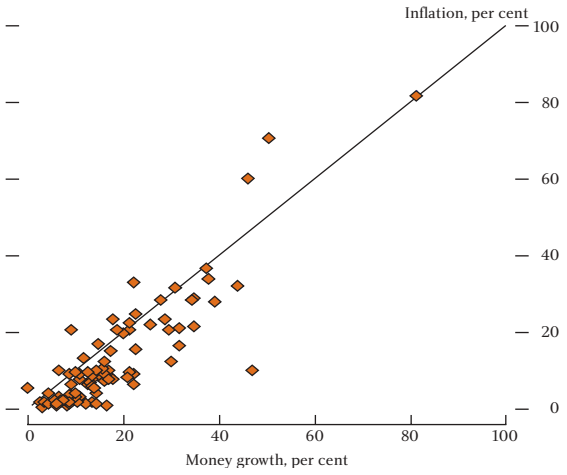
1 year



2 years



5 years



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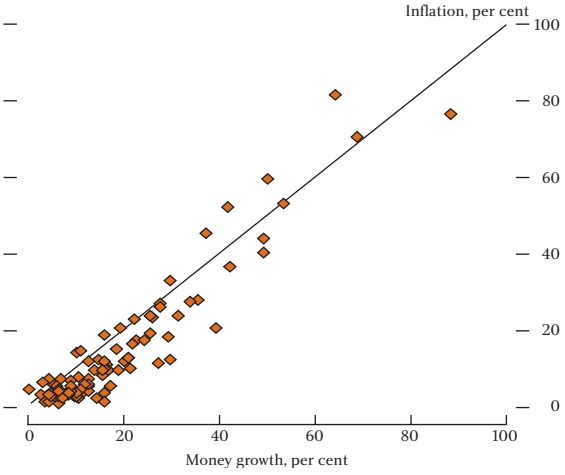

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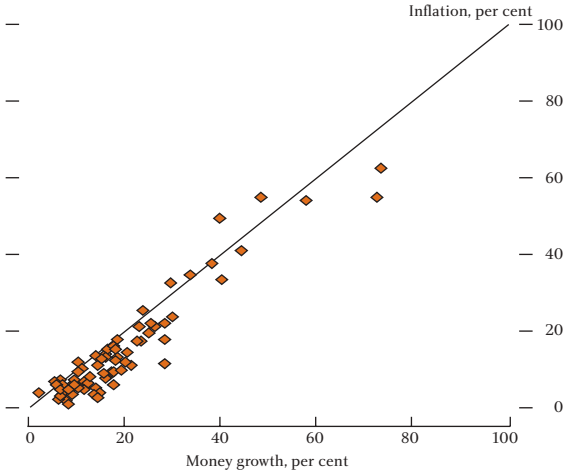
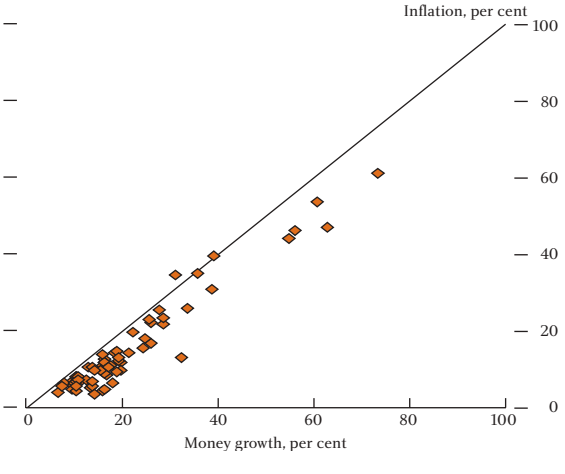


30 years

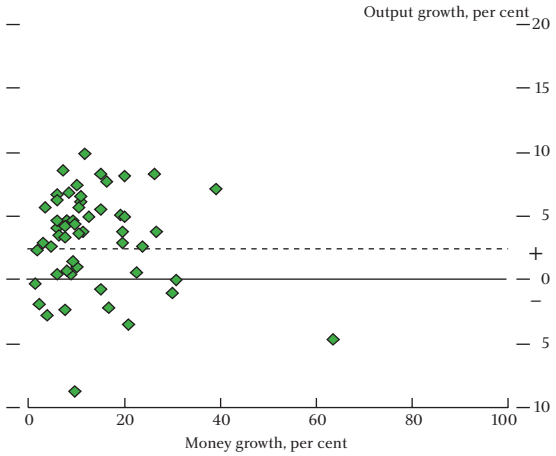


Note: Broad money includes demand deposits and time deposits (data items 34 and 35 in each IFS country table). Inflation is the percentage increase in the consumer price index (item 64). For presentation purposes, countries with average annual money growth or inflation exceeding 100% have not been included in the charts.

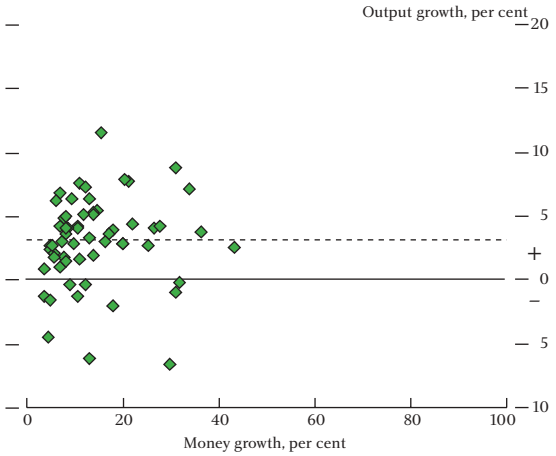
Source: *International Financial Statistics*, International Monetary Fund.

Chart 3
Annual growth of broad money and output at different horizons across countries

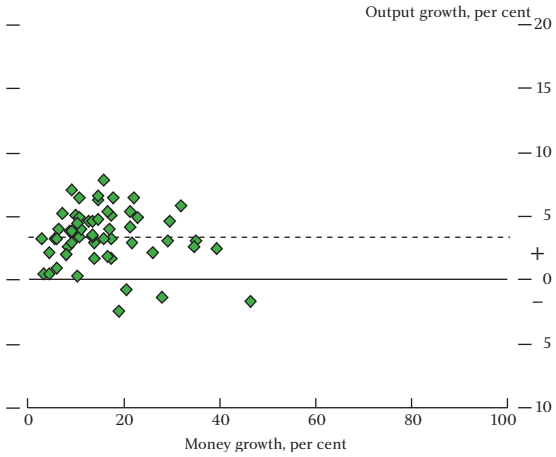
1 year



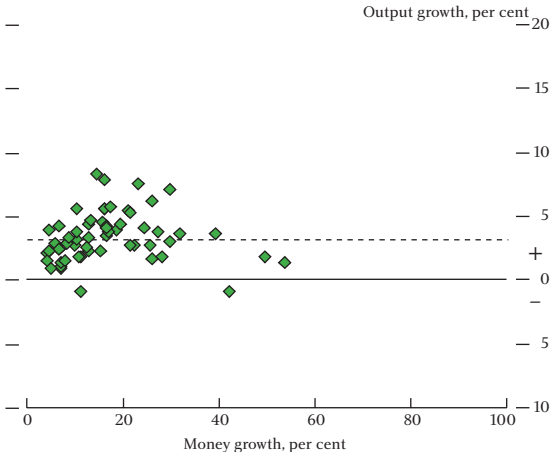
2 years



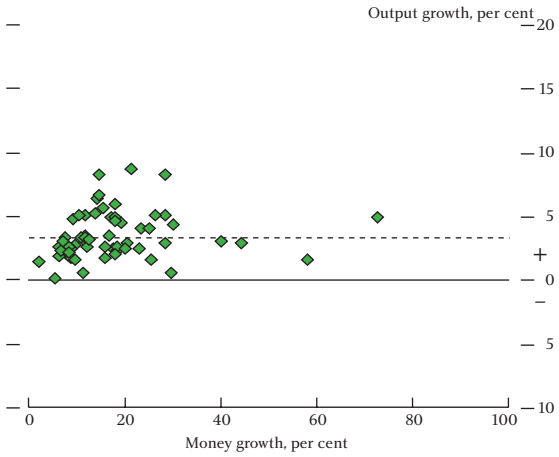
5 years



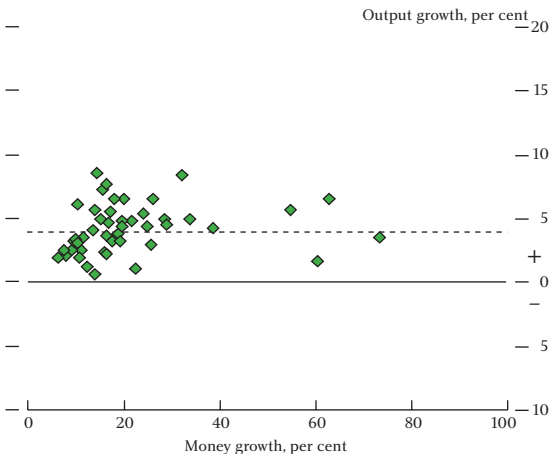
10 years



20 years



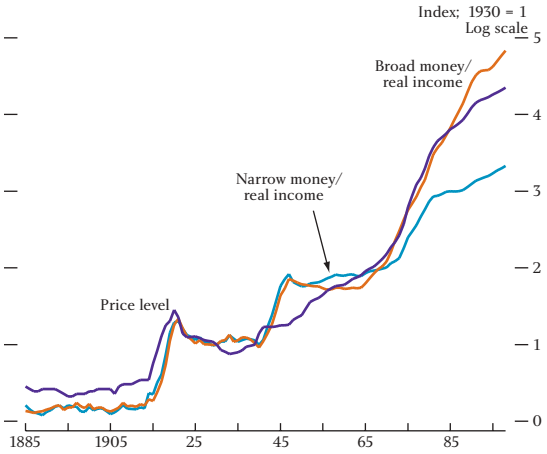
30 years



Note: Real output is nominal GDP (data items 99b in each IFS country table) deflated by the consumer price index (item 64). A GDP deflator was only available for a small sample of countries, and was therefore not used. The dashed horizontal line represents the average annual money growth across countries for each time horizon. For presentation purposes, countries with average annual money growth or inflation exceeding 100% have not been included in the charts. There were eight countries that had negative average real output growth over the 1978–98 period. These countries have not been included in the charts.

Source: *International Financial Statistics*, International Monetary Fund.

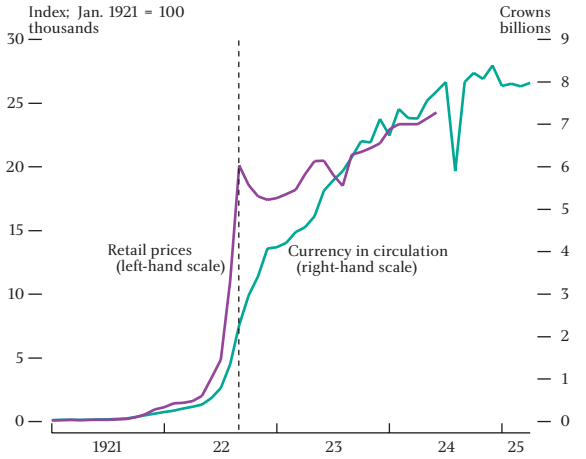
Chart 4
Prices and money relative to real incomes in the United Kingdom: 1885–1998



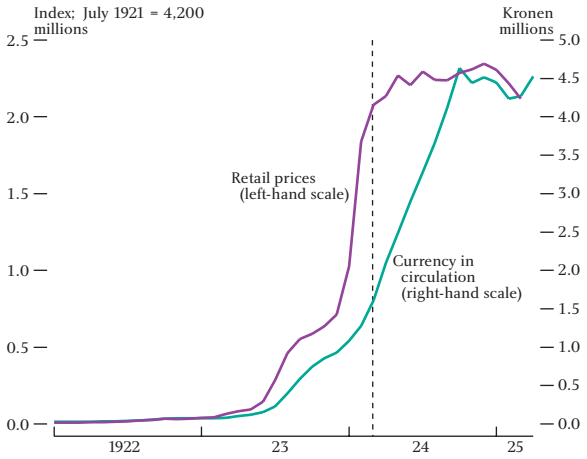
inflation encouraged real money demand to rise again, and so nominal money growth continued to rise for some time after inflation had fallen. Inflation was, therefore, stabilised ahead of the slowdown in money growth, although the causation ran from the credible announcement of monetary contraction to lower inflation. The dashed vertical lines in the charts indicate the announcement dates of stabilisation packages. In Argentina, inflation expectations were stabilised by the convertibility plan of 1991 which established a currency board to back the local currency in terms of the US dollar. Inflation expectations fell, and, as in the earlier cases, the fall in inflation preceded the slowdown in money growth. The case of Israel is somewhat different in that the absence of any delay between the announcement and the implementation of the stabilisation programme in 1985 meant that the gap between the fall in inflation and the contraction of monetary growth was shorter than in the other cases shown in Chart 5. Although hyperinflations are extreme examples, they do illustrate the fact that, even when monetary contraction is evidently the cause of a fall in

Chart 5
Money and prices during four hyperinflations

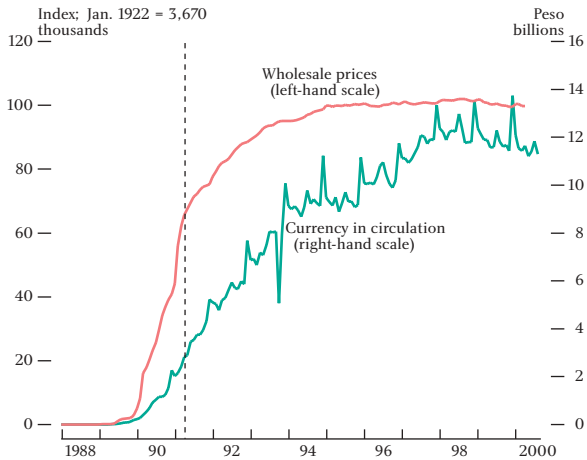
Austria



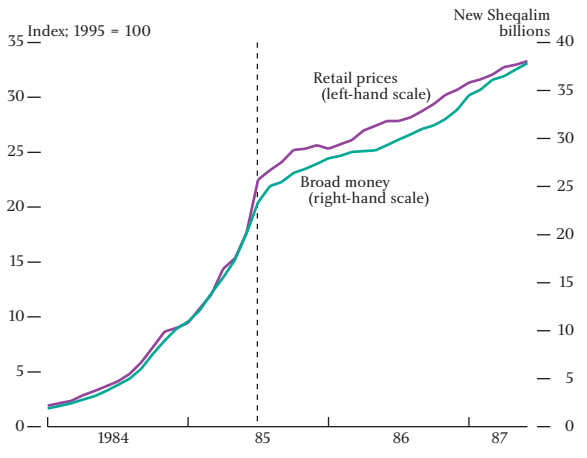
Hungary



Argentina



Israel



Note: Dashed vertical lines indicate the date at which a stabilisation plan involving fiscal and monetary reforms was announced.

Sources: Austria and Hungary: Sargent, T (1993), *Rational expectations and inflation*, Harper Collins College Publishers, New York, pages 80–92. Argentina and Israel: *International Financial Statistics*, International Monetary Fund.

inflation, the rapid response of expectations means that inflation may fall before signs of a slowing of monetary growth itself.

To make progress, a more complete account is required of the role of money in the transmission mechanism, and it is to this that I now turn.

Understanding the role of money

There is an old joke to the effect that economists spend their time trying to work out how something that works in practice can work in theory. The role of money in the economy offers an excellent example. In modelling the monetary transmission mechanism, economists have tended to rely on two types of 'rigidities' which introduce time lags into the process by which changes in money lead to changes in prices. These are lags in the adjustment of prices and wages to changes in demand—so-called 'nominal rigidities'—and lags in the adjustment of expectations to changes in the monetary policy regime—so-called 'expectational rigidities'. These rigidities mean that money affects real variables in the short run and prices in the long run.

But we have no good theories to explain either type of rigidity, nor a clear idea of when the short run turns into the long run. Hence Milton Friedman's dictum that there are 'long and variable' time lags between changes in monetary policy and their impact on inflation. To understand these theoretical shortcomings, it is helpful to consider an abbreviated history of the models used by economists to analyse the impact of money. The standard or consensus model comprises four basic equations (see Table A). First, there is an equation for aggregate demand which relates total demand to either money or interest rates and to expected inflation. The aggregate demand function is sometimes known as the 'IS' curve. Second, there is an equation describing the supply side of the economy in which total output is related to differences between expected and actual inflation; this is the 'Phillips-Lucas supply curve'. Third, there is an equation for the demand for money relating broad money holdings to total expenditures and the interest rate; the 'LM' curve. Fourth, there is an equation describing monetary policy in which the supply of broad money is determined by the actions of the central bank in controlling base money (bank reserves plus notes and coin in circulation) which in turn influences broad money provided by the banking system through the 'money multiplier'. This equation represents the monetary policy reaction function of the central bank. The model determines the values of output, inflation, the interest rate, and money growth. Most models used to analyse monetary policy are based on a variant of this four-equation system, with increasing importance over time given to the role of expectations in the Phillips curve.

Table A
Standard monetary model

$$Y_D = f_1\,(M, i, E(\pi)) \quad (1)$$
$$Y_S = f_2\,(\pi\text{-}E(\pi)) \quad (2)$$
$$M_D = f_3\,(Y_D, i) \quad (3)$$
$$M_S = f_4\,(Y_D, i, \pi) \quad (4)$$

Given (i) a model for $E(\pi)$
(ii) equilibrium, ie $Y_D = Y_S = Y$; $M_D = M_S = M$
then the four equations determine $\{Y, M, i, \pi\}$.

In this framework, the standard theoretical view of the transmission mechanism of monetary policy works as follows. An unexpected increase in the money supply reduces the nominal interest rate in order to persuade households to hold larger money balances. If inflation expectations are slow to adjust to the increase in the money supply—because of expectational rigidities—then the fall in the nominal interest rate also implies a fall in the real rate of interest. This raises expenditures on items such as investment and consumer durables which are sensitive to interest rates. If prices and wages are slow to adjust to higher demand—because of nominal rigidities—then in the short run firms are induced to supply more output. As the pressure on capacity in the economy rises, employees demand higher wages to reflect increased demand and both wages and prices rise. In the long run output is determined solely by real factors, and the increase in money supply is reflected in a rise in the price level.

More recently, the equation for money supply has been replaced by an explicit feedback rule for interest rates. The money demand equation plays no explicit role in determining output, inflation and interest rates. Money, it would appear, has been eased out of the picture. In these new models, a loosening of monetary policy—characterised by an unexpected reduction in the nominal interest rate—raises demand, output and, ultimately, inflation. In the long run the inflation rate is determined by monetary policy, in the sense that the monetary policy reaction function determining interest rates contains an explicit inflation target. Money growth is higher, the higher is the inflation rate, but, if the model were an accurate description of the economy, the interest rate would be a sufficient statistic of monetary policy. Models of this type in which interest rates are

the policy instrument are widely used both in theoretical analysis and in the design of empirical policy rules, such as the well-known Taylor rule. Given this prominent role for interest rates rather than money in the theoretical analysis of policy, it is, perhaps, not surprising that econometric forecasting models in most major central banks include interest rates, but not the quantity of money.

Despite appearances, however, these new models give no less weight to money than the older versions. Irrespective of whether the central bank uses base money or interest rates as the policy instrument, the quantity theory of money still applies. In the new models, monetary quantities play no independent role in the transmission mechanism over and above that summarised in interest rates. But, equally, in the old models too, monetary policy impacted on the economy through its effects on interest rates. The key question is not whether the central bank uses the monetary base or interest rates as its policy instrument. It is whether the equations which are embedded in both the old and new models of monetary policy exclude important channels through which monetary policy works.

Before attempting to answer this question, the consensus model can be used to illustrate a key point made earlier, namely that there is no reason to expect a stable relationship between money and inflation in the short run. Using a linearised model of the type described in Table A, the exact details of which are given in the technical appendix, simulated data can be generated for long time periods corresponding to realisations of the various shocks to the economy. In particular, a quarterly model was constructed using calibrated parameters and processes for the stochastic shocks in each equation. Several variants of the model were then created, keeping the main model parameters constant, but altering the variance and persistence of the stochastic shocks. By simulating the shock processes 10,000 times for each variant, several datasets spanning 2,500 years were created. Reduced-form regressions were then run on the variants of the model to estimate the dependence of inflation on lagged values of output, money growth and inflation itself. Note that, by construction, money has a stable causal effect on inflation. The regression results obtained from different sample periods produce a wide variation of estimated coefficients on money in determining inflation (see Table B). In fact, these coefficients can be either positive, negative or insignificantly different from zero, depending on the constellation of shocks hitting the economy. Moreover, the reduced-form relationships change with the length of the horizon (see Table C). Money appears to contain little information about very short-term inflationary pressures, but it becomes much more significant in the long run. In contrast, the impact of output growth on inflation falls as the horizon lengthens. The conclusion is straightforward. Simple reduced-form econometrics are no substitute for a clear theoretical structural model of how monetary policy works (a point also made by Nelson (2001)). Thinking needs to be liberated from the 'tyranny of regressions'.

Table B
What can we learn from this model about simple econometrics?

Consider two reduced-form regressions, specified as:

$$\pi_t = \sum_{s=1}^{i} \gamma_s \pi_{t-s} + \sum_{s=0}^{j} \delta_s (y_{t-s} - \bar{y}_{t-s}) + \sum_{s=0}^{k} \mu_{t-s} (\Delta m_{t-s}) \qquad (1)$$

$$\pi_t = \sum_{s=1}^{i} \gamma_s \pi_{t-s} + \sum_{s=0}^{j} \delta_s (\Delta y_{t-s}) + \sum_{s=0}^{k} \mu_{t-s} (\Delta m_{t-s}) \qquad (2)$$

Long-run coefficient on money growth		Changes to the sources or magnitudes of shocks from the baseline
(1)	(2)	
-0.14	0.05	Case 1: None.
-0.50	-0.08	Case 2: Increase in the autocorrelation of demand shocks to 0.5.
-2.51	-1.4	Case 3: Increase in the standard deviation of mark up shocks to 0.01.
0.65	0.78	Case 4: Increase in the standard deviation of mark up shocks to 0.01, the autocorrelation of cost push shocks to 0.8 and the standard deviation of policy shocks to 0.04.

Notes and sources: Precise details are provided in the technical appendix. Under the baseline, demand ($\varepsilon 1$ from the technical appendix), mark-up ($\varepsilon 2$), monetary policy ($\varepsilon 3$) and supply ($\varepsilon 4$) shocks are generated with standard deviations of 0.01, 0, 0.0082 and 0.0072, respectively, and with first-order autocorrelation of 0.33, 0, 0.3 and 0.95 respectively. These values are consistent with Nelson (2000) and Neiss and Nelson (2001). Each regression uses 10,000 observations.

Table C
What can we learn about money from simple econometrics?

The correlations between the simulated data depend on their frequency, as they do in the historical data.

	corr $(y - \bar{y}, \Delta p)$	corr $(\Delta m, \Delta p)$
Short run	0.79	0.23
Long run	0.05	0.68

Note: Short run means a contemporaneous correlation between the variables and long run means a correlation between the output gap today and average inflation over the following 25 years, or average money growth and inflation both over a 25-year period.

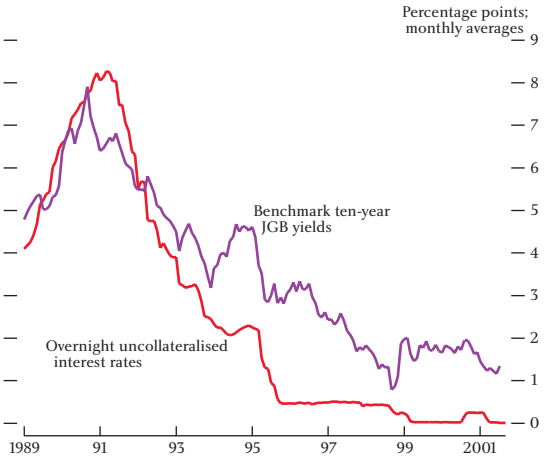
Both old and new models of the monetary transmission mechanism have important limitations. Crucially, there is only a single financial asset. But in the traditional monetarist account (Friedman and Schwartz (1963)) money is an imperfect substitute for a wide range of financial and real assets, including bonds, equity, physical capital and durable goods. A monetary policy

change induces a rebalancing of portfolios in general, affecting nominal demand both directly (through wealth and substitution effects on real assets), and indirectly (through adjustments in a wide range of financial yields relevant to expenditure decisions). Hence both old and new models may ignore an important part of the transmission mechanism of monetary policy.

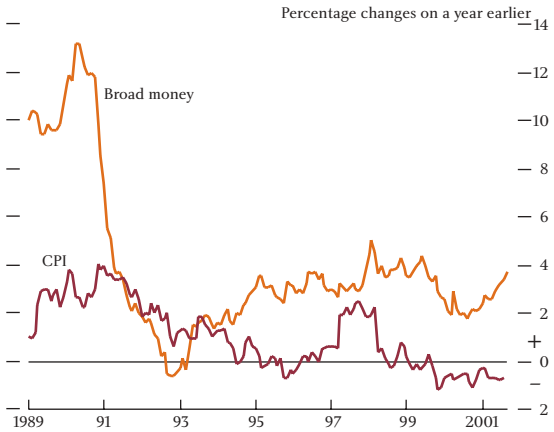
The practical relevance of this consideration is extremely topical. The conventional model suggests that monetary policy is ineffective if interest rates have reached their natural floor of zero and a further reduction of real interest rates is required to stimulate demand. Japan appears to be in exactly that situation at present. Chart 6 shows the recent experience of monetary policy in Japan. Inflation has been very low; indeed, it has been negative in recent years. The Bank of Japan has lowered interest rates to the point where they have now hit their lower bound of zero. Interest rates have been extremely low for five years, and have been almost exactly zero since February 1999. The question of whether monetary policy is impotent when interest rates are zero has remained open since the possibility of a 'liquidity trap' was suggested by Keynes in the General Theory and revived recently by Paul Krugman.

Chart 6
Interest rates, money and inflation in Japan (1989–2001)

A. Interest rates



B. Broad money growth and CPI



Broadly speaking, there are two answers to this question. The first is that monetary policy is indeed impotent when interest rates are zero. At this point, households and firms have an infinitely elastic demand for money balances, and so any increase in money supply is absorbed passively in higher balances. An increase in money supply has no implications for spending or output. In such circumstances, the only way to affect the economy is by an expansionary fiscal policy. The second answer is that, at some point, households and firms become satiated with money balances at the current level of income, and any attempt to increase the money supply leads them to adjust portfolios in order to limit their holding of money balances. These changes in household portfolios lead to changes in relative yields on different financial and real assets, and hence on asset prices and, in turn, real spending. Despite interest rates remaining at zero, monetary policy, in this world, can influence nominal spending and incomes.

Which view is the more attractive theoretically and empirically? It is clear that, in part, the answer depends on the response of the demand for money as interest rates tend to zero. If the demand for money tended to infinity, as the interest rate tended to zero, then an expansion in the money supply would have no real effect on demand and output because any additional money created would simply be absorbed passively in money holdings. But if the demand for money is satiated at a finite level as interest rates tend to zero, then the creation of money beyond that point would be translated into a demand for other assets and higher incomes. Since observations on interest rates close to zero are rare in practice, there is little evidence to enable us to distinguish between these two hypotheses.

A recent study by economists in the Bank of England (Bakhshi, Martin and Yates (2002)) finds some evidence of a satiation point in the demand for narrow money in the United Kingdom, although Bental and Eckstein (1997) and Lucas (2000) find evidence for an asymptote. The empirical evidence is not, therefore, decisive. There are very considerable uncertainties surrounding these estimates. But they are at least consistent with the

possibility that monetary policy may have potency even at zero interest rates.

What, therefore, has economic theory to say about how changes in money might affect nominal demand, over and above any influence via interest rates? This is a question that is relevant to all economies, not just those, such as Japan, facing zero interest rates. One view, associated with Pigou (1943) and Patinkin (1965) is that a monetary expansion will, in the presence of sticky prices ('nominal rigidities') lead to a rise in the real value of the money stock which will, in turn, raise household net wealth and lead to higher expenditures. There are two objections to this view. The first is that the only part of the money supply which constitutes net wealth for the economy as a whole is 'outside' money, namely the monetary base. And this accounts for only a very small fraction of financial wealth—a little over 1% in the United Kingdom. So the quantitative impact of the real balance effect is inevitably small.

Second, even this effect is subject to households failing to take into account the impact on future generations of the use of monetary financing. Nevertheless, models by which money changes real balances have become more fashionable recently. Building on the work of Sidrauski (1967), a number of economists have examined the impact of higher money holdings on the size of transactions costs. An unexpected monetary expansion lowers transactions costs, according to this view, and increases the attractions of consumption. Effects of varying size have been claimed by authors such as Ireland (2001a, 2001b), Koenig (1990), McCallum (2001) and Woodford (2002). Such transmission mechanisms, however, do not appear to be empirically significant nor do they correspond to the main channels of policy as seen by earlier generations of economists.

The main difference between the models described above and earlier writings on money is the absence in those models of financial yields other than the short-term interest rate. In principle, many more asset yields could enter the demand for money. In his own writings, Keynes placed emphasis on the yield on long-term government bonds. In this view, expansionary monetary policy can take the form of open market operations in which the central bank purchases a wide variety of assets, not just short-term government securities. Yields on a wide variety of financial assets respond, and in turn so does demand. One of these financial prices is the exchange rate. That is why some economists see the salvation for Japan in terms of the exchange rate. They recommend strategies such as expanding the monetary base in order to produce a fall in the market exchange rate which would lead to an upturn driven by net trade. Alternatively, economists such as Svensson (2001) have recommended pegging the yen at a much lower exchange rate against the dollar. This, it is argued, would lead to expectations of higher inflation which, given zero nominal interest rates, would produce a negative real interest rate that would generate an expansionary impact on the economy.

The major question, however, is how an expansion of the money supply operates through indirect effects on the yields of other assets which are excluded from conventional models of the transmission mechanism. If future interest rates are incorporated into optimal consumption behaviour, then the only channel by which monetary policy can operate, other then via interest rates, is through changes in risk premia.

How might we try to integrate monetary theory and portfolio theory? Little help will come from traditional finance theory. The reason is extremely simple. Most finance theory is based on the assumption that equilibrium yields on assets, including risk premia, are independent of the quantities of the supplies of different assets. Hence the search for a better model of the monetary transmission mechanism is, in part, a search for evidence of supply effects on financial asset yields. That is why the view that money matters, over and above interest rates, is intimately bound up with a question of whether the supplies of different assets affect yields, and hence whether the composition of government debt affects both money and real economic behaviour. In the United Kingdom, Tim Congdon has emphasised the importance of 'funding policy' in the determination of the broad money supply, a subject which has been analysed in detail by Goodhart (1999). The broad weight of opinion, to date, is that supply effects are hard to find. Many years ago, for example, the United States tried to change the slope of the yield curve on its government debt by 'Operation Twist' in which the composition of government debt was altered in an attempt to change relative yields. This experiment was widely regarded as a failure. Intriguingly, however, there is renewed interest among finance theorists in the impact of supply effects on yields. More and more puzzles in the theory of finance appear to be related to the existence of supply effects.

There seems to be a gap between modern finance theory and the traditional monetarist account in which a monetary expansion causes a rebalancing of portfolios putting direct upward pressure on a range of asset prices, which in turn stimulates higher nominal demand. To bridge this gap requires a more careful analysis of exactly what is special about money. Much of the traditional monetarist account relies on the imperfect substitutability between various marketable assets, including money. But there is often a weak theoretical rationale for the mechanisms discussed. Thus, while it is clear that financial markets have a much richer structure than is conventionally assumed by the models described earlier, the monetarist argument that this is sufficient to imply a significant role for money remains unproven. What are the promising avenues for future research? The solution, I conjecture, will be based on two observations:

1. Transaction costs are important in determining asset prices—many of the puzzles in the behaviour of asset prices, such as the equity risk premium, can be resolved by taking the effects of transaction costs seriously.

2. Money reduces transaction costs.

Rather than rely on a barter economy, goods (or labour) can be exchanged for money, and money for goods. But there is no reason to suppose that the same argument cannot be used in asset markets.

If the quantity of money can affect the size of transaction costs in financial markets, then it will have an effect on expenditures and inflation, over and above any change via the transmission from changes in risk-free interest rates. Over the past decade, economists have made strides in setting out a more coherent theoretical story of the way in which money reduces trading frictions in markets for goods and services. Traditional models of exchange economies make strong demands on the institutional arrangements that underlie transactions. Money can help reduce these transactions costs. And it is possible that money might have a similar role in alleviating frictions in financial markets, thus expanding the scope of the transmission mechanism of monetary policy. It is striking that nearly a quarter of the money stock in the United Kingdom is held by non-bank financial firms. The frictions which money helps to overcome in financial markets are related to its role in providing liquidity services. Money enables individuals, both households and firms, to avoid borrowing should they hit a cash-flow constraint. Since the probability of experiencing such a constraint falls as the stock of money rises, changes in money could affect relative asset returns. Introducing financial frictions into models of asset prices, and recognising the role of money in reducing those frictions, provides, in my view, a potentially more significant role for money in the transmission mechanism than has been examined hitherto in a rigorous way. The theoretical support for, and empirical relevance of, such an approach is still unclear. So there is a substantial agenda for future research.

The link between money and the provision of financial services more generally is clear in the historical evolution of 'inside money', such as checking accounts and credit cards, which now constitute the bulk of broad money. Credit services can displace the use of 'outside money' in transactions, but only where their cost is sufficiently low, and that may depend upon the individual characteristics of the agents undertaking the transactions. As a result, the parameters of the money demand function are dominated by the technology of transaction services, and can be unstable over time (as for example, in the model of Aiyagari, Braun and Eckstein (1998)). This instability derives not from the irrelevance of money, but from changes to technology.

Money and monetary policy

What does this debate about the transmission mechanism of monetary policy mean for the conduct of monetary policy today? The role of money in determining the price level, and its embodiment in the quantity theory of money, evolved over several hundred years. The broad shape of this theory was accepted by most economists. It is certainly evident in the writings of both John Maynard Keynes and Irving Fisher. As the theory of monetary economics developed, so too did the practice of monetary policy. In Britain, the beginning of the theory and practice of monetary policy as we know it today started with the Bank Charter Act of 1844. Keynes wrote that prior to the 1844 Act, 'the principles and methods of currency management were but ill understood by those responsible for its management, namely, the Governors and Court of the Bank of England.' (*Treatise on money*, pages 14–15.) He went on to conclude, 'The efficiency of bank-rate for the management of a managed money was a great discovery and also a most novel one—a few years earlier the Bank

of England had not had the slightest understanding of any connection between bank-rate policy and the maintenance of the standard' (*op cit* page 15). I hope that the Bank of England today has at least some understanding of the relationship between interest rates and inflation!

Thinking of monetary policy in terms of interest rates has become the norm in central banks today. Frequent and volatile shifts in the demand for money led central banks to change their focus from monetary aggregates towards the control of short-term interest rates. Few major central banks now place the monetary aggregates at the centre of their targeting regime. Instabilities in the demand for money are not new. In the early years of the Bank of England, there were unexpected shifts in the demand for money and credit resulting from uncertain arrival times in the port of London of ships laden with commodities from all over the world. The uncertainty derived from changes in the direction and speed of the wind carrying ships up the Thames to the port of London. Hence the Court Room of the Bank of England contained a weather vane which provided an accurate guide to these shifts in money demand—the weather vane is there to this day, and it still works. If only monetary policy could be as scientific today! Financial liberalisation and changes in the technology of payments and settlements have led to large volatilities in money demand. No one has yet worked out how to translate such shifts into a simple reading on the financial equivalent of a weather vane. So central banks have paid decreasing attention to the monetary aggregates as an intermediate indicator of their policy stance.

Although there is no mechanical link from the monetary aggregates to inflation, the underlying relationships, in quantitative form, still hold. Hence it is important for a central bank to understand changes in money. One of the features of Bank of England analysis of monetary developments is the attempt to understand the entire range of monetary quantities and prices facing agents in the economy. Each month the Monetary Analysis and Strategy Division of the Bank of England produces a *Quarterly Monetary Assessment* in order to provide the Monetary Policy Committee with as much information as possible about monetary developments. Part of this includes an analysis of equilibrium interest rates and the stance of monetary policy. Rules, such as the Taylor rule, provide a useful benchmark against which to judge whether interest rates are too high or too low. But the analysis provided by the Bank of England is not restricted to interest rates. It is crucial to look at developments in quantities in the monetary area and credit conditions, as well as prices. Using historical relationships estimated from the data, developments in money and credit, and their sectoral patterns, can be used as indicator variables for near-term activity and inflation. The short-term outlook for consumption, for example, can be related to movements in Divisia Money, and the outlook for investment is related to the financial position of the corporate sector.

Conclusions

I return to the paradox with which I began. Most people believe that economics is about money. Yet most economists hold conversations in which the word 'money' appears hardly at all. Surprisingly, that appears true even of central bankers. The resolution of this apparent puzzle, is, I believe, the following. There has been no change in the underlying theory of inflation. Evidence of the differences in inflation across countries, and changes in inflation over time, reveal the intimate link between money and prices. Economists and central bankers understand this link, but conduct their conversations in terms of interest rates and not the quantity of money. In large part, this is because unpredictable shifts in the demand for money mean that central banks choose to set interest rates and allow the public to determine the quantity of money which is supplied elastically at the given interest rate.

The disappearance of money from the models used by economists is, as I have argued, more apparent than real. Official short-term interest rates play the leading role as the instrument of policy, with money in the wings off-stage. But the models retain the classical property, that, in the long run, monetary policy, and hence money, affect prices rather than real activity. Nevertheless, there are real dangers in relegating money to this behind-the-scenes role. Three dangers seem to me particularly relevant to present circumstances. First, there is a danger of neglecting parts of the monetary transmission mechanism that operate through the impact of quantities on risk and term premia of various kinds. The current debate about the appropriate monetary policy in Japan illustrates this point. Second, by denying an explicit role for money there is the danger of misleading people into thinking that there is a permanent trade-off between inflation, on the one hand, and output and employment, on the other. Third, by

discussing monetary policy in terms of real rather than monetary variables, there is the danger of giving the impression that monetary policy can be used to fine tune short-run movements in output and employment, and to offset each and every shock to the economy. These dangers all derive from the habit of discussing monetary policy in terms of a conceptual model in which money plays only a hidden role.

Habits of speech not only reflect habits of thinking, they influence them too. So the way in which central banks talk about money is important. There is no inconsistency between the consensus models we use to analyse policy in terms of interest rates and the proposition that monetary growth is the driving force behind higher inflation. But it would be unfortunate if the change in the way we talk led to the erroneous belief that we could turn Milton Friedman on his head, and think that 'Inflation is always and everywhere a real phenomenon'.

My own belief is that the absence of money in the standard models which economists use will cause problems in future, and that there will be profitable developments from future research into the way in which money affects risk premia and economic behaviour more generally. Money, I conjecture, will regain an important place in the conversation of economists. As Hilaire Belloc wrote,

'I'm tired of Love: I'm still more tired of Rhyme.
But Money gives me pleasure all the time'.

Technical appendix on the generation of the simulation results

The model used here is a linearised version of that shown in Table A, similar to that given in McCallum (2001), where the interest rate reaction function below replaces the money supply equation.

1. Model

$$y_t = E_t y_{t+1} - (i_t - E_t \pi_{t+1}) + \varepsilon_1$$
$$\pi_t = 0.99\ E_t \pi_{t+1} + 0.1\ (y_t - \bar{y}_t) + \varepsilon_2$$
$$m_t - p_t = y_t - 7 i_t$$
$$i_t = (1.5)(1 - 0.3)(\pi_t - \pi^*) + (0.5)(1-0.3)(y_t - \bar{y}_t) + 0.3 i_{t-1} + \varepsilon_3$$
$$\bar{y}_t = \varepsilon_4$$

where y is the natural log of output, i is the nominal interest rate, π is the inflation rate, $\bar{y}$ the natural log of potential output, m the natural log of money, π^* the inflation target. The parameter values are based on Nelson (2000), Neiss and Nelson (2001), and Neiss and Pappa (2002).

2. Calibration of the stochastic shocks

Each of the shocks is independently normally distributed with mean zero, and standard deviations and autocorrelations shown below for the benchmark case.

ε_1 *(demand)*:	standard deviation 0.01, autocorrelation coefficient 0.33
ε_2 *(mark up)*:	standard deviation 0
ε_3 *(monetary policy)*:	standard deviation 0.0082, autocorrelation coefficient 0.3
ε_4 *(supply)*:	standard deviation 0.0072, autocorrelation coefficient 0.95

These values are consistent with Nelson (2000), Neiss and Nelson (2001), Neiss and Pappa (2002). In case 1, the baseline parameters shown above are chosen. In case 2, we use the benchmark parameters, but increase the autocorrelation of demand shocks to 0.5. Case 3 is the benchmark, with the standard deviation of mark up shocks raised to 0.01. Case 4 is the benchmark, with an increase in the standard deviation of mark up shocks to 0.01, the autocorrelation of mark up shocks to 0.8 and the standard deviation of policy shocks to 0.04.

3. The experiment

Simulated data were created by taking 10,000 random draws from a standard normal distribution for each shock, and scaling and transforming as appropriate for each of the shocks to create autocorrelated series where required. Using the realisations for the shocks, we can solve for the model variables using the solution algorithm of King and Watson (1995). This gives a time series of 10,000 simulated observations for each model variable. Correlation coefficients and ordinary least squares regression coefficients were then calculated using standard statistical techniques on the simulated data.

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