Money and credit in an inflation-targeting regime[1]

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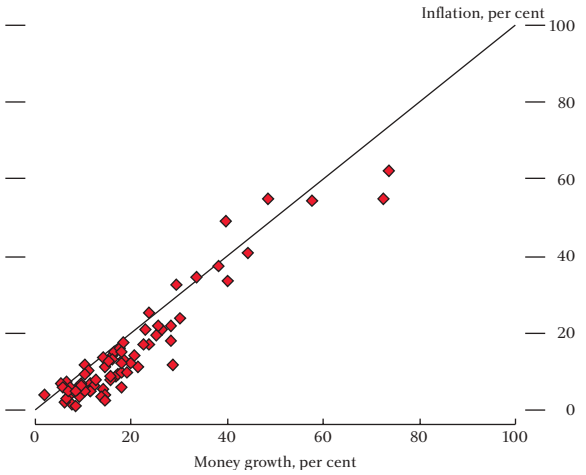
This article is one of a series on the UK monetary policy process.[2] *It discusses how the assessment of money and credit data fits into the Bank's quarterly forecast round.*

Introduction

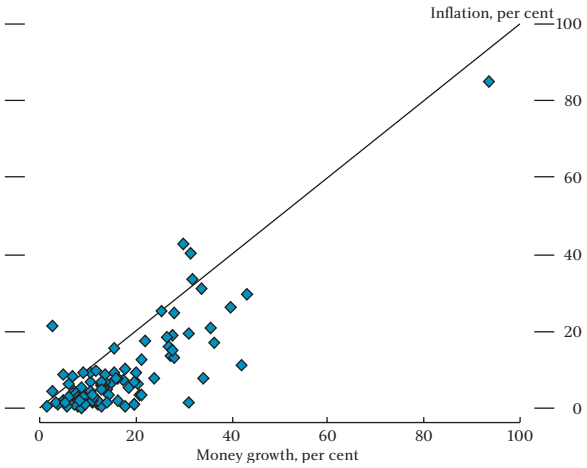
Inflation is ultimately a monetary phenomenon. Over long periods of time, and across many different countries, there has been a very close relationship between the average annual rate of growth of the money stock, and the average annual rate of increase of prices (see Chart 1). This suggests that the monetary aggregates should play an important part in the Monetary Policy Committee's assessment of the outlook for inflation. However, extracting information from these data is not a mechanical process. Over policy-relevant time horizons, the monetary aggregates will be influenced by many factors, such as cyclical shifts in the demand for money and credit, and innovations in financial structure, products and regulation. That explains why, in the short term, the correlation between monetary growth and inflation is much less marked (see Chart 2), and why, soon after its inception, the MPC took the decision not to reinstate the monitoring ranges for money that had been in place under the previous Government.[3]

Chart 1
Average annual inflation and broad money growth rates over the past 20 years[a]



(a) Based on data up to 1999 for 116 different countries. For presentational purposes countries with average inflation or broad money growth rates exceeding 100% have been excluded.

Chart 2
Average annual inflation and broad money growth rates over the past 2 years[a]



(a) Based on data up to 1999 for 116 different countries. For presentational purposes countries with average inflation or broad money growth rates exceeding 100% have been excluded.

It is important to understand and quantify the factors affecting monetary variables, and to draw out the key implications for the inflation outlook. In carrying out this task, the Bank of England can draw on a substantial quantity of published research in monetary economics, together with a wide variety of other tools for economic,

(1) An earlier version of this paper was presented at a workshop 'Monetary analysis: tools and applications' held at the European Central Bank in Frankfurt on 20–21 November 2000. It was subsequently published in Klöckers and Willeke (2001).
(2) See also Bean and Jenkinson (2001) and Clews (2002).
(3) These charts are taken from King (2002). A full account of the decision not to reinstate monitoring ranges is given in the box on pages 8–9 of the November 1997 *Inflation Report*.

institutional and statistical analysis.[1] These tools are used in many different ways to brief the MPC. This article focuses on how formal theoretical and empirical models are used to provide a quantitative evaluation of the information in money and credit aggregates as an input to the MPC's quarterly inflation forecast.

Money, credit and the Bank's suite of models

Bean and Jenkinson (2001) discuss how and why MPC members use a 'suite' of economic models in forming their overall forecast judgments. One element of this suite is a macroeconometric model (MM), which includes equations for each of the key behavioural relationships in the UK economy. That model is under continual development; the most recent published version was in September 2000.[2] But it is clear that, given substantial uncertainty over the true structure of the economy, and the need in any model-building exercise to focus on some economic interactions at the expense of others, no single model is likely to be able to encompass all possible factors bearing on the inflation outlook. The MM is therefore supplemented by a suite of auxiliary models, including a number of models based on money and credit data, designed to provide answers to the types of question not readily addressed within the MM, to analyse specific policy issues, or to act as a potential check on the output of the MM.

The MM has three central properties desirable of any model used for providing monetary policy advice. First, the long-run behaviour of real variables, such as GDP and employment, is independent of the level of prices. Second, there is no long-run trade-off between inflation and output. And third, both the level of prices, and the rate of inflation, depend ultimately on monetary policy. However, in common with nearly all large-scale macroeconometric models used in other central banks and research institutions, money in the MM reacts passively to changes in measures of economic activity, wealth and the rate of interest. Active roles for money and credit in the transmission mechanism are less well-developed. Consequently, if the inflation projections relied exclusively on the MM, then important factors affecting the outlook for inflation might be overlooked. It is therefore important that the MPC has access to alternative models capable of capturing and quantifying any incremental information in money and credit. Research at the Bank of England over the past few years has generated a rich set of empirical and theoretical models suitable for this purpose.[3] Bank staff use these models to provide the MPC with an updated analysis of the potential information in money and credit at an early stage in each forecast round.

Aims and objectives of the monetary assessment process

Implicit in the suite-of-models approach is a recognition that views about the role played by different variables, including (alternative definitions of) money and credit, may vary across academics, informed commentators and policy-makers. A central aim of the monetary assessment process is to reflect this range of views by offering policy-makers a menu of alternative projections and simulations, depending on the extent to which monetary variables are thought to play an active role in the transmission mechanism.

Monetary variables may be helpful to policy-makers in a number of different ways.

1 **Money and credit as short-run indicator variables.** Monetary statistics are available more rapidly than most other economic data, and are usually drawn from a complete population, making them less vulnerable to sampling errors. Consequently, they might assist policy-makers by providing an early, independent read on economic events. Statistical evidence on the value of this information is given in Astley and Haldane (1995).

2 **Money and credit as a source of incremental information on the transmission of shocks.** Data on money and credit can provide policy-makers with incremental information on the transmission of shocks through the economy, at least at certain points in the economic cycle. This sort of information can have a bearing on economic developments over a number of years. It is one area where monetary models are able to complement the output of the MM, and help to illuminate key issues in the preparation of the inflation projection. Taking this information on board reduces the probability of making policy mistakes.

(1) A comprehensive list of references is provided at the end of this paper.
(2) Bank of England (2000).
(3) See, for example, Nelson (2002) for a recent study of the possible incremental information contained in M0, also known as base money.

3 **Money and credit as indicators of the underlying stance of monetary policy.** The monetary aggregates might provide incremental information on the tightness or looseness of policy over and above other measures, such as the short-term interest rate and the amount of spare capacity in the economy. Though related to the second view, in the sense that money contains information incremental to other variables, the distinguishing characteristic of this view is the explicit link to the underlying stance of policy itself.

Money and credit as short-run indicator variables

Money and credit aggregates can be informative about the short-run outlook for activity and inflation. Bank staff use models based on household and corporate data to draw conclusions about the near-term outlook for consumption and investment, and models based on whole-economy aggregates to generate projections for aggregate demand. The Bank of England has for some time now looked particularly closely at sectoral money and credit data, reflecting a belief that sectoral relationships are likely to be more stable than those at an aggregate level.(1)

The short-run outlook for consumption

Most of these indicator-variable projections are based on a modelling philosophy set out in Thomas (1996, 1997a, 1997b) and Janssen (1996). The first stage is to estimate a system of equations for households' money holdings, consumption, income, wealth, inflation and interest rates. From this system, two long-run relationships are identified, which—after testing and imposing a set of theory-based restrictions—are interpreted as long-run equilibrium consumption and long-run equilibrium money holdings. The table shows examples of the sorts of equations that have been obtained, taken from Thomas (1997a). Households' long-run equilibrium money holdings depend positively on income and wealth, with a joint coefficient of unity, positively on the relative interest rate on deposits, and negatively on inflation (which measures the relative return between real and financial assets). Consumption depends positively on income and wealth—again with a joint unit coefficient—negatively on a measure of the real interest rate, and negatively on the change in unemployment, a term intended to capture the effects of precautionary saving.

Long-run money demand and long-run consumption equations

Households' long-run equilibrium money holdings (m^*)

$$m_t^* = 0.5y_t + 0.5w_t + 0.44(i_{dt} - i_t) - 1.6\pi_t$$

Households' long-run equilibrium consumption (c^*)

$$c_t^* = 0.9y_t + 0.1w_t - 0.64(i_t - \pi_t) - 1.2\Delta u_t$$

m = log real household sector M4
y = log real household sector disposable income
w = log real gross household sector wealth
i_d = weighted average interest rate on household sector M4
i = three-month Treasury bill rate
π = annualised rate of increase of consumption deflator
c = log real consumption expenditure
u = unemployment rate

If households' actual money holdings were always in long-run equilibrium, as represented by the equation for m^* in the table, and if all of the right-hand side variables in the equation were measured without error in real time, then money would contain no incremental information about the economy. In practice, however, none of these conditions are likely to hold. Even if money holdings were entirely demand determined, monetary data are available earlier, and with less chance of error, than those on incomes, prices and wealth, and so are helpful to policy-makers as short-run indicator variables.

But households' money holdings may not always be in long-run equilibrium. If adjusting portfolios is costly, or yields are sluggish to adjust, households may be willing to accept higher or lower money balances for a short period of time, as a temporary abode of purchasing power.(2) Long-run equilibrium is then restored only gradually, as households attempt to eliminate any excess holdings through purchases of goods, and financial and physical assets. In this scenario, money also plays an incremental role in the transmission of shocks.

These considerations suggest that there may be useful information in both money growth, and in any gap between actual money holdings and estimated equilibrium holdings. To capture both of these potential effects econometrically, the estimated long-run relationships are embedded in separate equations for the quarterly growth rates of money and credit. Consistent with the discussion above, residuals from the long-run money demand function are found to help explain the path of consumption. So the resulting system expresses consumption growth as a function of both monetary growth and 'money gaps'. For given assumptions about the exogenous variables, the model

(1) For further details on this see, for example, Thomas (1997a).
(2) This is sometimes referred to as the buffer stock theory of money.

can therefore be used to generate 'money-based' projections for future consumption growth.

Even within the class of monetary models, there is debate about which monetary aggregate best captures the concept of money likely to be most closely associated with activity. So, as part of the monetary assessment process, forecasts are presented from models using both household M4 and household Divisia money, together with output from a model based on narrow money.(1) These projections have been helpful in highlighting influences on consumption which may have been missed by other forecasting approaches that omit an explicit role for money.

The short-run outlook for investment

A similar exercise is carried out for the corporate sector. The model used is based on Brigden and Mizen (1999), and is functionally similar to the consumption model described above. The main difference is that, in addition to equations for corporate money demand and investment expenditure, the model also includes a long-run relationship describing firms' bank borrowing. The rationale for this is that firms have greater capacity to manage their net liquidity position than households, so looking at only one side of their balance sheets could give a particularly misleading picture. The model relates investment growth to both change and disequilibrium terms in firms' money and credit. This type of research can help to enrich the analysis of particular forecast issues, even where the projections from the auxiliary models themselves are not given a central role in the MPC's own assessment.

Recent years have seen significant changes in the structure of corporate finance in the United Kingdom. A stronger government fiscal position and lower inflation, together with increased internationalisation and innovation in capital markets, have led firms progressively to shift more of their liabilities from bank to market-based finance (see Chart 3). As a result, some of the traditional relationships between bank deposits, credit and investment have become less reliable over time. The links between firms' overall financial position, activity and inflation remain a key focus of policy-makers' concerns, however. Recently, Bank staff have constructed a 'financial accelerator' model of the corporate sector, which is discussed later in this article.

Chart 3
Stock of PNFCs' borrowing from banks and building societies as a fraction of their total liabilities

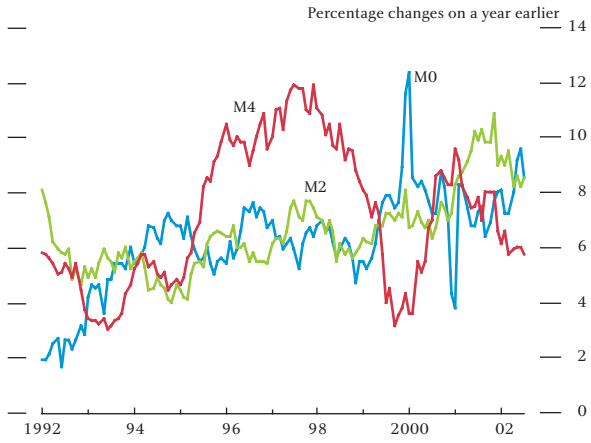
The short-run outlook for aggregate nominal activity

Bank staff also use systems of equations based on whole-economy (rather than sectoral) money aggregates to derive short-run forecasts for nominal GDP, inflation and real activity. Again, a range of projections are presented from models based on alternative monetary aggregates: narrow money (M0), retail money (M2) and broad money (M4). All of these potentially contain information about the stance of monetary policy.

The reason for producing models based on both M2 and M4 relates mainly to the behaviour of non-bank financial firms, or 'OFCs', the money holdings of which are captured in M4, but have little impact on M2. Recent years have seen sharp growth in OFCs' balance sheets, associated with the structural changes to the corporate sector discussed above, the growth in asset prices, the increased use of securitisations of retail portfolios, and so on. This growth has also been associated with significant fluctuations in OFCs' money holdings, and therefore in the rate of growth of M4 (see Chart 4). Some commentators believe that the money holdings of at least part of the OFC sector may have a causal impact on inflation via their effects on asset prices. Others prefer to see OFCs' money as primarily reflecting volatile financial activity, or the precise way in which financing arrangements are constructed, with little implication for the prices of goods and services.(2) In the absence of conclusive evidence it is important that policy-makers have access to projections consistent with either interpretation. Bank staff therefore present forecasts from both M2 and M4 models.

(1) Divisia is a measure of money that weights together different components—including notes and coin, and sight and time deposits—according to their relative liquidity. The construction of Divisia money is discussed in Fisher, Hudson and Pradhan (1993).
(2) These issues have been regularly discussed in the Bank's *Inflation Report*. See, for instance, the box on pages 6–7 of the May 1998 *Report*. For a recent empirical study of OFCs' money and credit holdings see Chrystal and Mizen (2001).

Chart 4
Growth rates of the monetary aggregates

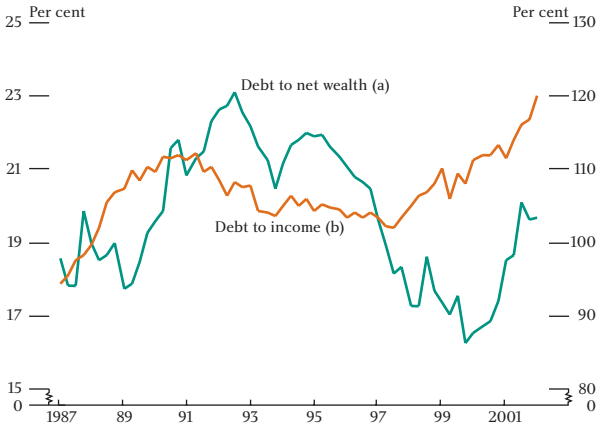


Money and credit as a source of incremental information on the transmission of shocks

A second strand of the regular assessment of money and credit data focuses on their role in the transmission mechanism. Much of this involves a careful assessment of prevailing credit conditions. A key insight from the 'credit channel' literature is that—contrary to the predictions of more traditional economic models—credit may play a separate role in the propagation of economic shocks.(1) This issue is likely to be most acute at times of potential financial instability, such as during the events related to Russia and to Long-Term Capital Management (LTCM) in 1998, when policy-makers spent considerable time assessing the implications for the financial health of the UK financial and private sectors.(2) But it is not necessarily limited to such periods. As the recent financial accelerator literature stresses, if the effective cost of capital depends not just on observed rates but also on agents' financial positions, credit conditions could also contain incremental information relevant to an assessment of the true cyclical position of the economy.(3)

At present, much of the assessment in this area is based on careful data analysis, backed by a substantial pack of charts and tables summarising the latest developments in credit conditions. The analysis includes a review of households' and firms' financial positions—including an assessment of gearing levels—a review of non-price credit effects and an appraisal of the private sector's borrowing capacity. A simple example of the type of data on which this analysis is based is given in Chart 5, which compares households' debt to wealth and debt to income ratios, two alternative measures of household gearing. In preparing this work for the MPC, Bank staff working in Monetary Analysis are able to draw heavily on assessments prepared by colleagues in the Financial Stability area.(4)

Chart 5
Household sector gearing ratios



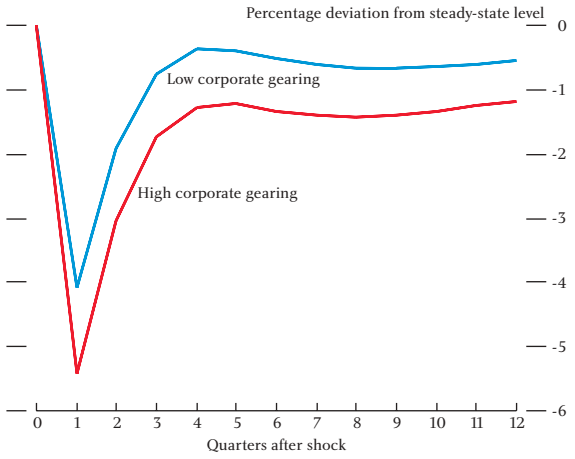
(a) Ratio of households' total financial liabilities to the sum of households' net financial and physical assets.
(b) Ratio of households' total financial liabilities to households' annualised gross disposable income.

Increasingly, however, this analysis is also being informed by the type of more formal theoretical and empirical work discussed elsewhere in this article. The Bank has developed a calibrated financial accelerator model of the UK corporate sector. This model, described in Hall (2001), links firms' spending behaviour to their overall financial position via an external finance premium.(5) It offers a potentially rich range of insights into the role of credit in the transmission mechanism, the effects of financial innovation, and the impact of asset price movements. A similar model has recently been developed for the household sector.(6) And it is hoped that in the future these theoretical models will be supplemented by more detailed econometric studies based on micro data sets. An attractive aspect of the calibrated theoretical models is that they provide a quantitative link between measures of financial health and expenditures. They also allow

(1) A summary of key aspects of the credit channel literature is given in Bernanke and Gertler (1995).
(2) See, for instance, Section 1 of the November 1998 *Inflation Report*.
(3) For a discussion of the policy implications of a credit channel, and other financial frictions, see Bean, Larsen and Nikolov (2002).
(4) A full overview of these issues is given in the *Financial Stability Review* (published twice a year), which is also available on the Bank's web site.
(5) More specifically, the external finance premium (the difference between the cost of borrowing money and the cost of using one's own funds) varies inversely with the size of the firm's balance sheet.
(6) See Aoki, Proudman and Vlieghe (2001).

staff to perform a wide variety of simulations, based on alternative assumptions about possible future shocks or changes to the structure of the economy. An example of this type of analysis is given in Chart 6, which shows how the response of investment in the corporate sector model to a monetary policy shock varies under alternative assumptions about gearing levels. Because of its relative simplicity, the model does not capture every aspect of the data—such as the speed of adjustment in response to shocks—particularly well. But it can, for example, be used to provide an estimate of the incremental effect of higher gearing on the level of investment under alternative scenarios.

Chart 6
Response of investment to a positive monetary policy shock of 100 basis points(a)



(a) Based on a simulation of the model described in Hall (2001).

Money and credit as indicators of the underlying stance of monetary policy

The final element of the monetary assessment process is based on the view that money and credit data might contain information about the underlying monetary stance.

Each quarter, Bank staff review the output of a number of simple policy 'rules'.(1) One of these rules—the Taylor rule—relates the short-term interest rate to the deviation of inflation from target in the previous period, and to an estimate of the output gap in the previous period.(2) Another rule, the Brainard rule,(3) suggests a way for policy-makers to behave when they are uncertain about some of the key parameters in the economy.(4) A third rule, the McCallum rule, effectively puts more weight on signals from the monetary data.(5)

The McCallum rule is of the following form:

$$M_t = x^* - v_{t-1} + 0.5(x^* - x_{t-1}) \qquad (1)$$

where M is the rule's prescription for narrow money growth, x is actual nominal income growth, x^* is nominal income growth in steady state,(6) and v is trend velocity(7) growth (a four-quarter moving average of narrow money velocity growth). The rule implies that narrow money growth should be lowered whenever nominal income growth is above its steady-state value. The velocity term in the rule also allows for changes in the rule's prescriptions due to shifts in money demand,(8) which should be accommodated by the monetary authority.(9)

The staff use the output of each rule as an illustrative benchmark. Whenever the actual policy rate differs substantially from that suggested by either the Taylor or the Brainard rule, or the growth rate of money differs substantially from that suggested by the McCallum rule, it is necessary for staff to consider why.

In addition to these measures, the MPC is provided with an analysis based on a small monetary model, known as a structural vector autoregression (SVAR), of the UK economy, developed by Dhar, Pain and Thomas (2000). An important lesson drawn from experience with earlier models is that, in general, there is no single deterministic link between money, activity and inflation. In practice, all three are determined simultaneously, so the precise relationships between them will depend on the underlying shocks affecting the economy at each point in time. Policy-makers should therefore beware of drawing firm inferences about future inflationary pressures solely on the basis of past correlations

(1) Some of these simple rules are described in more detail in Stuart (1996).
(2) Taylor's original rule for the United States is given in Taylor (1993).
(3) Named after Brainard (1967).
(4) The Bank's Brainard rule is derived from a small four-equation model for output, inflation, the short-term interest rate and the sterling effective exchange rate. It is described in Martin and Salmon (1999).
(5) McCallum's original rule for the United States is given in McCallum (1988).
(6) This is based on an inflation target of 2.5% and assumed trend real GDP growth.
(7) The velocity of circulation of money is the speed with which money circulates throughout the economy over a given time period. Velocity is given by nominal GDP divided by the money stock.
(8) Inflation in monetary models is driven by excess money supply. So shifts in money demand should be met by an increase in the money supply in order to maintain equilibrium in the money market and keep inflation stable.
(9) Persistent differences between the McCallum rule's prescriptions and actual money base growth in the absence of inflationary pressure could also indicate trend velocity shifts or changes in the economy's trend growth rate.

between simple monetary statistics and other economic variables. Instead, a view must be taken on the likely structural shocks driving the economy. SVARs represent one way of attempting to identify these shocks.

The monetary SVAR model is estimated as follows. Starting from a system of eight equations for real money, income, inflation and a set of asset prices, four long-run relationships are identified, including a money demand equation, a term structure relationship, and an asset-pricing function. Theory-based restrictions are then used to identify four permanent and four temporary shocks. These include both temporary and permanent monetary policy shocks, and two types of velocity shock, one reflecting changes in the provision of credit by the banking system, and one reflecting changes in liquidity preference.

In the model, different shocks have different implications for the observed correlations between money, measures of economic activity, and prices. This has long been understood from the monetary assessment side. But the formalisation and quantification of this idea represents an important advance from this line of research. The model also provides Bank staff with a highly flexible tool for use in longer-term policy analysis and advice.

Summary

The inflation projection published in the quarterly *Inflation Report* is drawn up by, and owned by, the MPC. In producing its forecast, assisted by Bank staff, the Committee is able to draw on the analysis of the monetary models, other parts of the suite of models, or any other sources. In principle, the MPC might use output from the monetary models in several ways. First, the indicator-variable projections might be used to help form a judgment about the evolution of different components of expenditure during the preceding quarter,(1) improving the data set for the very near-term outlook. Second, the analysis on money and credit in the transmission mechanism might be used to adjust the output of some of the equations in the MM or elsewhere where the money or credit data are thought to contain incremental information. Third, the longer-run projections and measures of the monetary stance provide a potential cross-check on the provisional outputs of the forecast. And, fourth, any or all of this material could help the MPC to assess the risks around possible central projections, reflected in the inflation and GDP fan charts.

The monetary models, like other parts of the Bank's suite of models, are subject to continual review. In providing a menu of alternative projections, it is recognised that different policy-makers may have different interpretations of, or put different weights on, developments in the money and credit data. Some of the models described here may also be thought to have more relevance at some points in the cycle, or in certain market conditions, than others. There is therefore no mechanical link between the material provided, and the MPC's final projections for GDP and inflation. Nevertheless, it is important that Committee members are made aware of, and are able to draw on, the best possible technical representations of these alternative paradigms when taking monetary policy decisions.

(1) Official estimates of many economic time series will not be available for either the current or the preceding quarter at the time each *Inflation Report* is published.

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