

Macroeconomic forecasting in the Bank of England

This memorandum⁽¹⁾ describes the rôle of the main components of a forecast, and the way they impinge on its overall accuracy, in the context of forecasting in the Bank of England. It begins with a brief discussion of the purposes of forecasting in the Bank and goes on to describe the part played by its macroeconomic model. Data problems are described, along with the rôle of judgment and assumptions. The issue of whether the Bank's forecasts should be published is then considered. Most of the questions raised by the Committee are addressed in the course of the foregoing discussion but in order to complete the responses, and to assist the Committee, answers are summarised in a concluding section.

1 A forecast is an amalgam of four components:

- (i) a model embodying behaviour based on past research;
- (ii) statistical data (historical and current);
- (iii) judgment, which is a subjective assessment of likely deficiencies in the previous two; and
- (iv) assumptions about the future course of certain variables.

2 Forecast errors can arise from errors in any of these four components and a full understanding of how these components interact is necessary to understand why particular errors occur. In addition, the perceived error may change as later revisions occur in the estimates of the variables being forecast. Assessment of forecasting accuracy is therefore not a straightforward affair.

3 Equally, there is scope for misunderstanding the nature of a forecast. For example, a non-official forecast, such as might be produced by a stockbroker for clients, will aim to predict the recorded statistics (often the first estimates of them) on the basis of assumptions about the authorities' future policy actions. On the other hand, a forecast by the authorities may assume no policy action in order to assess the need for such action. By pointing out the need for action it may provoke changes that render it inaccurate. But it will nevertheless have served its purpose. The accuracy of these different types of forecast must be assessed in the light of the purposes for which they were made. Forecasting in the Bank is very much in the second category. The purpose of our forecasts is to understand the economic processes at work and to apply this understanding to an analysis of policy options. We also attach importance to identifying the margins of error of the modelling and forecasting process and its sensitivity to shocks. The process of forecasting in the Bank is therefore one in which a base case is calculated, around which variants are run to suggest the range of

uncertainty. Variants can be in principle, and often are in practice, reworked in the light of subsequent information about shocks, policy actions, and other changes in background circumstances. Thus the idea that the Bank forms a central view of the most likely course of the economy at discrete points which could fairly be compared with other forecasts or the outcome does not properly reflect what the Bank actually does.

4 Besides their use in informing discussion of monetary policy, forecasts have recently started to be used to guide the supervisory side of the Bank who need to consider how prospective developments in the economy may impinge on the institutions they oversee. Here again it is the range of risks rather than a set of point forecasts that is of most interest. Supervisors need to consider, in the light of the forecast, how the quality of assets might change and what particular concentrations of risk might give most cause for concern. There could be implications for banks' profitability, provisioning and hence the need to raise capital.

5 The following sections address in turn the four main components of a forecast.

The model

6 The Bank's view on how the economy works is summarised in its model. This is described in the model manual (available to the Committee on request). The model equations are deposited at the ESRC Macroeconomic Modelling Bureau at Warwick University where their properties have been compared with those of other similar large-scale models.

Why do we have a separate model?

7 The Bank model has been developed from a version of the London Business School one which was acquired in 1972. There had been some earlier work in the Bank aimed at developing an independent model but as that work

(1) This paper was submitted by the Bank to the Treasury and Civil Service Committee in June 1991 and was published by the Committee on 25 July 1991.

progressed it became clear that it would be a protracted and costly exercise. It was decided therefore to start from a ready-made model and to modify it to reflect the particular policy interests of the Bank.

8 An econometric model provides a coherent framework for organising research and forming policy advice. The technical and operational benefits of using a model include:

- (i) being able to deal properly with simultaneous relationships and to use far more complex equations than informal figuring can deal with;
- (ii) having the capacity to run variants and simulations around a main forecast quickly and easily;
- (iii) the ability to quantify the behaviour assumed, and contributing to consistency between forecasts and among variants;
- (iv) models demand an explicit set of historic data, the internal consistency of which can be verified using the model's identities;
- (v) a model acts as a store of knowledge regarding economic relationships, important historic events recorded in dummy variables, etc.

9 In the early 1970s the Treasury were developing their own computerised macroeconomic model and in order to facilitate discussion the Bank felt that its own policy advice should also be couched within a coherent framework that allowed the wider consequences of policy suggestions to be articulated. This was particularly so at that time because of the essentially Keynesian demand-management terms in which the policy debate was conducted—terms that were particularly suited to discussion within the national accounting framework of a model. Nevertheless, there were clear differences of emphasis, interest and expertise between the Bank and Treasury which were reflected in differences in our respective models. For example, the Treasury had greater interest and expertise in the modelling of public expenditure and taxation while the Bank was more concerned to articulate links between the real and financial variables.

10 A model is the embodiment of research work by its authors and is a summary of their collective view of how the economy works. In an active research environment it is an organic entity, changing in response to new research results which may be the consequence of perceived shortcomings of the model (including shortcomings in its forecast performance) or may reflect new insights from developments in economic theory or econometric practice. In the early 1970s most models were built on Keynesian national income principles. Although this remains the basic structure, most models now have significant 'classical' elements, including more explicit modelling of the supply side. Some models (though not the Bank's) also incorporate forward-looking expectations. This change reflects the

reappraisal of economic theory in the 1970s and 1980s. Other changes have followed changes in the structure of the economy. For example, the public sector has less impact on the rest of the economy now than in the past as major sections have been transferred to private ownership. The North Sea sector may also be diminishing in importance.

11 It is important to recognise that all models are deliberate simplifications of reality. Practical constraints limit the amount of disaggregation that is possible. The variables that are included represent the actions of millions of individual agents who are subject to different constraints, pressures and preferences. The choice of variables, and the specification of equations in the model to determine them, are based on historic data. In making those choices modellers will have looked as far as possible for consistency of past behaviour. That may not continue. This is one reason why judgment may be necessary. For example, at present it is unlikely that models will be able to reflect fully the consequences of changes in the regulatory structure and competition in the financial services industry that took place in the mid-1980s and the balance sheet changes that followed. These changes have allowed persons and companies to adjust their balance sheets in ways that are without precedent but there are insufficient data since these changes occurred, and, more important, no experience of behaviour through a complete economic cycle, to estimate behavioural equations with confidence. It is difficult therefore to be confident that when faced with the pressures that recession brings they will react in the ways that model equations predict. Similarly, entry into the exchange rate mechanism of the EMS carries implications for wage bargaining behaviour that are not reflected in the historic data on which wage equations are estimated; there are real uncertainties about how quickly those implications will be absorbed into behaviour. Thus there are important areas of uncertainty about how equations that have predicted well in the past will perform today. One should not assume that the forecast performance of a model will be invariant over time even if the model is conscientiously maintained.

12 The Bank's model reflects what economists working in the Bank regard as the key relationships determining the variables and issues that are of most concern to the Bank. A good deal of attention in recent years therefore has been given to the structural relationships behind the transmission mechanism of monetary policy to the price level. Analysis of the impact of a change in short-term interest rates on inflation needs to take into account its effect on the exchange rate and hence import prices; on consumption, investment and hence the pressure of demand; and the effect of these two on domestic prices. These areas are relatively well researched.

How does the Bank model compare with others?

13 There are numerous models of the UK economy. Many of these are designed to address particular, narrowly focused, questions. Six of the larger ones are deposited at the ESRC Macroeconomic Modelling Bureau at the University of Warwick and their properties were compared in an article

published recently by the National Institute of Economic and Social Research in its Review.⁽¹⁾ In general, the Bank and Treasury models were shown to be more similar to one another than to other models. Some examples of the distinguishing characteristics that emerge are:

- (i) the multiplier effects of an increase in Government expenditure on GDP build up more in the Bank model than in the other models through the effect on demand of a fall in the exchange rate that the initial spending precipitates;
- (ii) in general the impact of policy variables on unemployment is higher in the Treasury and London Business School models than in others (including the Bank model)—for example, a 1p cut in the standard rate of income tax, that leaves real wages roughly constant in the Bank model, reduces them in the Treasury model producing a more favourable profile for unemployment;
- (iii) the Bank model has a lower long-run effect of changes in unemployment on wages than most models.

Data problems

14 A great deal of attention is given to ensuring that the data base for a forecast is consistent and up to date. Nevertheless, data deficiencies can be a major source of error. As the Committee will be aware, there were particularly acute problems in 1987 and 1988 when the output and expenditure measures of GDP grew at quite different rates and revisions to the data made it very difficult to be confident about what was happening. For example, the initial expenditure-based estimate of GDP for the fourth quarter of 1987 (published in March 1988) showed a rise of under 3% on a year earlier (at constant prices) while the output measure was showing growth some 2¼ percentage points higher. The next set of estimates for the same period, made three months later, showed the gap between these two estimates widening to 2¾ percentage points. The discrepancies continued until 1989 when CSO introduced National Accounts Statistical Adjustments to impose consistency on the various GDP measures. Nevertheless, the scale of the adjustments that remain raises worrying questions about how much reliance can be put on the estimates of the component series which play a vital rôle in the model. (At the time the Bank's model played a useful rôle in highlighting the inconsistencies between the output and expenditure measures. A number of model equations suggested, as was confirmed subsequently by data revisions, that the expenditure measure was underrecorded.)

15 Concern about the quality of economic statistics became widespread and in 1989 an official investigation was undertaken. In the light of this study, a year ago, the then Chancellor announced a programme of work to improve statistics in three key areas—service activity, company statistics and the balance of payments. Since then CSO have

set up new surveys of turnover in selected parts of the service sector, a new quarterly survey of company profits is being introduced and improvements made in the reporting of stockbuilding and capital expenditure; also, the company liquidity survey is being expanded. CSO have made improvements to the coverage of their overseas direct investment surveys, and have conducted a share register survey to improve estimates of sectoral holdings of UK equities. A review by a senior statistician of the system for producing balance of payments statistics is due shortly and expected to identify areas for further improvements. The Bank has been actively involved in helping CSO to improve national accounts statistics and has undertaken a number of projects, including improving income and expenditure data for banks and other financial institutions, investigating the coverage of activity in the Channel Islands and Isle of Man, reviewing the accuracy of sectorisation of banking transactions, and developing proposals for the treatment of options, futures and swaps in the national accounts.

16 Inaccuracies permeate the financial accounts too. For example, in the last two years there has been much concern about the size of the financial deficit of industrial and commercial companies which was estimated from data on corporate income and spending to have been over £21 billion in 1989 and nearly £27 billion in 1990. Yet overall more than half this deficit was not identified in the financial accounts showing companies' acquisition of financial assets and liabilities, leaving balancing items of nearly £14 billion in 1989 and £12½ billion in 1990. Models such as the Bank's which seek to integrate real and financial behaviour inevitably suffer when the statistical articulation of the real and financial accounts is so poor.

17 Data inaccuracy affects forecasting in three ways. First, it can distort the estimation of equations in a model. We cannot know how much of a problem this is because we never know the 'true' values of the variables being measured, but in estimation relatively little weight is usually given to recent data that are most liable to large inaccuracies. Second, inaccurate data can seriously distort the forecaster's perception of where he is starting from. This was a particular problem in 1988 and 1989. Third, it poses a problem of what the forecaster should be trying to predict. The Bank, like most forecasters, seeks to predict the published series, but this is not a uniquely defined target as there is a sequence of different estimates for each time period. Thus the observer's perception of how accurate a forecast is changes over time.

The rôle of judgment

18 Judgment enters the forecasting process partly in response to the second of these problems. Getting the starting point right is crucially important. Much partial and anecdotal information, including survey evidence of intentions and prospects, can be, and is, incorporated in this way. Thus in the Bank, and in most other large forecasting

(1) 'Comparative properties of models of the UK economy' by P G Fisher, D S Turner, K F Wallis and J D Whitley; *NIESR Review*, August 1990, pages 91–101.

exercises, the latest observation period, and the immediately following one, are heavily influenced by judgmental adjustments. The balance shifts towards the model and away from judgmental adjustment as the forecast horizon increases.

19 Another way that judgment is used is to modify or override an equation in the model that is performing badly or expected to do so. Of course, in the medium term a poorly performing equation will lead to research to improve it. In the short term that may not be practical (or warranted) and it may be sufficient to impose residual adjustments. These can help an equation cope with shocks or structural change as well as accommodating systematic errors that are not fully understood. The ability of a model to allow its user to impose such judgmental adjustments enables it to be used to simulate counterfactual outcomes and alternative scenarios, or to override the model if results for a particular variable seem implausible.

20 A topical example of a variable where judgment may need to be exercised is the personal savings ratio. Conventional theory and empirical evidence suggest that in a recession the savings ratio will fall. This indeed happened in 1981. At the present juncture, however, there are some grounds for uncertainty as to whether, how quickly, and how much of a fall might occur. In the recent past the ratio has been rising strongly, although it is possible that to some extent this may reflect errors in the data. The uncertainty relates to the indebtedness of the personal sector which is currently much higher than in previous recessions. Will the personal sector in these circumstances reduce its saving (which would probably involve adding further to its indebtedness)? Past experience may not be as good a guide to behaviour this time as usual. Yet getting the savings ratio right is crucially important to the outcome of any forecast. Consumption accounts for two thirds of domestic demand or nearly 80% of private demand and quite small errors in the savings ratio can have a substantial impact on the forecast for this major component and therefore on overall growth prospects.

The assumptions

21 Certain exogenous inputs need to be set by assumption. One could think of this as a rather extreme form of judgmental intervention. It is these assumptions (together with the dynamic characteristics of the model) that determine the shape of the forecast.

22 There are two main kinds of assumption. One is those variables which affect the economy being forecast but do not significantly interact with it. The main example here is world trade. The UK economy is sufficiently small in world terms that UK activity does not affect demand in the rest of the world in ways that feed back significantly into demand for UK goods. Therefore, forecasts of world output, trade and prices can be separated from the process of forecasting the domestic economy. The Bank runs a World Economy Forecast (WEF) before its domestic forecast, using the

Global Econometric Model (GEM) supplied by the National Institute of Economic and Social Research. The results, in summary form, are published in the Bank's *Quarterly Bulletin* (see, for example, the *May Bulletin*, pages 187–89, for the latest forecast).

23 The second type of assumption relates to policy variables. These assumptions are agreed with appropriate Executive Directors.

24 At times of particular uncertainty variant forecasts are produced making alternative assumptions. For example, an alternative course of oil prices might be postulated. Last year, when entry to the Exchange Rate Mechanism was an ever present possibility, this also was a subject for variants. It is then not necessary to form a view about what is the likeliest course for the uncertain event or exogenous variable as the base and variant cases show the range of uncertainty in main variables of interest. In practice some of these exogenous influences may be most likely to polarise to one or other of the extremes and an average between them may in fact be the least likely outcome.

Some matters of practice

25 At present, the Bank conducts a full-scale forecasting exercise twice a year, in the late spring and late autumn. The first of these incorporates the first estimates of world trade and activity in the previous calendar year and the WEF forecast published in the *May Quarterly Bulletin*. It seeks to work through the consequences of Budget changes to give a basis for discussing policy questions through the summer and autumn. The second round incorporates information (for example, on public expenditure) from the Chancellor's Autumn Statement and is used as the basis for the Bank's Budget advice to the Chancellor. The WEF that precedes it is published in the *November Quarterly Bulletin*. Updates are undertaken as necessary—often in response to shocks or policy changes—but are more restricted exercises and do not always involve new WEFs.

26 Forecasting follows the quarterly frequency of the national accounts but for many purposes the quarterly path may give an unnecessary and misleading impression of accuracy. Although forecasts are usually constructed for periods of up to five years, it is the most immediate eighteen months to two years that is usually the main focus of interest. For this reason, a number of variables—the retail prices index being a prime example—are forecast 'off model' on a monthly basis. The longer term is not usually taken very seriously as a forecast because unforeseeable events or policy changes are likely to render it obsolete well before that time arrives. But it can have an important rôle in considering the sustainability of policies.

The question of publication

27 As part of its relationship with Government the Bank of England offers advice to the Government on a range of issues covering monetary policy, funding policy and economic management. In some areas that advice makes use

of confidential information and may include tactical advice on market operations which is both market sensitive and potentially damaging to the public interest if disclosed. The advice given must therefore remain confidential. The Bank's forecasts provide background to the regular policy discussions that take place and form part of that advice. They are therefore covered by the same confidentiality.

28 The public is already well served by economic forecasts. For example, the latest 'Golden Guru' award published in the Independent on Sunday (14. 4.91) ranks the performance of 44 different teams on forecasting growth, inflation and unemployment. An official view is, of course, given by the Treasury forecasts. Because the Bank model is publicly available, and it uses published data, the only value added that would arise from publishing Bank forecasts would be what they revealed about assumptions (including policy assumptions) and judgmental adjustments. Perceived differences between the Bank and Treasury would naturally become a focus of attention for commentators, whether or not such differences were statistically or operationally significant, and this could undermine the usefulness of the Bank's advice to Government as well as being potentially disruptive to markets. For these reasons, the Bank has taken the view that it would not be in the public interest to publish its forecasts, though as noted above it is very ready to make publicly available its understanding of economic relationships and of the current state of the economy through its economic model, research papers and assessments in its *Quarterly Bulletin*; and also the Bank publishes its forecasts of world activity, trade and prices.

29 The Bank of England is not unusual among central banks in taking this view. For example, among the Group of 7 major industrial countries only in the United States does the central bank publish domestic economy forecasts and in that case the forecasts comprise a range of projections for GNP growth, consumer prices and unemployment for the coming year made by members of the Federal Open Markets Committee and other Federal Reserve Bank presidents; these are provided to Congress along with growth ranges for the main monetary and credit aggregates as part of the Humphrey-Hawkins testimony. Of a group of nine other industrial countries where the Bank is aware of practices, a majority do not publish and in cases where forecasts are published it is normally only for a year or less ahead.

Summary of answers to the Committee's questions

(i) *A brief description of the Bank's economic forecasting; how forecasts are made and how often they are produced.*

The Bank's forecasts are used to analyse policy options and to provide advice on them. They are based on its computer model of the economy which embodies the latest view of Bank economists on how the economy works, as established

through its research programme. The model is deposited at the Warwick University Macroeconomic Modelling Bureau. The model is supplemented by judgmental adjustments, both to the model and to establish an appropriate starting point of data, and the forecast is conditioned by various assumptions. Some of these assumptions relate to exogenous variables such as world trade which is forecast separately; some relate to policy instruments. Variants are produced to demonstrate the range of uncertainty or to explore alternative policy options. A major forecasting exercise is undertaken twice a year (late spring and late autumn) but updates are carried out from time to time in response to major external events and policy changes.

(ii) *Whether the Bank forecasts have become more or less accurate over the past ten years and what are the reasons for any change in accuracy?*

It is difficult (and misleading) to give a straightforward answer to this question. Accuracy depends on several factors and is not necessarily a good guide to the usefulness of a forecast: and the variables of most interest now are somewhat different from those dominating the debate ten or so years ago. The Bank model has changed considerably over this period as a result of research and to reflect major changes in the way the economy operates—for example, supply side changes including those in the financial sector. Furthermore, data inaccuracies have been a major and increasing source of actual or apparent forecast error. One cannot be sure that recent forecast 'errors' will not be changed as further revisions are made to the national accounts statistics. It is fair to say, however, that the importance attached to modelling and forecasting as a discipline for coherent analysis of economic questions has not diminished.

(iii) *What steps does the Bank take to investigate the reasons for inaccuracies in the forecasts?*

The Bank monitors the behaviour of individual equations in its model and directs its research programme towards improving the performance of those considered most important to its understanding of the effects of policy decisions. Where errors arise for other reasons, eg data revisions or incorrect assumptions, these too are investigated and an assessment made of their impact.

(iv) *Whether Bank forecasts could be published?*

Forecasts form part of the advice given to the Treasury and confidentiality is necessary in order that that advice can be given in the fullest and most useful way. The Bank publishes the model on which its forecasts are based and the external assumptions relating to world trade, output and prices that go into it. The Bank has concluded that to go further than this would not be in the public interest. The public are already served by one official forecast made by the Treasury and by a wide range of private sector forecasts. The only value added that would arise from publishing Bank

forecasts would be in revealing differences in assumptions which may have little genuine significance but disproportionate potential for misinterpretation and damage.

(v) How Bank forecasting methods compare with Treasury methods.

The basic methods are very similar. Differences in the structure of the respective models have been described in published academic research. These mainly relate to slightly different foci of interest in the two organisations. The resulting forecasts may differ because of different starting assumptions.

(vi) What contacts and collaboration take place between Treasury and Bank forecasters?

There is regular contact between Bank and Treasury economists and research results are shared and discussed. Differences between the models are examined and understood so that forecast differences can be explained. The forecasting processes are carried out independently. From the Bank's point of view this puts it in a position to offer independent advice when occasion demands.

(vii) Whether survey evidence of intentions could be included in forecasting models.

In practice it can be and is incorporated within the judgmental adjustments that are made to establish the starting position. This is not, however, a mechanical

process. To give such evidence a more formal rôle within an econometric model poses some practical problems but these are not insurmountable. Econometricians seek to build the best explanatory equations that are soundly based both theoretically and empirically. Where survey evidence can be shown to contribute to the forecasting performance of a model it will be used. In general, however, survey evidence is most useful as an aid to 'forecasting' the present, for which data is not yet available.

(viii) Any other matters which are relevant to the production and accuracy of Treasury forecasts.

Forecasts are not seen within the Bank as an end in themselves and this is likely to be the case also in the Treasury. The models on which they are based provide a coherent framework for the discussion of policy options and their performance an agenda for research activity towards a better understanding of economic relationships. Furthermore, forecasts provide a yardstick against which economists can assess subsequent statistics and decide to what extent they contain new and surprising information. The forecasts therefore aid understanding of the economy as it evolves in a continuous way. In that sense the perceived inaccuracies carry the important messages of the new data. Of crucial importance to the production and accuracy of any forecasts is the quality of the basic data and the Bank shares the concern of the Treasury, the Committee and outside users over the deterioration in quality that occurred in the mid-1980s and the importance of steps to improve it.