Speech

Challenges for Monetary Policy: New and Old

Speech given by

Mervyn King, Deputy Governor

27 August 1999

Paper prepared for the Symposium on "New Challenges for Monetary Policy" sponsored by the Federal Reserve Bank of Kansas City at Jackson Hole, Wyoming, 27 August 1999. I am very grateful to Ravi Balakrishnan, Nicoletta Batini, Mark Cornelius, Spencer Dale, Ben Martin, Ed Nelson, John Vickers and Anthony Yates of the Bank of England, who not only made helpful comments and suggestions but also contributed most of the ideas to this paper.

1 Introduction

The turn of the millennium seems an appropriate moment to assess the role of central banks in the modern world. On second thoughts, perhaps a millennium is not the correct unit, for it is the past century which has seen the rise and rise of central banks. One hundred years ago there was no Federal Reserve System. Indeed, in 1900 there were only 18 countries with central banks. Today that number is 172. How many will there be one hundred years from now? Will central banks exist at all?

At the beginning of this century, outside continental Europe only Japan and Indonesia had central banks. The number – and status – of central banks rose throughout the century, and has risen to the point where well over 90% of the countries represented at the United Nations have central banks (see Chart 1). Part of this rise resulted from the conversion of colonial currency boards into central banks of independent countries. But a further impetus was given by the creation of new central banks in Eastern and Central Europe in the 1990s. And only this year the latest, and arguably the most important, of the new central banks was created with the establishment of the European Central Bank.

It is not just the number of central banks that has increased steadily throughout the century. Their power and independence has also increased substantially, especially over the past decade. Although the definition of "independence" is as much a matter of practice as of legal status, ten years ago it was possible to argue that the only large countries with independent central banks were the United States, Germany and Switzerland. Since then, in all three principal time zones there have been significant moves towards independence of central banks. In the Americas, independence was granted in varying degrees to central banks in Argentina, Brazil, Chile and Mexico. In Asia, the Bank of Japan was made independent. And in Europe, not only was the European Central Bank set up, but the Old Lady of Threadneedle Street herself acquired independence in 1997. The result is that after a century of expansion, central banks now find themselves in a position of power and responsibility unrivalled in their history.

Today, central banks are rarely out of the headlines. Monetary policy is news. It is news in the G7, where newspapers continually speculate about future policy moves, and it is news in emerging markets, where the very stability of a country sometimes seems to depend on a resolution of its currency and financial problems.

But this is no time for hubris. For much of the century discretionary monetary policy, freed from the constraints of, first, the gold standard and subsequently the Bretton Woods system of pegged exchange rates, produced inflation (see Chart 2). Unfettered discretion has not been a success. It is no accident that the inflation target approach to monetary policy, so popular in the 1990s, has been described as "constrained discretion" (Bernanke and Mishkin 1997, King 1997a). Mechanical policy rules are not credible – in the literal sense that no-one will believe that a central bank will adhere rigidly to such a rule irrespective of circumstances. No rule could be written down that describes how policy would be set in all possible outcomes. Some discretion is inevitable. But that discretion must be constrained by a clear objective to which policy is directed and by which performance against the objective can be assessed.

Giving a central bank a clear remit of maintaining price stability, and holding it accountable for achieving that, is seen as a *sine qua non* of a credible monetary policy regime. The language in which that remit is embodied varies from country to country. But the view that price stability is the overriding objective of monetary policy is now common to both industrialised countries and emerging markets. In part that reflects the intellectual revolution which "rediscovered" the absence of a trade-off in the long run between inflation and output. But it also reflects the experience of the past thirty years in which high and unstable inflation led to greater fluctuations in output and employment than accompanied periods of low and stable inflation. A commitment to price stability is now seen as the key to achieving broader economic stability. Indeed, John Taylor has described the past fifteen years, which contained the two longest post-war expansions, in the United States as the "Long Boom". In Europe, the past fifteen years might be more accurately described as the "Long March" to stability.

There is now a widespread intellectual consensus – almost a conventional wisdom - about the objectives which central banks should pursue, and the means by which they should pursue them. This is a very dangerous position. Could it be that 1999 is the apogee of the power of central banks? I believe that if central banks are to retain their central position in economic policy making, they must face up to the intellectual and technological challenges that lie ahead. Unless they do so, popularity will turn to disillusion.

Those challenges are in two main areas of monetary policy. They are (a) the objectives of monetary policy and (b) the transmission mechanism through which monetary policy affects those objectives. I discuss these issues in section 2 and 3, respectively. Sections 4 discusses, more briefly, the international arena in which central banks operate. I return to the future of central banks in Section 5.

2 Monetary policy in a low inflation world: objectives

It may seem strange to identify the objectives of monetary policy as a challenge to central banks. Surely, there is a consensus that price stability is the overriding objective of monetary policy. A decade ago, when Alan Greenspan (1989) defined price stability as – "price levels sufficiently stable so that expectations of change do not become major factors in key economic decisions" – many industrial countries were some way from price stability. A more precise definition was unnecessary. It was clear along which path policy should proceed. But now that inflation has fallen in the main OECD countries, from 12.4% in 1980, to 5.2% in 1990 and 1.6% in 1998, the fact of price stability raises a number of challenges for both the formulation and explanation of the objectives of monetary policy[1].

Irrespective of the words used to describe it, any monetary policy can be thought of as a combination of an *ex ante* inflation target and a strategy for responding *ex post* to unanticipated shocks (King, 1996, 1997b). The relevant shocks are those to which the central bank can respond before the private sector is able to adjust nominal wages and prices. In a world of low inflation, the private sector will want to know three things about the corresponding monetary policy reaction function. First, how "low" is the inflation rate at which the central bank is aiming? Second, what precisely does the central bank mean by the exercise of its "constrained discretion" to respond to shocks in order to stabilise inflation and output? Third, does the central bank intend to bring the price level back towards some desired longer-term path? The efficiency of monetary policy increases when central banks are open about all three aspects of their policy. Consider them in turn.

2(i) The optimal inflation rate

What is the optimal rate of inflation? As inflation has fallen from earlier high levels towards something approaching price stability, the question of what is the optimal inflation rate has become more important. Indeed a growing number of central banks have adopted an explicit and numerical target for inflation. Milton Friedman (1969) argued that anticipated inflation should, on average, be negative. Steady deflation – at a rate equal to the real rate of interest – is optimal because only at a zero nominal interest rate is the marginal opportunity cost of holding cash equal to its marginal production cost (close to zero in practice).

Other considerations suggest that a changing price level - whether inflation or deflation - creates costs. These include the distortionary effects of an unindexed tax system, especially on capital income, and increased menu costs as prices have to be adjusted more frequently. As a result, many have argued for the objective of pure price stability, that is zero measured inflation (for example, Feldstein, 1996). One problem with the objective of zero inflation is that the official indices used to measure inflation are subject to biases of several kinds. Most studies suggest that these measures overstate the "true" rate of inflation by an amount that could lie in a range from 0.5% to 2% a year. The Boskin Commission (1996) produced a central estimate of the overstatement of inflation in the US consumer price index of 1.1% a year[2].

Such estimates are not uncontroversial and there is no reason to presume that the bias remains constant from year to year. Moreover, there is no unique price index to measure general inflation in a world in which relative prices move around. When average inflation is high the differences in inflation recorded by different indices are small. But when overall inflation is low, differences between indices are more apparent. For example, Johnson, Small and Tryon (1999) found sizeable discrepancies between alternative inflation measures in the US since 1975. The Bank of England discusses a number of measures of inflation in its quarterly *Inflation Report*. No one measure fully captures all of the information that is relevant to the setting of monetary policy. A single measure, and a single target, for inflation are useful in terms of the transparency of the objectives of policy and the accountability of those responsible for decisions. But the need to examine different measures of inflation highlights the difficulty of identifying precisely an "optimal" rate of inflation. Nevertheless, concern about the measurement bias problem has led to suggestions that the optimal measured rate of inflation is positive.

Yet other economists have argued that an inflation rate well above zero is desirable because it leads to higher output and employment. Krugman (1996), for example, proposed a long-run inflation target of 3-4%. Two reasons, in particular, have been advanced for aiming at a positive inflation rate. The first concerns the significance of downward nominal rigidities in wages and prices. If nominal wages and prices are inflexible downwards, then a higher rate of inflation might enable a

---

[1] The countries excluded from these comparisons are Greece, Hungary, Mexico, Poland and Turkey.

[2] Broadly similar estimates were produced for the UK by Cunningham (1996).

faster adjustment of real relative wages and prices which would improve efficiency. Second, the fact that nominal interest rates cannot fall below zero may constrain monetary policy in a time of recession. Both arguments have attracted some support recently, and I consider them in turn.

2(i) a Downward Nominal Rigidities

In a provocative and much-cited paper, Akerlof, Dickens and Perry (1996) claimed that "targeting zero inflation will lead to a large inefficiency in the allocation of resources, as reflected in a sustainable rate of unemployment that is unnecessarily high". They studied how downward nominal wage rigidity affects the optimal inflation rate. Their contribution was twofold. First, they reported the empirical evidence on the frequency of nominal wage cuts in the United States. Second, they argued that the existence of downward nominal wage rigidity implied that, at low rates of inflation, there is a permanent trade-off between inflation and unemployment - a trade-off whose existence many of us expend a great deal of energy denying.

It is not surprising that downward nominal rigidity in wages and prices means that zero inflation will be costly for unemployment. But is such rigidity theoretically plausible? And does theory imply that inflation would be a cure? The assumptions required to generate downward nominal rigidities, for which inflation would be a cure, are complex. For example, it is commonly thought that if wage earners were subject to 'money illusion' then positive inflation would provide room for periodic real wage cuts without necessitating cuts in nominal wages or undesirable increases in unemployment. There is indeed some evidence that supports the existence of money illusion. For example, Shiller (1996) found that 59% of his respondents stated that they would be happier with higher money wages though unchanged real wages. Even 10% of economists displayed this kind of money-illusion! However, money-illusion is not by itself sufficient to generate downward nominal rigidities whose effects could be mitigated by inflation (see Yates (1998)). Money illusion means that people care about nominal wages in addition to real wages. But it does not explain why people care more about a fall in nominal wage growth from 0% to -3% than a change from 3% to 0%.

Akerlof, Dickens and Perry argued that the proportion of salary earners accepting nominal pay cuts could be as low as 2-3%. The evidence on the frequency of nominal wage cuts is not so clear cut if we look at other studies[3]. Product markets also exhibit a prevalence of nominal price cuts. For example, towards the end of 1998, more than 25% of the components of the US CPI were falling. Broadly the same was true for the RPI index in the UK.

[3] Crawford and Harrison (1998) found that between 9-20% of employees experienced nominal wage cuts in Canada between 1995 and 1996.

Moreover, it is difficult to believe that any downward inflexibility of nominal wages would be unaffected by changes in inflation. As low inflation becomes the norm, resistance to nominal wage cuts could well disappear. In Japan, money wages have been falling since the beginning of 1998. And trend increases in productivity leave scope for changes in relative real wages, without reductions in the level of nominal wages. For example, an inflation target of 2% a year and productivity growth also of 2% a year, mean that nominal wages would rise at an average rate of 4% a year, leaving scope for reductions in relative real wages without cuts in nominal wages.

It is important to focus not only on the frequency of price or wage cuts at any one time, but also on how the distribution of prices and wages evolves over time. If the world were characterised by downward nominal rigidities we would expect to find that the skewness of price changes increases, with more zero changes, as the inflation rate falls. Charts 3 and 4 suggest that this does not happen: as inflation falls, so the proportion of the index that is falling goes up. The evidence from more formal regression studies is also broadly unsupportive of the downward nominal rigidity theory (see Yates (1998)).

Finally, the most casual, but at the same time the most striking, piece of evidence relates to recent experience. Akerlof *et al* argued that, at inflation rates below 3%, the existence of a permanent trade-off meant that unemployment would rise. In fact, since their paper was presented to a Brookings Panel in March 1996 there have been only four months when the recorded annual inflation rate in the US was above 3%, yet during that period unemployment has continued to fall. No doubt there are many reasons why this might have happened, but at least one of them is that any downward nominal rigidity is too small for the Fed to worry about. A new Akerlof *et al* study is in the pipeline, to be presented in the autumn. Until that is available, I remain unconvinced that nominal rigidities mean we should abandon the pursuit of price stability.

2 (i) b **Zero bound on nominal interest rates**

A second argument for targeting a positive average rate of inflation derives from the observation that nominal interest rates cannot fall below zero. Given the existence of this lower bound, the ability to reduce interest rates in response to large and persistent negative demand shocks is likely to be constrained if the average level of interest rates, and hence inflation, is low. This is no theoretical curiosum. In Japan, official interest rates have now been below 1% since September 1995 and have been virtually zero since February 1999. And in Europe, where the average inflation rate is at present close to 1% a year, interest rates have been reduced to 2.5%, a level not seen even in

Germany for over 20 years. The experience of Japan, in particular, poses a serious challenge to central bankers and economists alike in how to think about monetary policy in a world of low inflation.

The proposition that the inability to reduce interest rates below zero might create problems for monetary policy was emphasised by Keynes (1936) in the 1930s, later by Vickrey (1955), and, more recently, by Phelps (1972), Summers (1991) and Fischer (1996). For most of the post-war period, those problems seemed to belong to the past. But the return to price stability raises the question of whether such concerns may be more pressing in future. The significance of the zero lower limit on nominal short-term interest rates hinges on whether monetary policy becomes impotent at the point when the constraint begins to bind. In other words, can a "liquidity trap" render monetary policy ineffective? I return to this question in section 3.

The welfare analysis of the optimal inflation target depends on both (i) the probability that nominal interest rates will be constrained at zero, and (ii) the cost of that constraint should it bind. In the rest of this section I focus on (i), because if the constraint is unlikely to bind (ii) is redundant. The cost of the constraint depends critically upon whether monetary policy is impotent at that point and is discussed in section 3.

There are few historical episodes that throw light on the question. In the 1930s, nominal short-term interest rates were close to zero in a number of countries, including the US, for a decade or more; and the same was true of Switzerland in the 1970s. History can, however, shed light on the frequency of negative real interest rates in past cycles. Is it common for real rates to be negative? That is of interest because the lower limit on nominal interest rates implies a bound on real interest rates equal to minus the expected rate of inflation. The lower the expected rate of inflation, the higher the lower bound on real interest rates. In the limit, if prices are expected to be stable, then real interest rates too cannot become negative.

So how likely is it that negative real interest rates will be needed? Summers (1991) suggested that "the real interest rate [in the US] has been negative in about a third of the years since World War II". He did not specify the details of exactly which real interest rate had been negative. Defining the real rate as the one-year Treasury constant maturity rate less the actual CPI inflation rate, the *ex post* rate was negative for about 20% of the period since 1950. But the relevant concept is the *ex ante* expected short-term real interest rate. That rate cannot be observed directly. Estimates using survey-based measures of inflation expectations produce much lower frequencies of negative real rates than for *ex post* rates. Chart 5 shows the *ex ante* real rate of interest in the US from 1953 to

1998 H2 defined as the one-year Treasury constant maturity rate less the expected inflation rate from the Livingston survey. There are only three brief episodes of negative real rates. These are 1976 H2 – 1977 H1, 1980 H1 and 1993 H1. So *ex ante* real interest rates have been negative only rarely in the post-war period. A similar finding holds for the UK (see Chart 6)[4].

Data on the past behaviour of real interest rates, even *ex ante* rates, are not conclusive. Low inflation, and the associated change of monetary policy regime, is likely to have altered the cyclical profile of interest rates. So theoretical models of monetary policy may throw further light on the potential importance of the lower limit on nominal interest rates. There has in the past two or three years been an explosion of interesting and imaginative technical research on exactly this question[5].

It is helpful to start, however, by considering a back of the envelope calculation based on the assumption that the central bank follows a "Taylor rule" under which interest rates are raised or lowered according to whether output is above or below trend and inflation is above or below its target level. That rule may be represented by the following equation for nominal short-term interest rates:

$$i_t = i^* + l_1(y_t - y^*) + l_2(p_t - p^*) \qquad (1)$$

where *i* is the short-term nominal interest rate, *i** is the "neutral" nominal interest rate, *y* and *y** are the logarithms of the levels of actual and trend output respectively, B is the inflation rate and B* the target inflation rate. The two parameters 8_1 and 8_2 represent how active monetary policy is in responding to deviations of output from trend and inflation from its target level.

Negative demand shocks mean that output can temporarily be below trend and inflation fall below its target. Suppose that the inflation target was 2% a year, and the "neutral" real interest rate was 3% a year. Then the "neutral" nominal interest rate would be 5% a year. Imagine a large negative demand shock which led output to fall some 4% below its trend level, and inflation to fall from its target level of 2% a year to zero. Suppose that before the shock output and inflation were at their desired levels and interest rates were at their neutral level. The impact of the shock would require a reduction in interest rates. But by how much? That would depend on the coefficients in the Taylor rule. Typical

---

[4] Details of the construction of the *ex ante* real interest rate are given in Appendix 1. Chart 6 uses data from Gallup. *Ex ante* real interest rates for the UK were also calculated using the Basix survey. According to measures of inflation expectations from this survey, UK *ex ante* real rates have not been negative since 1986, when the survey began.

[5] Among this work are papers by Fuhrer and Madigan (1997), Krugman (1998), Orphanides and Wieland (1998), Rotemberg and Woodford (1997), Wolman (1998), and a recent conference volume edited by Taylor (1999). The literature is surveyed by Johnson *et al* (1999).

estimated values for the coefficients 8_1 and 8_2 on output and inflation, respectively, are 0.5 and 1.5. The latter coefficient must exceed unity in order that the policy response to an inflationary shock is a rise in real interest rates. In our example, interest rates would fall by two percentage points because of the shortfall of output from trend, and by three percentage points because of the shortfall of inflation below its target. Hence interest rates would fall from 5% to zero if policy followed the simple rule.

What does this tell us about the likelihood that interest rates would hit zero? Only shocks which had a large impact on either output or inflation would create a problem. Such shocks are not inconceivable, but are unusual. The example suggests that policy would most likely be constrained when demand shocks were persistent, so that a negative shock to output and inflation occurred when output and inflation were already below their normal levels. Suppose that output was 2% below trend and inflation 1% below target when a negative demand shock occurred. Then interest rates would already be 2.5 percentage points below their normal level, and a shock of only 2% to output and another 1% to inflation would be sufficient to reduce interest rates to zero. That suggests that in practice the constraint is likely to bind primarily when either shocks are persistent or policy-makers have failed to react quickly to demand shocks in the first place, and find themselves with slow growth and inflation below target when another negative shock occurs. A <u>pre-emptive policy</u> that is <u>symmetric around the inflation target</u> will help to make less likely the need for extremely low interest rates.

The idea that monetary policy does or should follow a Taylor rule has been extremely influential. Like most good ideas, its virtue is simplicity. It is not a mechanical rule to guide policy, but a vehicle to clarify issues. The calculation above is extremely simple. To analyse the frequency of interest rates being close to zero requires a more careful analysis of the shocks hitting the economy. The more recent technical literature (see footnote 5 above) has tried to do exactly that.

More sophisticated policy rules have been developed. These imply that it may be better to act more "aggressively" in response to shocks to inflation or output than in the above example of the Taylor rule. Changing interest rates quickly and sharply in response to news reduces the volatility of inflation and output. This is the case for pre-emptive monetary policy action in which interest rates should move in anticipation of likely prospects for inflation.

At first sight, one might think that interest rates would hit the zero bound more often with a pre-emptive strategy than with less aggressive policies. There is, indeed, some truth in this proposition. But matters are more complicated. And it is instructive to see why. Look at the simple Taylor rule described by equation (1). It is tempting to think that the larger are the coefficients, 8_1 and 8_2, which describe the response of interest rates to output and inflation respectively, the greater will be the movement in interest rates over the cycle. But equation (1) alone does not determine the path of interest rates over time. That depends on how inflation and output themselves respond to earlier movements in interest rates. In technical jargon, inflation and output are endogenous variables, and equation (1) is a policy reaction function not a reduced form describing the time path followed by interest rates. If a more aggressive policy response reduced the volatility of output and inflation, then interest rates might actually be less volatile over the cycle as a whole than under a less aggressive strategy. Hence pre-emptive monetary policy does not necessarily mean that interest rates are volatile over the cycle.

The benefits of a pre-emptive policy depend upon the transmission mechanism. That lesson comes from exploring modifications of the simple Taylor rule. One such, which I shall call the extended Taylor rule, takes the form

$$i_t = i^* + l_1(y_t - y^*) + l_2(p_t - p^*) + l_3 i_{t-1} \qquad (2)$$

where not only are the coefficients 8_1 and 8_2 typically larger than in the simple Taylor rule, reflecting a bigger response to current deviations of output from trend and inflation from its target, but interest rates also depend on their previous level.

Table 1 shows the probability that interest rates might hit the zero bound implied by four different models of the transmission mechanism published recently in the conference volume entitled **Monetary Policy Rules** edited by John Taylor (1999). Each model simulated the behaviour of interest rates for two different policy reaction functions. The first was a simple Taylor rule with coefficients 8_1 = 0.5 and 8_2 = 1.5, as in equation (1). The second was the extended Taylor rule, as in equation (2), with coefficients 8_1 = 0.8, 8_2 = 3.0 and 8_3 = 1.0. For two of the models, the simple rule is sufficient to reduce to negligible proportions the risk of zero interest rates. But the extended rule significantly increases the risk that interest rates might hit the zero bound. Indeed, for those two models the risk of zero interest rates is between one quarter and one third under the extended rule. These models are traditional macroeconomic models where private sector behaviour is more backward-looking than forward-looking.

In the other two models, private sector expectations play a key role. This forward-looking element to behaviour changes the conclusions quite dramatically. The simple rule generates a higher, though not large, probability that interest rates might need to fall to zero. But the extended rule does not, in one case, lead to a significant rise in that probability, and, in the other, actually leads to a very substantial fall in the risk of zero interest rates. The reason is that in those models aggregate demand is sensitive to long-term interest rates. With the extended Taylor rule, a rise in interest rates is expected to persist. This will increase the leverage of monetary policy. Hence a small rise in interest rates today may induce quite large changes in private sector demand, followed by equally rapid responses of output and inflation. In turn that makes it less likely that nominal interest rates will have to fall towards zero.

So the relationship between the simple and the extended forms of the Taylor rule is sensitive to assumptions about the nature of the transmission mechanism of monetary policy. These models are not yet sufficiently robust for strong conclusions about policy to be drawn. But they do have one interesting implication for the interpretation of central bank behaviour. Much of the academic literature tends to describe extended Taylor rules which contain a lagged interest rate as interest rate smoothing: interest rates have a tendency to stay at their current level. Such smoothing is often described as evidence of an inherent central bank degree of caution, or “gradualism”. This is often contrasted with more “activist” policies. Yet, as we have seen, the presence of lagged interest rates in a policy reaction function could, depending on the transmission mechanism, be evidence of an aggressive or pre-emptive policy stance. Moreover, the lagged interest rate in (2) could also be an appropriate response to the fact that future inflation depends on lagged values of output and inflation. A central bank that followed the extended Taylor rule, could be described as either “activist” or “gradualist”. Hence such words should be used with enormous care. Their meaning is not at all obvious outside a well-defined economic model.

The insight that a prompt response to shocks may prevent the need for larger subsequent movements (“a stitch in time saves nine”), and hence a less volatile path for interest rates is general. The lessons of recent research provide many insights into the way monetary policy should be set. But they do not provide an accurate quantitative guide to the risk that interest rates may need to fall to zero. In part, this reflects our incomplete understanding of the way the economy behaves. But it also reflects the fact that the probability of zero interest rates depends on the likelihood of extreme shocks. That is very hard to assess from historical experience when the frequency of such shocks is small. Econometricians require a large number of observations before their conclusions can be firm. So, as ever, central banks will need to keep an open mind. They must be prepared not only to act quickly but to think quickly.

All in all, the observations that there may be downward nominal rigidities in wages and prices and that there is a zero lower limit on nominal interest rates, do not appear to justify a policy of deliberately targeting a higher rate of inflation than is currently pursued by most central banks. Summers (1991) concluded that "the optimal inflation rate is surely positive, perhaps as high as 2 or 3 per cent". In his latest book, Krugman (1999) argued that the United States and Europe should "make sure that inflation does not get too low when times are good: to set a target rate of at least 2 per cent, so that real interest rates can be reduced to minus 2 rather than merely to zero if the situation demands" (op.cit. pps. 161-2). Although the evidence for such propositions does not seem to me conclusive, the practical difference between the inflation targets recommended by Summers and Krugman and the inflation targets pursued by central banks is in practice small. The inflation target agreed by the Reserve Bank of New Zealand and its government is a range of 0 to 3 per cent; the Bank of England has been given an inflation target of 2.5 per cent a year; and the European Central Bank has a quantitative target for inflation of "a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%". Academic economists and central bankers – and an increasing number are both - are perhaps closer to each other than their rhetoric sometimes suggests.

2(ii) Stabilising output and employment

What can and should central banks do to stabilise output and employment? There are two overriding constraints on the ability of central banks to target real variables. First, in the long run, when the lags in the monetary policy transmission mechanism have worked themselves out, monetary policy affects the price level, not output or employment. Second, in the short run, before policy has fully worked through, the effect of monetary policy on real variables is extremely uncertain because the transmission mechanism is neither sufficiently well understood nor sufficiently stable over time for policy easily to target real variables. Nevertheless, monetary policy does have real effects in the short run. As Benjamin Friedman (1998 p viii) has pointed out, "the tension created by the joint effect of central bank actions on inflation *and* on aggregate output, or employment, is usually of the essence whenever public policy discussion turns to monetary policy".

Faced with shocks that tend to shift output and inflation in opposite directions, central banks have a choice. They can try either to bring inflation back to its target level as soon as possible, which might exacerbate the initial impact of the shock on output, or they can accommodate the change in inflation, bringing inflation back to the target more slowly and so reducing the impact on output. Although there is no stable trade-off between inflation and output, there is a trade-off between the **variability** of inflation and the **variability** of output. Such a trade-off is known as a – yes, you've guessed it – Taylor curve (Taylor 1979). Chart 7 shows the Taylor curve. The position of the curve is determined by the structure of the economy (in particular by the variances of the shocks hitting the economy) and the behaviour of monetary policy. The Taylor curve plots the locus of combinations of inflation and output variability that can be attained by appropriate monetary policies. It is traced out by changing the relative weights on inflation and output variability in the central bank's "loss function", or, in other words, by changing the implicit horizon for the inflation target. Moving down the curve from left to right is equivalent to choosing a shorter horizon over which to bring inflation back to target, thus lowering the variability of inflation and increasing the variability of output.

So a central bank has "constrained discretion" about the horizon over which to bring inflation back to target; that is, a choice about how to trade-off variability of output against variability of inflation. This choice has no implications for the average level of either output or inflation, but reflects a choice about whether inflation or output should bear the strain of the initial impact of any shock. And it is at the heart of public debate over monetary policy.

Is it possible in practice to exploit the trade-off described by the Taylor curve? The curve is a useful expositional device to explain the choices facing central banks. But its empirical value is limited for two reasons.

First, the curve is a "volatility possibility frontier" which can be identified from actual data only if the central bank is pursuing the best of all possible monetary policies. That cannot be independently verified. Second, the curve is likely to shift over time as the variances of the shocks hitting the economy themselves move around. Empirical estimates of Taylor curves are highly model specific, and can be estimated in practice only by the use of model simulation. Research by Bean (1998) and Batini (1999) suggests that the Taylor curve appears to bend sharply around the point where the standard deviation of fluctuations in GDP relative to trend is equal to the standard of deviation of inflation. Hence policy-makers with different preferences might well generate very similar outcomes for inflation and output variability. This, however, is conjecture. The Taylor curve is a useful conceptual tool, but is difficult to use empirically.

There are further reasons for supposing that monetary policy should focus on keeping inflation close to its target and not on fine-tuning output. The particular difficulty with implementing policy rules of the Taylor kind is that, as formulated, they presume a knowledge of output relative to its trend level. Estimates of the output gap, or the difference between unemployment and the current NAIRU, not only vary greatly from one method to another, but are often of opposite signs. Ignorance not only of the transmission mechanism of monetary policy but also of underlying productive potential, mean that basing monetary policy on short-term movements in output can be hazardous. In a recent study of US monetary policy in the post-war period, Orphanides (1999) found that simple policy rules behaved extremely well when interest rates were set with the benefit of hindsight – using retrospective knowledge about movements in output that identified the trend path for productivity. But when they were based on information available to policy-makers at the time, they performed much less well. Orphanides concluded that there were risks in responding too aggressively to estimates of deviations of output from trend, and that "the stabilization promise suggested by these activist policy rules is indeed illusory". Changing interest rates in response to movements in inflation appears to be a relatively robust policy rule. Moving interest rates in response to changes in output, however, is much more sensitive to a knowledge of both the structure of the economy and, in particular, the forces determining the long-run growth of productive potential. To illustrate this, Christiano and Gust (1999) found that in a rather different model of the transmission mechanism than the conventional sticky price model used by many, the only robust policy rule was one which targeted inflation

So although there are, in principle, reasons for using constrained discretion to respond to shocks, central banks would do well to have modest ambitions about the scope for output stabilization. A keen appreciation of how limited is our present knowledge of the economy should be central to the policy-making process. It is precisely that lack of knowledge which makes mechanical policy rules incredible. The use of constrained discretion is sensible. But, as Orphanides pointed out, such a strategy "requires continued vigilance against mechanical attempts to exploit historical relationships to fine-tune the performance of the economy". Beware of (non-Greek) econometricians bearing false relationships. Perhaps one of the strongest arguments for delegating decisions on interest rates to an independent central bank is that, whereas democratically elected politicians do not often receive praise when they say "I don't know", those words should be ever present on the tongues of central bankers. And, in a state of ignorance, it is important for the central bank to be transparent about both what it thinks it understands and what it knows it does not understand. In so doing, it may reduce the scale of wasted resources devoted to discovering the secrets of central bank thinking, and reduce the numbers of players in financial markets who fear that others have inside information.

2(iii) Targeting prices or inflation

The third challenge to the objectives of central banks is whether monetary policy should be directed to meeting a target inflation rate or a target price level. The case for price stability suggests that it is the stability of the long-run price level which creates confidence in the monetary standard and enables nominal contracts to play an important role in the economy. The long-term lender knows what her return will be in real terms, and equally the long-term borrower knows what he will pay. Yet the arguments presented in section 2(i) imply that a positive average measured inflation rate, might be desirable. Can price stability be reconciled with low inflation? The choice between price-level targeting and inflation targeting has attracted some interest recently[6]. The proponents of price-level targeting point out that under inflation targeting the variance of the price level increases without limit as deviations of inflation from the target level are treated as bygones. This is analogous to base level drift with monetary targeting. Proponents of inflation targeting point out that to return prices to their previous level might imply significant volatility of output.

I find this contrast somewhat artificial. The reason is that the dichotomy between the two approaches is analysed in models in which the target variable, whether inflation or the price level, is returned to its desired level in the following period. Earlier, I suggested that it was useful to think in terms of the horizon over which inflation was brought back to its target level in the context of an inflation target strategy. Equally, one can think in terms of the horizon over which policy-makers wish to bring the price level back to some desired pre-determined path.

To make this clearer, consider the current framework for UK monetary policy. The Bank of England's Monetary Policy Committee (MPC) has been given an inflation target of 2.5% a year by the Government. Members of the Committee will be held accountable for their actions in achieving that target. Imagine that the parliamentary committee to which the MPC is accountable holds hearings in 2007 to discover whether the new arrangements had been successful in meeting the inflation target. They might well ask what the average inflation rate was over the first 10 years of the Committee's existence. Most commentators would regard that as a framework for inflation targeting. But asking whether the Committee had achieved an <u>average</u> inflation rate over that period would in fact be equivalent to price level targeting, in the sense that the Committee would be asking whether the price level after 10 years was close to its desired pre-determined path implied by the objective that prices should rise by 2.5% a year. Hence an average inflation rate target is equivalent in many ways to price-level targeting. Although that is not the objective of the MPC – which is to aim continuously to meet the 2.5% target irrespective of past inflation outturns – it is worth exploring the implications of an average inflation rate target.

---

[6] See Hall (1984), Bank of Canada (1994), Svensson (1999), McCallum (1990), McCulloch (1991) and Dittmar, Gavin and Kydland (1999).

Just as the pursuit of an inflation target requires a judgment about the horizon over which inflation should be brought back to its target level following a shock, there is a second question that arises in the context of price-level or average inflation rate targeting. That concerns the horizon over which the price level should be brought back to its desired pre-determined path. Suppose that the average inflation target is p^*. That defines the desired price level path over time, P^*_t, which rises at the rate p^*. Policy might respond not only to deviations of output from trend and inflation from the target level, but also to deviations of the price level from its desired path. A key policy choice is the horizon over which the price level is brought back to that path. To avoid sharp changes in the current operational inflation target this horizon (denoted by H) could be a decade or more. The operational inflation target each period would be equal to the constant p^* adjusted for the fact that prices had deviated from their desired path. The current operational inflation target is then given by

$$p_t{}^{**} = p^* - \frac{1}{\mathrm{H}}\left(\frac{\mathrm{P}_t - \mathrm{P}^*_t}{\mathrm{P}^*_t}\right) \tag{3}$$

Substituting this expression into equation (1) for the Taylor rule gives the average inflation rate targeting rule as

$$i_t = i^* + l_1(y_t - y^*) + l_2(p_t - p^*) + l_3\left(\frac{\mathrm{P}_t - \mathrm{P}^*_t}{\mathrm{P}^*_t}\right) \tag{4}$$

where $l_3 = l_2/\mathrm{H}$

Equation (4) shows that the difference between inflation and price-level targeting is a matter of degree and not a qualitatively different choice. At one extreme, where the horizon H increases without limit, then “pure” inflation targeting means that policy follows a simple Taylor rule and the variance of the future price level increases without limit. At the other extreme, where the horizon H = 0, policy brings the price level back to its pre-determined path as quickly as possible. That implies greater volatility of output. Both in theory and in practice, policy-makers are likely to choose an intermediate horizon. To reduce short-run volatility in output and employment, central banks will bring inflation back to target gradually. But if central banks target an average inflation rate, then policy will aim also to return the price level to its pre-determined path. In this way, a policy rule such as (4) combines the advantages of the nineteenth century achievement of maintaining stability and predictability of the price level in the long-run, with the twentieth century achievement of reducing short-run fluctuations in inflation and output. That would be an appropriate policy rule to take into the twenty-first century.

In practice, the operational inflation target could be adjusted either at discrete intervals, such as five years, or when the deviation of the price level from its desired deterministic path exceeded some critical level, rather than continuously, so that the target could be expressed as a round(ish) number.

A concern with the predictability of the long-run price level does not necessarily imply greater volatility of output and inflation in the short-run. Dittmar, Gavin and Kydland (1999) and Svensson (1999) have shown that if there is persistence in shocks to output (that is, persistence in the short-run Phillips Curve), then price-level targeting may actually imply lower volatility of output and inflation. Again, the optimal policy rule is sensitive to the behaviour of the economy, about which there is great uncertainty (see also Batini and Yates, 1999).

Simulations of macroeconomic models which incorporate policy rules such as (4) show that significant reductions in the variance of the future price level can be achieved at small cost in terms of increases in the volatility of output. This should not be surprising. The commitment to predictability of the long-run price level does not mean sharp changes in the inflation target from year to year. Small changes, even at discrete intervals, are sufficient to maintain predictability of the long-run price level without much change in either the average inflation rate targeted over a decade or so, or the response of output to changes in interest rates. Simulations suggest that there may be a rather small sacrifice in terms of output volatility for significant reductions in future price level volatility. Chart 8 shows simulation results from a three equation macroeconomic model calibrated to quarterly data for the UK. They illustrate the qualitative properties of mixed inflation-price level targeting. The three equations describe aggregate demand as a function of the real interest rate, aggregate supply as a function of price "surprises" and a stochastic supply shock, and interest rates by the policy reaction function (4). The first two panels of Chart 8 show the paths for the price level and inflation, respectively, for a particular sequence of shocks over 100 quarters. Two lines are plotted, in addition to a line corresponding to the long-run inflation target of 2% a year, one corresponding to pure inflation targeting ($H = \infty$) and the other to mixed inflation-price level targeting ($H = 10$). The long-run price level is much more predictable with the mixed strategy than with pure inflation targeting and there is rather little difference in terms of the inflation profile. The trade-off between variability of the price level and the variability of output around its trend is shown in the third panel. In terms of standard deviations, this shows that significant reductions in price level uncertainty can be achieved at relatively low cost in terms of output variability, but that beyond a certain point further reductions are costly or difficult to attain.

3 Monetary policy in a low inflation world: transmission mechanism

In section 2, several questions arose to which the answers depended crucially on the transmission mechanism of monetary policy. Do central banks have the power to stabilise output in the short-run, and is this objective jeopardised by the pursuit of long-run price stability? Differences of view certainly exist, but there is broad agreement on the conceptual framework within which these questions should be answered. Before joining the FOMC, William Poole (1998) wrote that,

> "macroeconomists share a common core model, and most are well aware of the uncertainty over estimates of key parameters in the model. Some lean a bit one way, some another way. This fact makes a debate less exciting than in earlier days but is a sign of real progress in macroeconomics."

That is, I think, a fair description of the way economists see themselves. But is the current state of economic knowledge similar to that of nineteenth century physics, when many theories appeared to be settled but were soon shown to be inadequate in important cases? Certainly, there is much that we do not understand. The recent experience of Japan has reopened the question of whether a "liquidity trap" can exist and how best to respond to it. In the US, and elsewhere, asset prices have risen to levels that make it difficult for even the most sober central banker to avoid speaking of "asset price bubbles". Although there are many aspects of the transmission mechanism about which central banks would like to know more, I focus in this section on the following question. Is monetary policy impotent when nominal interest rates are close to zero?

The issue of how monetary policy works when interest rates are at or close to zero has been contentious since the possibility of a "liquidity trap" was suggested by Keynes (1936) formalised by Hicks (1937) and revived by Krugman (1998). But it is only the recent experience of Japan, where interest rates have been virtually zero since February 1999, that the subject has again acquired immediate policy relevance. There are two views:

(i) when interest rates are zero, households and firms have an infinitely elastic demand for money balances. An increase in the money supply is absorbed passively in higher balances, and there are no implications for broader measures of money or demand and output. Monetary policy is impotent; there is a liquidity trap[7].

(ii) when interest rates are zero, households and firms become satiated with money balances, and any increase in the money supply leads to changes in household portfolios with consequent

[7] The Keynesian response to a liquidity trap is either to expand fiscal policy or to find ways to tax cash balances. The former became the staple diet of policy-makers in the immediate post-war period, before the difficulties of stabilisation policy became apparent, and the latter is rarely suggested as a serious option (although it is discussed by Buiter and Panigirtzoglou, 1999).

changes in relative yields on different financial and real assets, and direct and indirect effects on spending.

The policy implications of the two views are clearly very different, but which one is the more attractive theoretically and empirically? In part, this depends on the demand for money. The response of the short-term nominal interest rate (a price variable) and of the monetary base (a quantity variable) to central bank operations are opposite sides of the same coin (or is it note?). The preferences of households and firms for money balances can be described in terms of either their demand for quantities of money or their response to interest rates. What happens when the nominal interest rate goes to zero - effectively making money and short-term securities perfect substitutes? If the demand for money balances tended to infinity, as the interest rate tended to zero, then monetary policy would have no effect on real demand and output because any additional money created would simply be absorbed passively in money holdings. But if preferences for money balances exhibit satiation such that the demand is finite at a zero price, then the creation of money beyond that amount would be translated into demand for other assets and ultimately – via effects on relative yields - into nominal spending. So, in principle, empirical estimates of the demand for money should help us to resolve the issue. These two possible views of the money demand curve are shown in Chart 9. Of course, there is rather little evidence on the demand for money at zero interest rates[8].

In principle, all relevant relative prices should enter the demand for money as well as the demand for other assets and goods. With a myriad of financial assets, and unobservable shadow interest rates on different consumer durables, there are many candidates for the prices or interest rates to include in a model of money demand. Both in theory and in practice, it is sensible to try to limit these. But that choice leaves room for disagreement about whether the relevant rates have been included, and it is precisely that scope for disagreement which continues to divide Keynesians and monetarists. (These differences are explored in details in the symposium on the Monetary Transmission Mechanism published in the **Journal of Economic Perspectives** in 1995).

Keynes himself realised that other assets had to be included in the model for a satisfactory account of the demand for money. He focussed on long-term government bonds. When short-term interest rates were extremely low, long-term bond yields would also be low, albeit above zero. But at such low rates the prices of long-term bonds would become extremely volatile with respect to small changes in the interest rate. For example, a consol with a yield of 5% would fall in price almost 5% if the long-term interest rate were to rise by 25 basis points, whereas it would fall by 20% for the

---

[8] It is interesting that the Lucas (1994) logarithmic money demand function is equivalent to the Keynesian infinitely elastic demand for money at a zero interest rate.

same absolute rise in interest rates if the yield were only 1%. Hence, as has been seen in Japan over the past two years, bond prices become extremely volatile at low interest rates. That might lead to a significant risk premium on long-term bonds which, in turn, would place a floor under the long-term interest rate. As Keynes argued,

> "Circumstances can develop in which even a large increase in the quantity of money may exert a comparatively small influence on the rate of interest. For a large increase in the quantity of money may cause so much uncertainty about the future that liquidity-preferences due to the precautionary-motive may be strengthened; whilst opinion about the future of the rate of interest may be so unanimous that a small change in present rates may cause a mass movement into cash". (Keynes (1936), p.172)

At low interest rates, holding bonds was unattractive because they presented almost a one way option – the interest rate could only go up. Stability in such circumstances required differences of opinion about the future direction of interest rates. Only then would control of the money supply be a potent weapon in the hands of central banks.

The alternative view is that monetary policy retains its potency even when short-term interest rates are zero. The demand for money depends upon the yields of a wide variety of assets. It is not infinitely elastic at extremely low interest rates, and so an increase in the money supply will lead to changes in portfolio behaviour, changes in relative asset prices across a spectrum of assets, and, in turn, an increase in nominal demand and output. 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. In this way, changes in base money feed through to changes in broader measures of money. For there to be a liquidity trap, base money must be a perfect substitute for all other assets. In open economies, the exchange rate is one of the important relative prices that may respond to an increase in the monetary base. The essence of this "monetarist" model of the transmission mechanism is the impact of a change in money supply on the quantities and yields of a wide range of financial and real assets (Meltzer (1995)). In that model, an increase in the monetary base would not lower the interest rate below the zero bound, but would affect the yields on other assets. Asset prices in general would rise, and would have an impact on spending. There would be no liquidity trap.

To support this view, Meltzer (1999) has argued that there are three episodes in US monetary history between 1914 and 1950 in which the monetary base was a better empirical indicator of the policy stance than measures of short-term interest rates. In two of those three episodes (1937-38 and 1948-49) short-term interest rates were close to zero. Meltzer finds a significant impact of money base growth on consumption, even after taking into account the effect of interest rates and lagged consumption growth. Nelson (1999b) has replicated these results for the UK, and finds sizeable effects of real base money growth on growth in output, over and above effects via real interest rates. The orders of magnitude of the US and UK responses appear similar, although, if anything, the impact is larger in the UK than in the US.

What is the mechanism by which increases in base money affect demand and output when short-term interest rates are zero? It is hard to believe that an increase in real money balances induces a sizeable wealth effect – they are too small relative to other forms of wealth. Their impact must come, at least in part, from a change in the yields on other assets. In turn that is likely to reflect changes in risk premia. With short rates stuck at zero, the pure expectations theory of the term structure of interest rates and the uncovered interest parity arbitrage theory of exchange rates provide no way for monetary policy to affect other yields. Those theories ignore risk premia. A full explanation of the transmission mechanism of monetary policy at zero interest rates will require a general equilibrium theory of risk premia and how those risk premia are affected by monetary policy. Neither the Keynesian idea of a liquidity trap nor the Monetarist rejection of such a concept are based on a rigorous and fully articulated theory of risk premia. Perhaps such a theory will be the equivalent in economics of the special and general theories of relativity in physics.

So the question of whether monetary policy is impotent when short-term interest rates are zero remains, for the present, largely open. A rapid expansion of the monetary base in Japan might be an experiment from which we would learn much. But central banks are not in the business of engaging in experiments. In qualitative terms, it seems implausible that a sustained increase in money supply would simply lead to an addition to holdings of cash. But the quantitative impact on spending remains unclear.

The Japanese economy has been in recession for some time; interest rates have been low for several years, and virtually zero for much of 1999 (see Chart 10). Many commentators have urged the Bank of Japan to expand the monetary base. Since short-term government instruments have now become almost perfect substitutes for cash, open market operations should, so it is argued, concentrate on purchases of long-term government bonds, private sector financial assets and foreign currency. Such purchases would change relative asset yields, including the exchange rate, and produce a rise in private sector demand. In contrast, the Bank of Japan has argued against such a strategy on three grounds (Okina, 1999). First, an increase in base money would be unlikely to produce corresponding increases in broader measures of money because banks do not wish to expand their assets by lending to the private sector. Second, it is unlikely that long-term interest rates could fall further because of a risk premium reflecting the price volatility of bonds when interest rates are low. Third, there may be political obstacles to a significant depreciation of the yen - namely, opposition from the US and in Asia itself. Although there has, indeed, been substantial foreign exchange intervention by Japan over the past year, that has been directed to stabilising the Yen-Dollar exchange rate, and the intervention has been sterilised.

Support for the rejection of money base expansion as a way out comes from McKinnon and Ohno (1999). They pointed out that, in an open economy with no capital controls, long-term interest rates in Japan should reflect expectations of future currency appreciation. Bond yields could have fallen to their present levels only if the market believed that the yen would continue to appreciate in future as it has over the past twenty years. They regard the expectation of further yen appreciation as given, which leads to an externally-generated liquidity trap. Attempts to weaken the yen would, they argue, fail because investors believe that any depreciation would be only temporary. Quite why expectations of future yen appreciation cannot be influenced by monetary policy is unclear. The announcement of a medium-term commitment to an inflation target comparable with those elsewhere should eliminate expectations of perpetual yen appreciation.

In future, economists will surely learn much about monetary policy at low interest rates from the current experience of Japan. There is no doubt that monetary policy becomes more complicated when nominal interest rates are very low. There may be institutional or political objections to the consequences of a policy of base money expansion. Nevertheless, it is hard to believe that monetary policy is completely impotent.

4 The International Monetary System

No central bank can be an island of stability. Interdependence among countries is a feature of modern economic life. For most countries their exchange rate is one of the most important relative prices in the economy, and some countries have gone further and either delegated monetary policy to another country – as with a currency board – or have determined to decide monetary policy collectively – as in a monetary union.

Over the past ten to fifteen years, since freely floating exchange rates and unrestricted capital movements characterised the world financial system, two "stylised facts" have emerged. First, with floating exchange rates the volatility of real exchange rates has risen significantly compared with earlier regimes of various types of fixed exchange rate. Second, the size and volatility of international capital flows has often made fixed but adjustable exchange rate pegs hard to sustain.

This experience poses three questions for the design of the international monetary system. First, should currency arrangements take one of two extreme forms, either (a) a floating regime with a domestic nominal anchor (such as a money growth or inflation target), or (b) abandonment of a national currency through unilateral "dollarisation" or multilateral monetary unions? Several countries, ranging from Britain to Brazil, have abandoned fixed exchange rate pegs and adopted floating regimes with domestic nominal targets. Other countries, such as Argentina and members of the Euro area, have moved towards either rigid currency boards or a fully-fledged monetary union.

Second, if this is indeed the choice, how should a country decide between retaining its own currency with a domestic nominal target or allowing its monetary policy to be determined elsewhere?

Third, what should be the arrangements for the "governance" of the international monetary system? Changes in the number of currencies, and the associated number of central banks, have already led to active discussion about the appropriate fora in which decisions on the international monetary system are discussed and made.

The proposition that the world is becoming polarised into countries with freely floating exchange rates and countries with rigidly fixed rate regimes is, on the face of it, plausible. It describes the failed experience of many countries who tried to pursue a middle path of fixed but adjustable rates. But recent experience may tell us more about the need for clarity in a country's monetary policy framework, and the resulting credibility which that generates, than an iron law of exchange rate regimes. For countries that have acquired credibility in their willingness to take whatever measures are necessary to maintain a fixed exchange rate, a fixed but adjustable peg may be a feasible regime. And there may be cases in which countries in transition from a state of hyperinflation to more conventional rates of inflation can benefit, at least for a time, from the clarity and simplicity of a commitment to an exchange rate objective. Nevertheless, it is likely that the number of countries choosing the two extremes will continue to increase.

As far as the choice between the two extremes is concerned, the issue hinges on the costs and benefits of an exchange rate agreement with other countries. This is not the place to rehearse the costs and benefits of a monetary union. In Europe, the greatest potential economic benefit is, in my view, the impact on growth of trade resulting from the greater exploitation of the larger market made possible by a single currency. Against that benefit must be set the economic cost of more pronounced business cycles which may result from interest rates which are inappropriate for the country concerned, even if they are in the interests of the monetary union as a whole. It will be interesting to see whether the example of the Economic and Monetary Union in Europe leads to an expansion of the number of regional monetary unions in other parts of the world.

The immediate implication of a monetary union is that a wide range of decisions which were previously taken within a country are now made collectively. That requires mechanisms for those joint decisions on matters such as exchange rates and fiscal policy. For example, the Euro 11 Group of finance ministers has an important role to play in the operation of monetary union. Its role is not to provide a political input into monetary policy. It is to provide a forum for member countries to reach agreement on those issues which are not the responsibility of the ECB. These include fiscal policy and any formal exchange rate arrangements between the euro and other currencies. They also need to develop a common view on a range of issues which will then be represented to other countries on the international stage.

Changes in currency arrangements will have implications for the international monetary system. Will fixed exchange rates spring up within the three regions in which the dollar, the euro and the yen are the most important currencies? Or will currency boards emerge which link emerging market currencies to the dollar, irrespective of their regional affiliation? How will the three major currencies relate to each other? The answers will depend on politics at least as much as on economics.

There has been much talk, and even some action, about the architecture of the international financial system. Some of this relates to international monetary co-operation. The proliferation of meetings means that there are now many groups of a Gx form, where x is almost any integer between two and

182. Indeed, there is even a group called GX which has not yet determined the composition of its membership. The international monetary system is now very different from when the Bretton Woods Institutions were set up. Free capital mobility has changed the playing field. The role of those institutions, and the way in which the member countries interact is certain to continue to evolve. The G7 might become smaller (perhaps a G3); or it might become larger (including the leading emerging market countries); or it might even stay the same.

5 The future of central banks

Despite some ups and downs, central banks are ending this century well ahead of where they started it. There are more of them, and they have greater power and influence. But is this the peak? Will future historians look back on central banks as a phenomenon largely of the twentieth century?

Although central banks have matured, they not yet reached old age. There remains much to be done. The case for price stability, and the role of central bank independence in achieving it, needs to be made to a wide audience. We must build a constituency for low inflation, without having to resort to episodes of high inflation to prove that instability is costly. To that end, communication has become more important – central banks have moved from mystery and mystique to transparency and openness. The language of central banking must evolve to reflect the need to maintain broader support for the objective of stability and the legitimacy of independent central banks in pursuing it.

Looking further ahead, the future of central banks is not entirely secure. Their numbers may decline over the next century. The enthusiasm of governments for national currencies has waned as capital flows have become liberalised and exchange rates more volatile. Following the example of the European Central Bank, more regional monetary unions could emerge. Short of this, the creation of currency boards, or even complete currency substitution, might also reduce the number of independent national monetary authorities.

But much more important is the potential impact of technological innovation. At present, central banks are the monopoly supplier of base money – cash and bank reserves. Because base money is the ultimate medium of exchange and of final settlement, central banks have enormous leverage over the value of transactions in the economy, even though the size of their balance sheet is very small in relation to those of the private sector. For years, economists have had difficulty in incorporating money into rigorous general equilibrium models. To the elegance of the Walrasian model of an exchange economy has been bolted on an assumption about the technology of making payments such as a "cash in advance" constraint. These untidy ways of introducing money into economic models are not robust to changes in institutions and technology. Is it possible that advances in technology will mean that the arbitrary assumptions necessary to introduce money into rigorous theoretical models will become redundant, and that the world may come to resemble a pure exchange economy?

Electronic transactions in real time hold out that possibility. There is no reason, in principle, why final settlements could not be carried out by the private sector without the need for clearing through the central bank. The practical implementation of such a system would require much greater computing power than is at present available. But there is no conceptual obstacle to the idea that two individuals engaged in a transaction could settle by a transfer of wealth from one electronic account to another in real time. Pre-agreed algorithms would determine which financial assets were sold by the purchaser of the good or service according to the value of the transaction. And the supplier of that good or service would know that incoming funds would be allocated to the appropriate combination of assets as prescribed by another pre-agreed algorithm. Eligible assets would be any financial assets for which there were market-clearing prices in real time. The same system could match demands and supplies of financial assets, determine prices and make settlements.

Financial assets and real goods and services would be priced in terms of a unit of account. The choice of a unit of account (perhaps a commodity standard, which would produce broad stability in the price level) would be a matter for public choice and regulation, along the lines of existing weights and measures inspectors. Final settlement could be made without any recourse to the central bank. As Henckel et al. (1999) have noted, the key to a central bank's ability to implement monetary policy is that it "remains, by law or regulation, the only entity which is allowed to 'corner' the market for settlement balances".

Without such a role in settlements, central banks, in their present form, would no longer exist; nor would money. Economies of this kind have been discussed by Black (1970), Fama (1980) and Hall (1983). The need to limit excessive money creation would be replaced by a concern to ensure the integrity of the computer systems used for settlement purposes. A regulatory body to monitor such systems would be required. Existing regulators, including central banks, would no doubt compete for that responsibility. Moreover, in just the same way as the Internet is unaware of national boundaries, settlement facilities would become international.

The key to any such developments is the ability of computers to communicate in real time to permit instantaneous verification of the credit worthiness of counterparties, thereby enabling private sector real time gross settlement to occur with finality. Any securities for which electronic markets exist could be used as part of the settlement process. There would be no unique role for base money, and hence the central bank monopoly of base money issue would have no value. Central banks would lose their ability to implement monetary policy. The successors to Bill Gates would have put the successors to Alan Greenspan out of business.

As a central banker interested in information technology, should I regard this prospect as a dream or a nightmare? Perhaps the answer is that central bankers should enjoy life today. I shall place my faith in the words of Walter Bagehot who, in *Lombard Street* (1873), wrote that

> "Nothing would persuade the English people to abolish the Bank of England; and if some calamity swept it away, generations must elapse before at all the same trust would be placed in any other equivalent."

Central banks may be at the peak of their power. There may well be fewer central banks in the future, and their extinction cannot be ruled out. Societies have managed without central banks in the past. They may well do so again in the future. The website of my favourite football team has the banner "heroes and villains". For some, central bankers are heroes – more powerful and responsible than political leaders – and for others they are villains – too fanatical to be entrusted with the world economy. For all our sakes, it is important that central bankers are seen neither as heroes nor villains. They should be modest technicians, striving to improve the way they use the tools of their trade, and always eager to learn. Openness of mind and fleetness of foot will be the best way to avoid extinction.

Appendix 1

THE CONSTRUCTION OF SURVEY BASED *EX ANTE* AND *EX POST* REAL INTEREST RATES FOR THE US AND UK

1. Background to the surveys

1.1 Gallup (UK)

The survey started in January 1984 but was discontinued in September 1997. It was conducted on a monthly basis, in the first two weeks of the month. The survey covered 1000 employees, drawn from a stratified sample of the population of Great Britain. Respondents were asked to forecast inflation in the following ranges: 0-1, 1-2, 3-4, 5-6, 7-8, 9-10, 11-12, 13-14, 15-20, and 20 plus. Gallup calculated an average by taking the mid-point of each range and weighting by the number of respondents within it. The 20 plus range was assumed to be 24 per cent.

1.2 Basix (UK)

The survey is conducted by Barclays Bank on a quarterly basis in early March, early June, early September and early December. It began in December 1986. It looks at the inflation expectations of six separate groups of people: general public, business economists, academic economists, finance directors, trade unions and investment analysts. The question relates to twelve-month ahead RPI inflation expectations, except for the general public group for which inflation measure is not specified.

1.3 Livingston (US)

The survey asks a range of ‘professional’ forecasters and academics to forecast US CPI inflation. The number of participants has been fairly steady over time averaging about 50 respondents in each survey. One set of questionnaires is sent out in May and must be returned in early June, and the other set of questionnaires is sent out in November and must be returned in early December.

The timing conventions of the Livingston Survey have been consistent throughout the duration of time that the Federal Reserve Bank of Philadelphia has managed the survey (It took responsibility for the Survey in 1990), and seem to be generally consistent with the above pattern before that time.

2. Nominal interest rates.

2.1 UK nominal interest rate

The UK nominal rate is the 12 month London interbank offer rate (LIBOR).

2.2 US nominal interest rate

The nominal interest rate is the 1-year Treasury constant maturity rate. Yields on Treasury securities at “constant maturity” are interpolated by the US Treasury from the daily yield curve. This curve, which relates the yield on a security to its time to maturity, is based on the closing market bid yields on actively traded Treasury securities in the over-the-counter market.

3. Constructing a survey based *ex ante* measure of the real rate

3.1 UK real rates

To calculate the survey based *ex ante* real rate, the average of the 12-month LIBOR rate over the dates of the survey is calculated. The survey based inflation expectation corresponding to these dates is subtracted from this average nominal interest rate. The Gallup inflation expectations series tended to over predict inflation outturns. If this were allowed for by subtracting the average error of 1.61 percentage points from the Gallup series, then there would be no examples of negative real rates in Chart 6.

3.2 US real rates

The majority of the Livingston sampling period lies in May and November, the real interest rate is calculated as the monthly average for the nominal interest rate in either May or November less the appropriate inflation expectation. The Livingston expectations series has tended to under predict inflation outturns. If this were allowed for by adding the average error of 0.65 percentage points to the Livingston series, then real interest rates would be negative in ten half years out of 92, compared with four half years when no adjustment was made.

4. The *ex post* real rate

4.1 The UK ex post real rates

The nominal interest rate is again 12-month LIBOR rate. The actual RPIX inflation outturn is subtracted from the appropriate month-average nominal interest rate.

4.2 The UK ex post real rates

As with the *ex ante* real rate, the nominal interest rate is the one year Treasury constant maturity rate. The actual CPI inflation outturn is subtracted from the appropriate month-average nominal interest rate.

TABLE 1: PROBABILITY OF ZERO INTEREST RATES IN DIFFERENT ECONOMIC MODELS

(per cent)

Model	Simple Taylor Rule	Aggressive Taylor Rule
Batini-Haldane	1	31
Levin-Wieland-Williams	2	24
McCallum-Nelson	11	16
Rotemberg-Woodford	12	2

Note: The probabilities are calculated on the assumption that the exogenous shocks are normally distributed using the reported standard deviation of interest rates under the two policy rules, and that the average nominal interest rate is 5.0%.

REFERENCES

Akerlof, G. A., W. T. Dickens and G. L. Perry (1996), "The Macroeconomics of Low Inflation", **Brookings Papers on Economic Activity**, 1, 1-76.

Bagehot, W. (1873), **Lombard Street: A Description of the Money Market**, William Clowes and Sons, London.

Bank of Canada (1994), **Economic Behaviour and Policy Choice Under Price Stability**, Ottawa.

Batini, N. (1999), "The Shape of Stochastic-Simulation Generated Taylor Curves", mimeo, Bank of England

Batini, N. and A. Haldane (1999), "Forward-looking Rules for Monetary Policy", Bank of England Working Paper No 91.

Batini, N. and A. Yates (1999), "Inflation or Price Level Targeting?" mimeo, Bank of England

Bean, C. (1998), "The New UK Monetary Arrangements: A View from the Literature", **Economic Journal**, 108, 1795-1809

Bernanke, B.S. and F.S. Mishkin (1997), "Inflation Targeting: A New Framework for Monetary Policy?", NBER Working Paper No 5893.

Black, F. (1970), Banking and Interest Rates in a World without Money, **Journal of Bank Research**, Autumn 9-20.

Boskin, M. (1996), "Toward a More Accurate Measure of the Cost of Living", **Final Report of the Advisory Commission To Study the Consumer Price Index**, Washington DC.

Buiter, W.H. and N. Panigirtzoglou (1999), "Liquidity Traps: How to Avoid Them and How to Escape Them", mimeo, Bank of England.

Crawford, A. and A. Harrison (1998), "Testing for Downward Nominal Rigidity in Wages", in **Price Stability, Inflation Targets and Monetary Policy**, Proceedings of a Conference held by the Bank of Canada, May 1997.

Christiano, L.J., and C.J.Gust (1999), "Taylor Rules in a Limited Participation Model", NBER Working Paper No 7017.

Cunningham, A.W.F (1996), "Measurement Bias in Price Indices: An Application to the UK's RPI." Bank of England Working Paper No 47.

Dittmar, R., W.T. Gavin, and F.E.Kydland (1999), "The Inflation-Output Variability Trade-Off and Price-Level Targets", **Federal Reserve Bank of St. Louis Review**, January/February.

Feldstein, M. (1996), "The Costs and Benefits of Going from Low Inflation to Price Stability", NBER Working Paper No 5469.

Feldstein, M., ed., (1999), **The Costs and Benefits of Price Stability**, University of Chicago

Press for NBER.

Fischer, S. (1996), "Why Are Central Banks Pursuing Long-Run Price Stability?", in **Achieving Price Stability**, Federal Reserve Bank of Kansas City, 1996, 7-34.

Friedman, B.M. (1998), "Introduction", in Solow, R.M. and J.B. Taylor, **Inflation, Unemployment, and Monetary Policy**, The MIT Press, Cambridge, Massachusetts.

Friedman, M. (1969), "The Optimum Quantity of Money", in **The Optimum Quantity of Money and Other Essays**, Chicago: Aldine Publishing Company.

Fuhrer, J.C. and B.F. Madigan (1997), "Monetary Policy when Interest Rates are Bounded at Zero", **Review of Economics and Statistics**, 79, 573-585.

Greenspan, A. (1989), "Statement by Chairman, Board of Governors of the Federal Reserve System before the Committee on Banking, Finance and Urban Affairs, US House of Representatives, 24 January 1989", **Federal Reserve Bulletin**, March 1989, 139-42.

Hall, R.E. (1983), "Optimal Fiduciary Monetary Systems", **Journal of Monetary Economics**, 12, 33-50.

Hall, R.E. (1984), "Monetary Strategy with an Elastic Price Standard", in **Price Stability and Public Policy**, Federal Reserve Bank of Kansas City.

Henckel, T., A. Ize and A. Kovanen (1999), "Central Banking without Central Bank Money", mimeo, IMF.

Hicks, J.R. (1937), "Mr Keynes and the 'Classics': A Suggested Interpretation", **Econometrica**, 5, 147-159.

Fama, E. F (1980), "Banking in the Theory of Finance", **Journal of Monetary Economics**, 6, 39-57.

Johnson, K., D. Small and R. Tryon (1999), "Monetary Policy and Price Stability", Board of Governors of the Federal Reserve System International Finance Discussion papers No 641, mimeo, Washington DC.

Keynes, J.M. (1936), **The General Theory of Employment, Interest and Money**, Volume VII of **The Collected Writings of John Maynard Keynes** (1973), Macmillan, London.

King, M.A. (1996), "How Should Central Banks Reduce Inflation? – Conceptual Issues" in **Achieving Price Stability**, Federal Reserve Bank of Kansas City.

King, M.A. (1997 a), "The Inflation Target Five Years On", **Bank of England Quarterly Bulletin**, November.

King, M.A. (1997 b), "Changes in UK Monetary Policy: Rules and Discretion in Practice", **Journal of Monetary Economics**, 39, 81-97.

Krugman, P. (1996), "Stable Prices and Fast Growth: Just Say No", **Economist**, 31 August, 19-21.

Krugman, P. (1998), "It's Baaack! Japan's Slump and the Return of the Liquidity Trap", **Brookings Papers on Economic Activity**, 2, 137-205.

Krugman, P. (1999), **The Return of Depression Economics**, W. W. Norton and Co., New York.

Levin, A., V. Wieland and J.C. Williams (1998), "Robustness of Simple Monetary Policy Rules under Model Uncertainty", **Federal Reserve Board Finance and Economics Discussion Series** No 45.

Lucas, R.E. (1994), "The Welfare Costs of Inflation", CEPR Working Paper No 394.

McCallum, B.T. (1990), "Could a Monetary Base Rule Have Prevented the Great Depression?", **Journal of Monetary Economics**, 26, 3-26.

McCallum, B.T. and E. Nelson (1999), "Performance of Operational Policy Rules in an Estimated Semi-Classical Structural Model", in J.B. Taylor (ed), **Monetary Policy Rules**, Chicago: University of Chicago Press for NBER, 15-45.

McCulloch, J.H. (1991), "An Error-Correction Mechanism for Long-Run Price Stability", **Journal of Money, Credit and Banking**, 23, 619-624.

McKinnon, R. and K. Ohno (1999), "The Foreign Exchange Origins of Japan's Economic Slump in the 1990s: the Interest Rate Trap", mimeo, Stanford University.

Meltzer, A.H. (1995), "Monetary, Credit and (Other) Transmission Processes: A Monetarist Perspective", **Journal of Economic Perspectives**, 9, 49-72.

Meltzer, A.H. (1999), "The Transmission Process", Paper prepared for conference on the Monetary Transmission Process: Recent Developments and Lessons for Europe, Bundesbank, Frankfurt, 25-27 March.

Nelson, E. (1999a), UK Monetary Policy 1972-1997: A Guide Using Taylor Rules", mimeo, Bank of England.

Nelson, E. (1999b), "Direct Effects of Base Money on Aggregate Demand: Theory and Evidence", mimeo, Bank of England.

Okina, K. (1999), "Monetary Policy Under Zero Inflation: A Response to Criticisms and Questions Regarding Monetary Policy", **Bank of Japan Institute for Monetary and Economic Studies Discussion Paper Series** No 99-E-20.

Orphanides, A. and V. Wieland (1998), "Price Stability and Monetary Policy Effectiveness when Nominal Interest Rates are Bounded at Zero", Federal Reserve Board Finance and Economics Discussion Series No 35, August.

Orphanides, A. (1999), "The Quest for Prosperity without Inflation", Federal Reserve Board, May, mimeo.

Phelps, E. (1972), **Inflation Policy and Unemployment Theory**, MacMillan, London

Poole, W. (1998), "Comments", in Solow, R.M. and J.B. Taylor, **Inflation, Unemployment, and Monetary Policy**, The MIT Press, Cambridge, Massachusetts.

Rotemberg, J.J. and M. Woodford (1997), "An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy", in B. S. Bernanke and Rotemberg (eds), **NBER**

Macroeconomics Annual 1997, MIT Press, 297-346.

Shiller, R. (1996), "Why Do People Dislike Inflation?", NBER Working Paper No 5539, April.

Summers, L. (1991), "How Should Long Term Monetary Policy be Determined?", **Journal of Money Credit and Banking**, 123, 625-631

Svensson, L.E.O. (1999), "Price Level Targeting vs. Inflation Targeting", **Journal of Money Credit and Banking**, forthcoming.

Taylor, J.B. (1979), "Estimation and Control of a Macroeconomic Model with Rational Expectations", **Econometrica**, 47, 1267-86.

Taylor, J.B. (1998), "Monetary Policy and The Long Boom", **Federal Reserve Bank of St Louis Review**, November/December.

Taylor, J.B., ed, (1999), **Monetary Policy Rules**, University of Chicago Press for NBER.

Vickrey, W. (1955), "Stability Through Inflation", in K. Kurihara (ed), **Post-Keynesian Economics**, George Allen and Unwin Ltd., London.

Wolman, A.L. (1998), "Real Implications of the Zero Bound on Nominal Interest Rates", Federal Research Bank of Richmond, mimeo.

Yates, A. (1998), "Downward Nominal Rigidity and Monetary Policy", Bank of England Working Paper No 82.

Chart 1: Number of central banks , 1870-1999

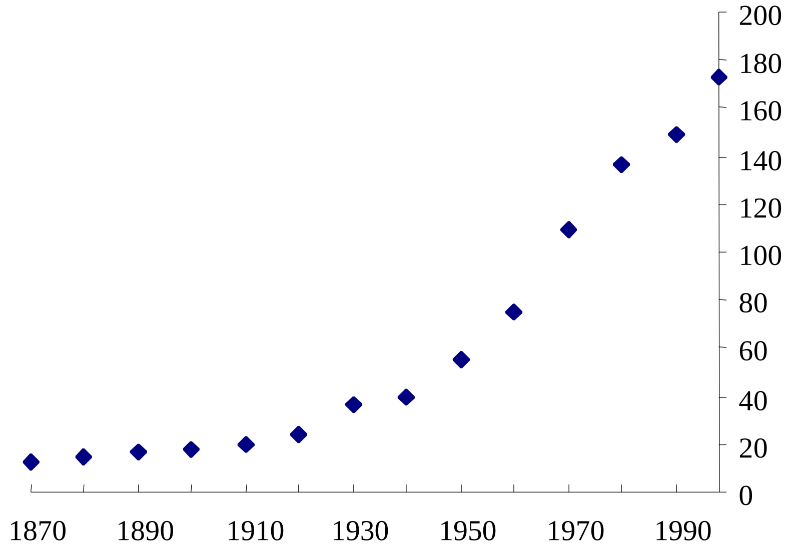


Chart 2: Global inflation, 1870-1998 (per cent)

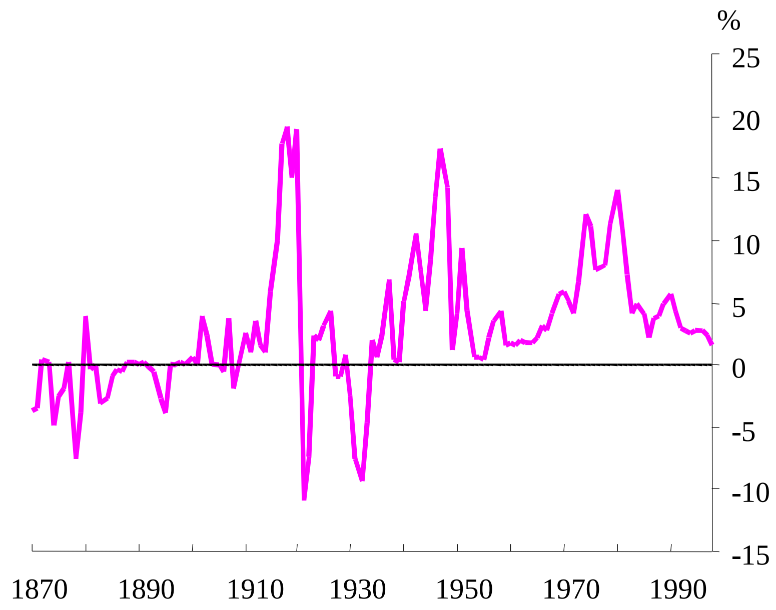


Chart 3: US CPI and the proportion of price cuts in the index, 1988-1999

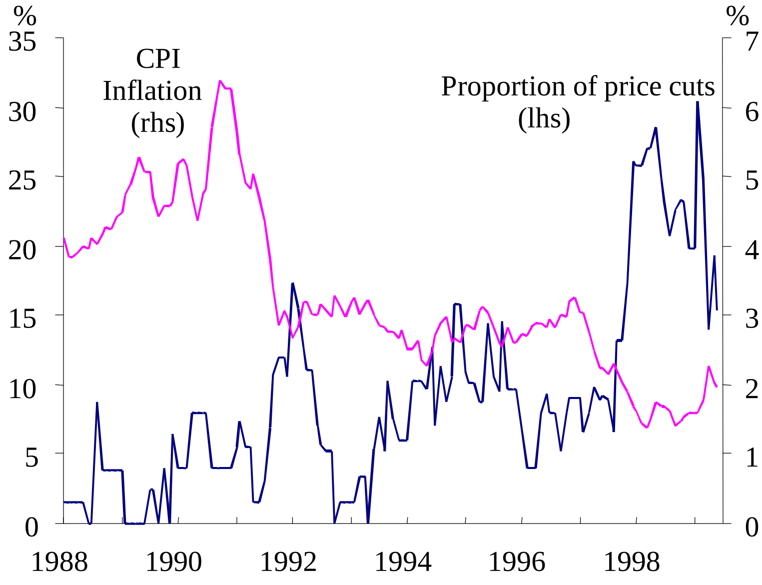


Chart 4: UK RPI and the proportion of price cuts in the index, 1988-1999

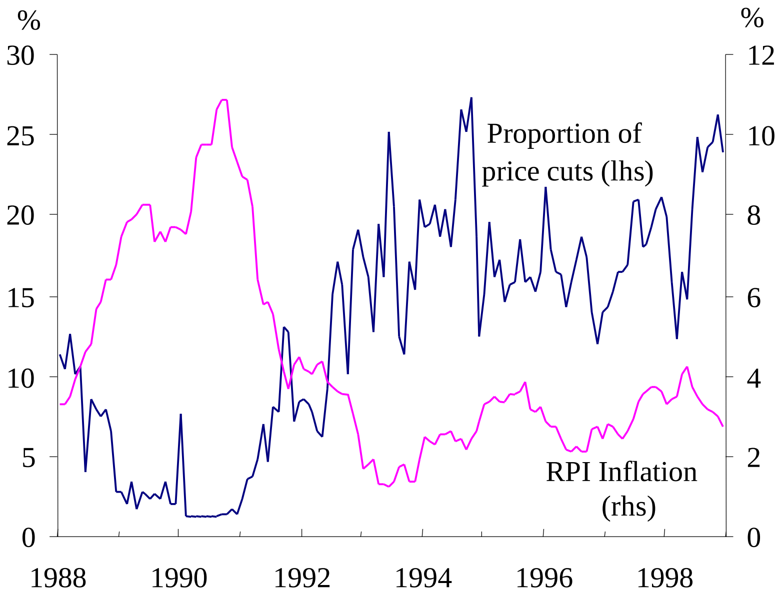
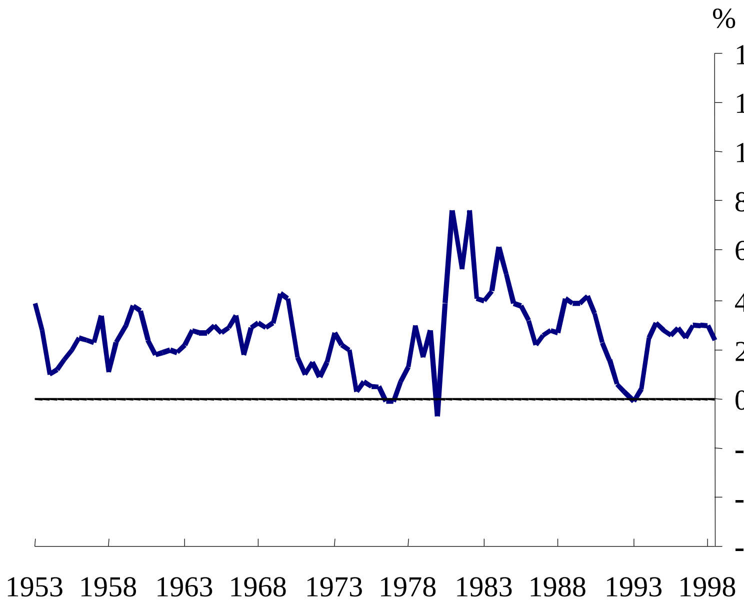
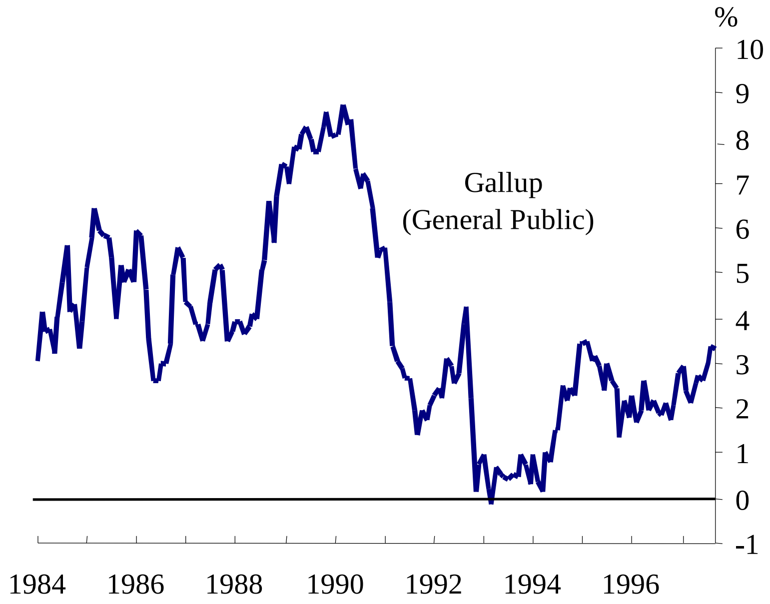


Chart 5: *Ex ante* one-year real interest rate[1], US 1953-1998 (per cent)



1 Based on Livingston survey. See Appendix 1 for definition.

Chart 6: *Ex ante* one-year real interest rate[1], UK 1984-1997 (per cent)



1 Based on Gallup survey. See Appendix 1 for definition.

Chart 7: The Taylor Curve

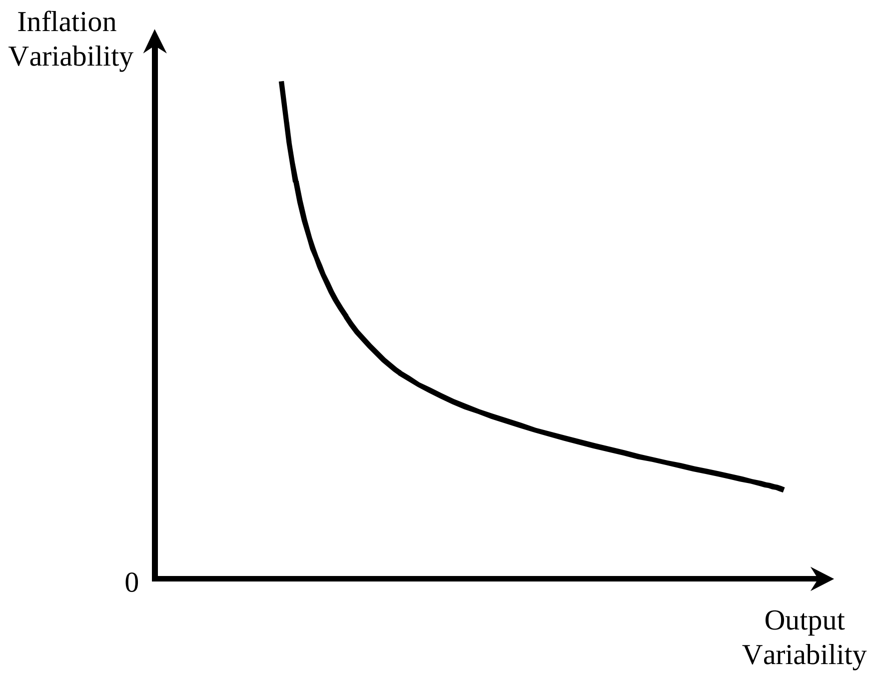


Chart 8: Comparison of inflation and price level targeting

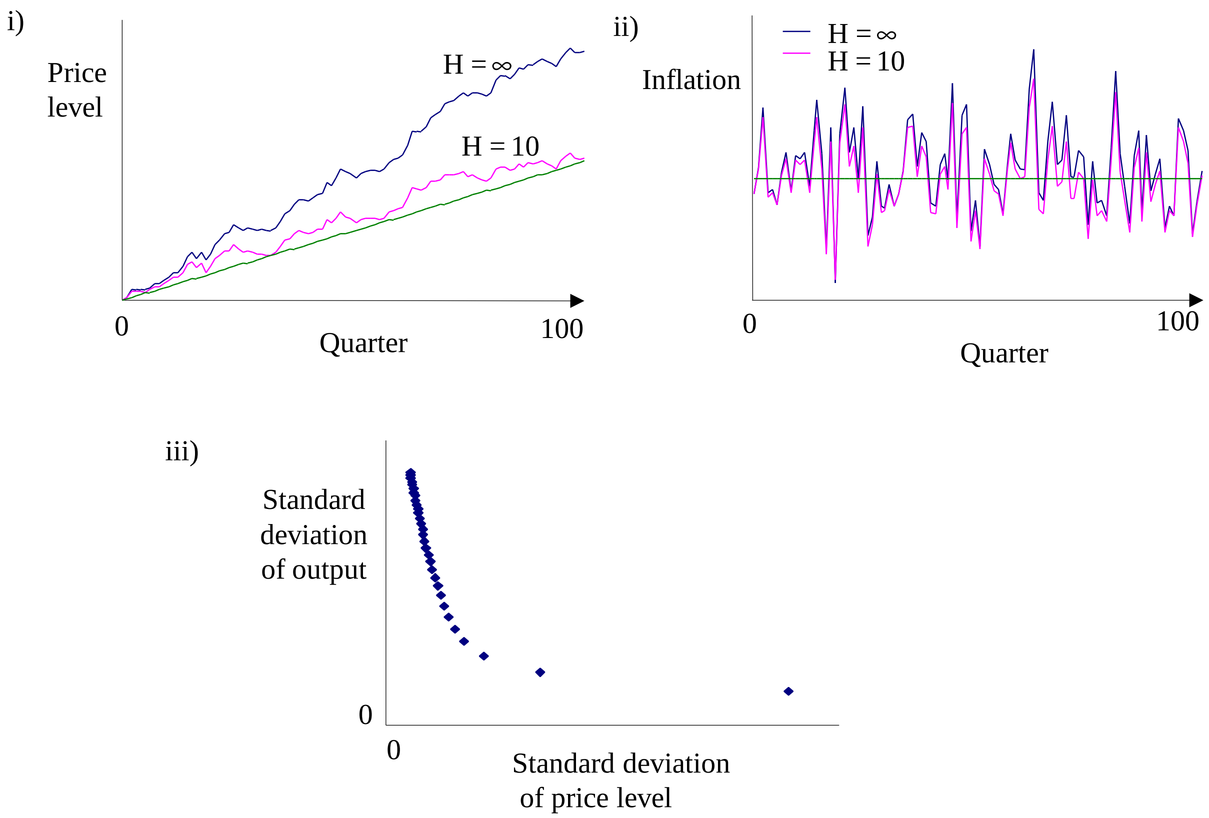


Chart 9: Demand for money

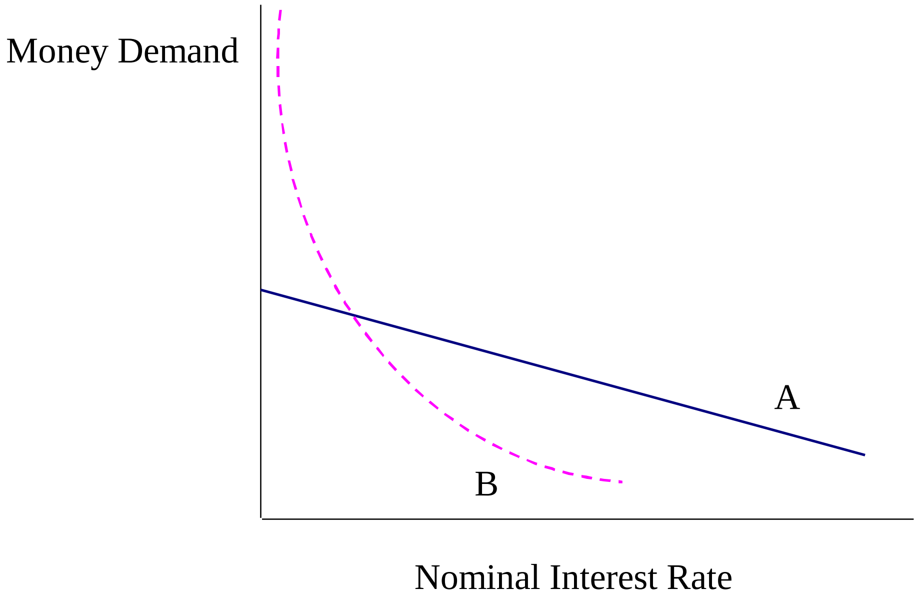
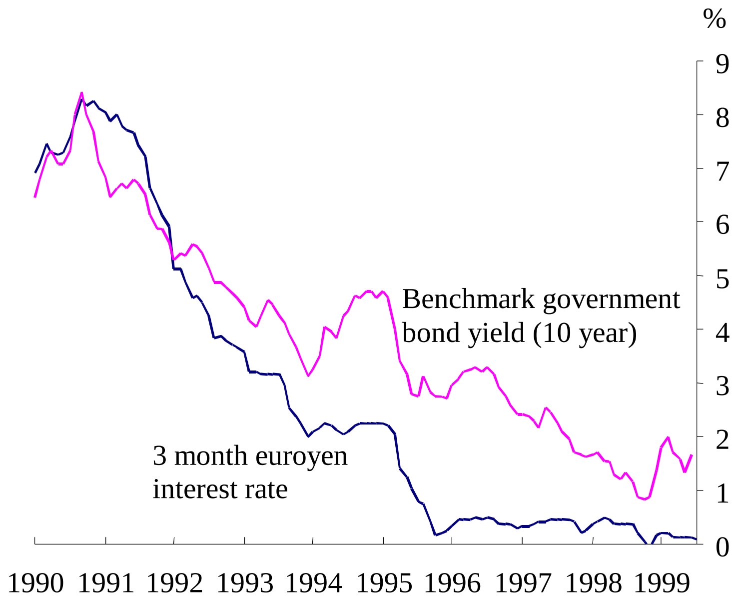


Chart 10: Interest rates in Japan, 1990-1999 (per cent)



Source: BIS