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SETTING THE OPERATIONAL FRAMEWORK FOR PRODUCING INFLATION FORECASTS

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Resumen

¿Cómo debe organizarse un banco central para producir el mejor pronóstico posible de inflación? El presente artículo discute los elementos que constituyen la estructura operacional básica de un sistema de pronósticos de inflación. El artículo describe el ejercicio de pronóstico de inflación como un proceso de producción. Los ejercicios de proyección inducen a una disciplina estricta con respecto al manejo y recopilación de datos, a la aplicación de un aparato estadístico conveniente y al uso de estrategias adecuadas de comunicación, reforzando la reputación y la credibilidad de la autoridad monetaria. Resulta indispensable la organización eficiente de los bancos centrales para producir pronósticos relevantes, con una consideración especial sobre el diseño del producto, los requisitos esenciales del proceso del pronóstico, y temas organizacionales claves. El trabajo, además, propone utilizar funciones de reacción de política de las autoridades como un elemento básico en la producción de los pronósticos de inflación, coherentes con el espíritu del régimen de metas de inflación.

Abstract

How should a central bank organize itself to produce the best possible inflation forecast? This paper discusses elements for building a comprehensive platform for an inflation forecasting framework. It describes the exercise of forecasting inflation as a production process, which induces a strict discipline concerning data management and collection, the use of a suitable statistical apparatus, and the exercise of sound communication strategies to reinforce reputation and credibility. The efficient organization of the central bank becomes critical in producing relevant macroeconomic forecasts, with special consideration to product design, the essential requirements needed in the forecasting process, and key related organizational issues. In addition, the paper proposes to factor the authorities' policy responses into inflation forecasts to ensure consistency with the spirit of the inflation targeting framework.

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I. INTRODUCTION

Inflation forecasts are key inputs for monetary policy decisions made within inflation targeting frameworks. The delayed impact of monetary policy actions on inflation, which varies over time and often takes longer than one year, necessitates a forward-looking approach. To be able to react in time, the central bank might find it useful to base its monetary policy decisions, not on past inflation outcomes, but on inflation forecasts. Some central banks even consider inflation forecasts the intermediate targets of monetary policy.[1] The inflation forecast is becoming not just a critical internal decision-making device but also a communication tool.

Inflation targeting frameworks organize monetary policy around long-term inflation objectives.[2] The central bank's commitment under inflation targeting is to keep a specific measure of inflation close to a given level or within a range over the medium to long term. Expressing the commitment in the medium to long term provides the central bank with significant flexibility in its response to short-term inflationary pressures, sparing the central bank the need to take measures that would unnecessarily hurt the economy. In particular, the transition periods for countries exiting pegs or adopting inflation targeting involve certain institutional requirements including a reliable methodology for forecasting inflation.[3] The commitment to a medium-term inflation goal can be honored when the central bank is free from political influence and the medium-term inflation objective has a clear priority over any other central bank concern.[4]

Central banks use a variety of tools and information sources to form a view on expected inflation outcomes and to reach their policy decisions concerning the dynamics of inflation. Usually, there are a number of models that produce inflation forecasts, ranging from large-scale structural models of the economy down to smaller time-series models. In addition to monitoring money and credit aggregates, survey results on consumer and firm expectations are closely watched, as are confidence level indices. Further information on expectations is available from financial markets, such as future markets or bond markets depending on the term structure of interest rates. A wide range of indicators of production capacity and prices is also scrutinized to assess the status of inflationary pressures. In some cases, central banks' regional offices provide information about local developments, obtained from a variety of sources including industry surveys and firm-level interviews. Thus, the challenging job of the decision-making body is to bring all the information, knowledge, expert opinion, and analysis together and make a policy decision.

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[1] Svensson (1997), Bogdanski, Tombini, and Werlang (2000).

[2] Laxton and Scott (2000) and Coats, Laxton, and Rose (2003) describe how to implement and develop forecasting systems.

[3] Duttagupta, Fernandez, and Karacadag (2004).

[4] For discussions of the preconditions for inflation targeting, see Carare and others (2002) and Truman (2003).

The exercise of forecasting inflation can be described as a production process. The forecasting practice induces a strict discipline concerning data management, information gathering, the use of statistical apparatus, and the exercise of sound communication strategies to reinforce reputation and credibility. To be fully aware of the methods of data collection and subsequent refinements in data revisions, it is critical to determine whether there are peculiarities in the data sets that might complicate forecasting. In this regard, it becomes crucial how a central bank organizes itself to produce relevant macroeconomic forecasts, with special consideration to product design, the essential requirements needed in the forecasting process (data inputs, staffing and organization of labor involved, the necessary capital, the choice of appropriate technology, and methodologies), and key related organizational issues. In addition, central banks should evaluate the comparative advantage of commonly used forecasting methodologies together with the optimal way to organize the forecasting capacity based on the particular transmission mechanism.

This paper discusses elements for building a comprehensive platform for an inflation forecasting framework. The treatment includes the use of short-term forecasts for major relevant domestic variables based on specific econometric modeling combined with expert judgment, statistical knowledge, data management, and the use of external outsourced variables. The starting point for this approach is to develop a medium-term forecast, usually based on small, semi-structural models characterized by the inclusion of model-consistent inflationary expectations, the authorities' reaction functions, and long-run equilibrium definitions. Section II addresses specific issues concerning forecast design and organization with special emphasis on inflation targeting frameworks. Section III introduces elements of the forecast, and Section IV deals with communication issues. The paper also presents the results of a survey, conducted in late 2005, on the inflation forecasting practices of several inflation targeting central banks.

II. Forecast Design and Organization

Under inflation targeting, forecasting inflation is an institutional priority. Central banks usually devote resources to this end and organize themselves efficiently to improve the quality of their monetary decisions. This process involves assigning responsibilities for undertaking those tasks, designing the incentive structure for those involved in the process, and providing the necessary inputs, tools, and training opportunities to the individuals in charge of producing the forecast on behalf of the institution. Forecasting inflation often requires building and maintaining databases, having a specialized forecasting team, and providing the team with adequate hardware and software for making projections. Central bank authorities are responsible for approving the design of the forecasting system and providing the resources available for its efficient operation.

A. Forecast Design

Good forecasts have several desirable characteristics. First, good forecasts are based on all available information that is relevant for prediction, including anticipated future developments. Second, they include a point estimate accompanied by a measure of uncertainty at each point in time over the forecasting horizon. A single consolidated forecast

of the inflation indicator being targeted presenting the central bank's view would avoid much of the expectational uncertainty concerning future policy decisions and consequently would enhance central bank credibility. Third, they meet the highest professional standards. Good forecasts are prepared in a systematic way considering the contributions of information provided by up-to-date theoretical and forecasting methodologies. Finally, good forecasts are honed by expert judgment and require an institutional mechanism for incorporating such judgment in a systematic way. Inflation projections represent the central bank's view summarizing the best collective judgment of the central bank board and are technically supported by the central bank staff's analysis.

The central bank must produce inflation forecasts that can be both used for policy decisions and shared with the public at large. Forecasts can play two roles in an inflation targeting framework: as an input into policy decisions and as a communication tool. While one can distinguish between forecasts used by the authorities and those communicated to the market for public accountability, the inflation forecast used by central banks in making its decisions on interest rates should be the same as the one communicated to the public at large, once policy decisions have been reached. In other words, once a central bank has decided to implement inflation targeting, and hence has set its monetary policy to anchor inflation expectations, it needs to build credibility in its own inflation projection and base its decisions around it.

The central bank forecasting framework must be designed to answer a basic question concerning future inflation: What will happen with inflation (and the other variables the central bank is concerned about in the short term) under specific assumptions about the future policy stance? Answering this question requires an understanding of the transmission mechanism. The answers are likely to differ among countries and over time because the transmission mechanism (or the central bank’s understanding of the transmission mechanism) can be expected to differ and change. Yet, the basic question is likely to remain the same.

B. Division of Labor

Producing an official inflation forecast may involve many tasks and the work of a large number of people within the institution (Box 1). Significant advantages in terms of efficiency can be obtained by an appropriate division of labor, assigning tasks according to the relative strengths of individual staff members. The larger the economy and the central bank, the more feasible it is to have a more specialized division of labor. In central banks with smaller resources, the same tasks may need to be done by a smaller group of people. Table 1 presents some central banking evidence for a group of selected countries.

Encouraging teamwork requires the careful design of an incentive structure for staff involved in the process. The incentive structure is especially important for the forecasting and data management teams. The authorities might find it useful to devise schemes that encourage the dissemination of information obtained by central bank staff during the normal course of their operations that could be useful for forecasting.

Box 1. Tasks Involved in Producing Inflation Forecasts

Forecasting inflation requires information on interest rates, productivity, commodity prices, etc. The process of producing forecasts involves the following course of action:

Design the forecasting system
- Identify the necessary tasks
- Assign responsibilities
- Design an incentive structure for individuals participating in the process

Design a methodology to analyze information
- Design the core model
- Design supporting models that provide alternative points of view or inputs into core model
- Estimate or calibrate core and supporting econometric models

Design a system for consolidating information obtained from different models into a single forecast

Gather the information
- Identify information that must be collected or produced
- Get the information from:
  - Other institutions
  - Different departments in the central bank
  - Surveys
  - Interactions with the private sector

Input data into the database
- A single point of entry to standardize and integrate information might become useful

Maintain a system to monitor and record news that could affect inflation outlook
- Maintenance of a repository system of related information might also improve information collection and aggregation
- It will also result in better collaboration and knowledge sharing within different units and departments and closer integration of different decision-making bodies

Have forecasting team present interest rate scenarios to Monetary Policy Committee
- Analyze the information
- Run the models
- Interpret the model results
- Integrate the results from different models into a single forecast
- Present the official technical forecast to the decision makers

Discuss the technical proposal of the staff at policy level

Interact with staff on the impact of alternative scenarios for future policy interest rates

Communicate forecast to the market
- Announce the forecast
- Prepare the report announcing the forecast

Follow up
- Assess the accuracy of the models
- Monitor new developments in modeling technology
- Design improvements in forecasting system

Table 1. Selected Countries: Staff Involved in Forecasting Analysis

	People Involved in Forecasting/ Their Qualifications	Increase (Recently) in the Number of Staff Working on Inflation Forecasting	Number of Departments Involved in Forecasting
Australia	Statement of Monetary Policy preparation involves 40 people, 2 weeks each quarter	Yes	Four
Chile	10 people; 1/3 Ph.D.s, 2/3 local Master's degrees	Tripled since 1999	Two (Conjunctural analysis and Modeling); another department provides international scenario
Colombia	10 people, most with Master's degrees	Yes	One (Programming and Inflation Forecasting Department); there is also a representative from the Macroeconomic Modeling Department
Czech Republic	7 (Ph.D.s with an international experience)	No	One (Monetary and Statistics Department, 4 divisions)
Peru	26 people; 14 with Master's degrees, 4 with Ph.D.s.	Yes	One (Economic Studies Department, 8 divisions)
Turkey	18 people; 5 Ph.D.s, 10 Master's degrees, 1 M.B.A., 2 B.A.s	Yes	One (General Directorate of Research and Monetary Policy, 2 divisions)

Source: National authorities.

A forecasting team is usually defined across departmental lines with a clear mandate and responsibility. The forecasting team must combine expertise in macroeconomic theory, econometrics, and survey analysis. Along with the central bank authorities, the forecasting team will act as the key body for forming a consensus view of the monetary transmission mechanism, as most of the analytical work will be undertaken by this team. The reference point for discussions on the inflation process is typically a structural macroeconomic model, which is built by the forecasting team. Specialization in monitoring leading indicators and main sectors of the economy, such as the external sector, domestic demand, labor markets, price developments, or financial markets is warranted to develop and maintain a comprehensive and coherent macroeconomic model. The latter would require knowledge of basic time-series analysis and regular contacts with industry participants.

C. Data Monitoring and Management

A central bank should make use of all the available information that is potentially useful to assess the inflation outlook. There is no clear ranking for the most useful sources of information. In addition to the standard variables in a central bank database such as macroeconomic and financial data, important series that have been developed and widely used in recent years by central banks should also be stored in the database. These might include, for example, survey evidence.

Proper documentation of forecasting rounds is warranted. It is essential to create an archive that contains the forecasts and the analyses that led to forecasts. A typical database includes numbers and also data, programs, and documents that are prepared for the quarterly forecast, together with the minutes of the discussion in the monetary policy committee. Documentation of each forecasting round would assist ex post analyses to draw lessons from systematic forecasting errors and form an institutional memory for the forecasting process, thereby becoming the lynchpin of the forecasting monitoring system.

The database must be carefully maintained. The database should be regularly updated and be accessible to all members of the forecasting team and the decision committee. It is important to document all sources of data, possible problems with the series if any, and a timetable for the arrival of data. An effort should be made to obtain all the right numbers and confirm their accuracy (Carson, Enoch, and Dziobek, 2002).

It is important to store the original database used for decision making. Policy decisions are made with imperfect data that includes preliminary estimates of several important economic series, such as GDP. It is often the case that preliminary data are subject to errors and are subsequently revised, sometimes more than once. It is essential to understand the nature of such revisions and their impact on modeling and forecasting. In order to do that, some central banks started to form real-time databases that contain successive releases of data for a number of different series. Research has shown that revisions matter for forecasting. For example, Orphanides (2001) shows that historical estimates of the output gap in the United States, an important measure of economic slack, changed significantly after data revisions.

A group within the institution should be in charge of collecting data with a consistent, easily accessible and integrated view. The group should report directly to decision makers and provide the database to both the forecasting team and the members of the decision-making body. The forecasting team uses its time to make forecasts, monitor procedures, and improve its professional ability to make forecasts. It should be spared from gathering information and entering numbers into a database, but should have access to the latest data at all times.

III. Elements of the Forecast

The forecasting framework of a central bank provides a comprehensive picture of the near- and medium-term economic outlook. That includes providing a framework to reach a policy decision consistent with achieving the inflation target. Main elements of the framework involve data monitoring and management, short-term forecasting, and medium-term forecasting.

Short-term forecasting involves assessing where the economy is now and where it will be in the next few quarters. This is the data-intensive part of the forecasting framework. It includes collecting and assessing wide-ranging information with a view to understand the current state of the economy including underlying inflation pressures (see Section III–A). Expert knowledge and judgment, econometric forecasting methods, and surveys are among the main avenues for providing short-term forecasts (see Section III–B).

Medium-term forecasting involves forming a view of the evolution of the economy in the next few years, or at the policy horizon. Forecasting the economy beyond the next few quarters is quite difficult, and short-term forecasting techniques are of little help there. Medium-term forecasts, often built on short-term forecasts, reveal a central bank's view of the monetary transmission mechanism, the way the economy evolves under certain assumptions about the policy rate, and other exogenous variables. Although the forecasting exercise is technical and numerical by nature, the ultimate objective of the exercise is to produce a nontechnical account or "story" representing the central bank's understanding of the evolution of the economy that is comprehensive, understandable, and consistent over time.

Models are needed to independently assess the impact of alternative interest rate policies on medium-term inflation. By necessity, such a task needs to be based on the team's understanding of the transmission mechanism. This understanding may be based on empirical time series evidence, on theory as presented in economic models, or on econometric or calibrated models that map the empirical evidence into a theoretical framework. The latter, which henceforth we call "core forecasting models," are more complex but allow a more professional answer to the question of how inflation will react to alternative future policy interest rate paths. That is, they allow for a discussion based on economic arguments, confronted with empirical evidence filtered and interpreted with the help of rigorous statistical techniques. Core forecasting models can differ in the aspects of the transmission mechanism emphasized, the economic or statistical theory behind them, the variables that are taken as given for the forecasting process, or the techniques for mapping data into those theoretical models, among others.

A. Data Issues

Forecasting systems and current statistical analysis involve data issues that include decisions on appropriate target indices and supported statistics. They also entail the proper design of surveys, the use of leading indicators, and the impact of asset price movements. Some evidence for selected countries on data availability, reliability, and indices is advanced in Appendix I.

Consumer price index

The construction of a Consumer Price Index (CPI) is a critical part of the forecasting system. In particular, many inflation targeting (IT) countries have chosen a CPI as the measure for the inflation target. There are several advantages to adopting a CPI target as opposed to some other price index. The CPI is usually produced and announced on a timely basis, is generally not revised, and is usually transparent, easily available, and understandable by the public. These are desirable properties for any country but even more important for those that are planning to move to IT as the policy variable is adjusted primarily in response to inflation developments. Thus, at the outset, a country moving to an IT regime should ensure that the CPI has all these desirable properties.

As the central bank in an IT country is accountable for the inflation outcome, it is essential that the relevant price index be calculated by an independent agency, such as a statistical agency. Separating of the calculation of the index from the body that is responsible for achieving the inflation target would help minimize political manipulation and enhance the central bank's credibility. The composition of the index should be clearly communicated to the public. By having easy access to the data used, the central bank would be ready to calculate the index for its own research on inflation.

Once a credible, up-to-date, and transparent inflation index is chosen as the target variable, the central bank must ensure that the basic properties of the index are well analyzed and understood. A thorough analysis of the index would start by studying the basic time series properties of the index, such as seasonal patterns, volatility, and persistence. Similar analyses can be undertaken for all the components of the index. Furthermore, an analysis of the lead and lag relationships of the components with the index itself could be done to identify whether some of the components do have leading indicator properties for inflation. It is also important to have an idea about the import content of the CPI to better gauge the imported inflation and the pass-through of the exchange rate effect.

Core inflation

Central bankers are typically concerned with inflation over the medium term and in principle do not respond to short-term, transitory inflationary developments. CPIs generally contain many components that are highly volatile and prone to transitory shocks such as food and energy prices. Moreover, some components are not primarily influenced by monetary factors, such as administered prices. Thus, the CPI is not always the ideal target for monetary control purposes, and policymakers prefer to focus on the underlying trend in inflation. The trend component is, of course, not observable but can be approximated by measures of core inflation.

There are several different methodologies for calculating core inflation indices, and these can be grouped under three broad categories. The first one is the most common and traditional approach of excluding certain items from the index, such as food and energy. In the second category, there are methods that examine the distribution of price changes of the components of the index and exclude the extremes. As the distribution of prices may change in each period, so do the excluded items and thus the composition of the index. This is different from the first approach where a fixed set of items is excluded from the index. Finally, time series techniques can be used to estimate the trend component of the index, as advocated by Quah and Vahey (1995).

There is no single best definition of core inflation; different measures are relevant for different purposes. Exclusion-based indices are likely to be more useful for communication purposes, since the developments in them are easier to explain to the public compared with others that are calculated using statistical and time series techniques. The latter group, however, may capture the underlying trend in inflation better and could be more useful for modeling and forecasting purposes. This is ultimately an empirical issue. Although a useful guide for monetary policy, core inflation is not a substitute for a thorough analysis of price

developments. Macklem (2001) and Mankikar and Paisley (2002) describe intuitively why central banks are interested in core inflation measures and how these measures are used as part of the central bank toolbox.

Surveys

Surveys of inflation expectations are important tools employed by almost all inflation targeting central banks, and these have proved to be useful sources of information on future inflation. Long-term inflation expectations may also be used as an indicator for central bank credibility within an inflation targeting regime. Central banks use a variety of surveys to gather evidence on current economic conditions, as well as perceptions regarding current and expected economic activity.[5] Three groups are often surveyed by researchers: households, businesses, and professional forecasters.

Surveys usually provide useful information that cannot be extracted from official data sources. Neither time series models nor calibrated models are good at capturing future human and company psychology and future behavior. Surveys provide valuable added information on individuals' and consumers' intended future behavior and expectations. For example, in the case of a major shock to the economy, consumer confidence indices could provide important information about future consumption that cannot be captured by standard consumption models. Finally, surveys are often timely compared to most other data, including national income accounts.

The University of Michigan has for a long time been a leader in consumer surveys. The methodology of the University of Michigan Surveys is described in Curtin (1996). Forsells and Kenney (2002) show how to derive a measure of expected inflation from the European Commission's Harmonized Consumer Survey. Lyziak (2003) undertakes a similar study for Poland and provides many references on measuring inflation expectations. Garcia (2003) is an example for surveys of professional forecasters, and Martin and Papile (2004) for businesses.

Leading indicators

Leading indicators of inflation are economic variables that are correlated with future inflation. The list of economic variables that can be useful for predicting inflation is a long one, ranging from consumption, investment, and (un)employment figures, to monetary aggregates, fiscal policy indicators, various price indices and wages, interest rates and spreads, exchange rates, and stock prices.[6] The actual set of leading indicators is, of course,

[5] Surveys may sample market and consumer inflation expectations (as in New Zealand), or the central bank may provide a summary of surveys of market inflation expectations (United Kingdom). In other instances, qualitative surveys of private sector conditions are used (Canada and New Zealand).

[6] Movements in spreads between the yields on indexed and nonindexed bonds have been used as a measure of inflation expectations (Australia, Canada, Israel, New Zealand, and the United Kingdom). Nevertheless, these data should be used with caution given that the market for indexed debt is sometimes shallow and risk premiums are highly variable.

an empirical issue that pertains to each country. To be useful, such series should be conveniently available on a timely basis and should not be subject to substantial and frequent revisions. Leading indicators can be used both individually to assess capacity pressures in certain sectors of the economy, or can be used in composite index form.[7]

Asset prices

Many asset prices are formed by expectations of future economic events and thus likely to contain useful information for central bankers. How to respond to asset price movements is heavily debated among central bankers and academics. For the purposes of this paper, what is critical is the impact of asset prices on the inflation outlook. One important channel through which asset prices may influence inflation is the wealth effect. Changes in asset prices, including equity and housing prices, may alter asset holders' perceptions of their net worth, which in turn may influence their consumption and could affect aggregate demand. In countries where housing forms a significant share of wealth, data on property prices can be especially important to assess wealth effects and resulting demand and inflation pressures.

B. Short-Term Forecasting

The first step in forecasting for policy is assessing the current and near-term state of the economy. As important data including national income accounts are produced with some lag, other sources of information, such as leading indicators, surveys, or industry contacts, are used to assess the current state of the economy. Time series and other econometric techniques are primarily used for short-term forecasting. While macroeconomic theory and structural models are essential to form a view about the medium-term evolution of the economy, short-term forecasting is more of a measurement issue. Sectoral expertise and judgment is especially important for short-term forecasting.

Short-term inflation forecasts usually involve a considerable number of variables such as economic activity, aggregate demand, interest rates, and exchange rates.[8] When forecasting inflation, many other variables, for instance, productivity, may become of interest too. It is often the case that forecasts of these intermediate variables are explicitly considered by policymakers when making decisions. It is also the case that boards at central banks and policymakers often ask for forecasts coming from a diverse group of forecasters involving a wide range of approaches.

In all cases, expert advice plays a critical role in adjusting raw econometric forecasting by combining knowledge of factors affecting relevant variables and insights on lagged structures, causal relationships, dynamics, and correlations. Better forecasts can be made by

[7] Stock and Watson (2003) investigated different methodologies that analyze leading indicators. See Woodford (1994) for a cautionary note on the limitations of leading indicators.

[8] Pagan and Robertson (2002) underline the problems associated with disaggregation, in particular when there are components that are difficult to predict compared to the aggregate.

combining insights from statistical models with judgments and sectoral experts' opinions concerning specific events. As stated in Table 2, the degree of judgment applied, either at an earlier or later stage in forecast formulation, is generally considerable.

Table 2. On the Use of Judgment

	Degree of Judgment Applied in Forecast Formulation	Stage at which the Judgment Enters
Brazil	Considerable amount	Beginning stage
Chile	Considerable amount	Beginning stage
Colombia	Considerable amount	Beginning stage
Mexico	Small amount	Beginning stage
Peru	Considerable amount	Beginning stage
Israel	Enormous amount	Beginning stage
South Africa	Considerable amount	Final stage
Hungary	Considerable amount	Modeling stage
Poland	Considerable amount	Modeling stage
Czech Republic	Considerable amount	Beginning stage
Korea	Considerable amount	Beginning stage
Philippines	Enormous amount	Beginning stage
Thailand	Considerable amount	Modeling stage
Australia	Enormous amount	Modeling stage
Canada	Considerable amount	Modeling stage
Iceland	Considerable amount	Final stage
New Zealand	Considerable amount	Beginning stage
Norway	Considerable amount	Beginning stage
Sweden	Considerable amount	Beginning stage
Switzerland	Considerable amount	Beginning stage
United Kingdom	Considerable amount	Beginning stage

Source: Central banks' self-assessments as part of the underlying survey of the World Economic Outlook, September 2005.

Sectoral expertise and judgment play an important role in some central banks for short-term forecasting. A macroeconomic forecast based on judgment is built up in a fully coordinated way from sectoral forecasts provided by sectoral experts. This is a full macroeconomic forecast as an alternative or a complement to a model-based one. To start the process, a forecast coordinator sets up assumptions about variables that are common but exogenous to each sector. Each sectoral expert then comes up with his or her own forecast, using a variety of techniques, including econometric models of their sector, surveys, anecdotal evidence, and his or her own judgment of the impact of developments that cannot be captured by other tools. These forecasts are then aggregated, and additional iterations are done to ensure consistency of the macroeconomic framework.

The advantage of this approach is the incorporation of specific information about the current quarter and the near future. A key disadvantage is the difficulty of analyzing alternative scenarios under different assumptions. Often, it is too difficult to coordinate the aggregation process for anything other than the central projection. There are alternative uses of judgmental forecasts. They can either be used as the main forecast for the next few quarters,

and feed into a structural model for beyond, or be used as an alternative to model-based forecasts with a view to reconcile the two.

Storing experts' opinions and advice in a systematic way may complement the statistical analysis of forecasts, especially in the wake of structural changes or unexpected events. Experts' opinions and judgments may be stored in databases for future use to improve the quality of forecasts. Short-term forecasting is usually based on time series analysis, whether univariate or multivariate, and might be enhanced by incorporating key indicators of construction, price changes, information on exchange rate pass-through effects, and financial sector developments.

Econometric models are used to inform and complement expert knowledge and judgment. The simplest econometric tools used in time series forecasting are univariate linear models. Time series models impose less economic structure. However, they provide accurate short-term forecasts and a good reference for consistency checks for larger structural models.[9] Within this set, ARIMA models became the customary device for time series analysis. In the ARIMA specification, a variable of interest (for instance, CPI) is modeled, exclusively, as a function of its own past and hence is governed by the autocorrelations of the process. Sometimes, simple random walk is the best possible univariate representation. However, this modeling approach does not incorporate useful information about the structure of the economy and thus becomes useless as a vehicle to discuss, explain, and elucidate policy decisions.

Multivariate modeling strategies involve models in which the variable of interest depends on its own past values and on those of other accompanying variables. In this venue, it is important to adequately distinguish between statistical specifications based on endogenous forecasts of the dependent variable and those that require the use of exogenous forecasts of the explanatory variables. The first approach has been popularized by the VAR (vector autoregression) methodology, which seems particularly useful for that purpose. The second approach involves specifying a model in which the forecast of the dependent variable relies on other explanatory variables rather than its own past and uses exogenous forecasts—computed outside the model—as explanatory variables. Some VAR models combine the two approaches by including exogenous variables in their specifications.

In addition to macroeconometric (core) models, central banks might be willing to use Output Gap Models (OGMs) or Phillips Curve types of models. These models relate nominal price or wage inflation to some measure of excess demand or real disequilibrium (unemployment or output gap). In many instances, given their simplicity and transparency, OGMs are used to cross-check forecasts on wage/prices derived from core models. They can also be used to calibrate parameters of structural models. The focus on the relationship between inflation and

[9] Univariate models of the aggregate inflation index, subcomponents of the index, or other key inflation indicators are relatively easy to produce and allow for constant evaluations of economic and financial conditions.

summary measures of real disequilibrium make them useful for policy simulation exercises. Nevertheless, simplicity comes at the expense of omitting other important variables.

While the previous techniques provide an understanding of the statistical behavior of key variables, they are routinely complemented with medium-term forecasting procedures that usually involve assumptions about the structure of the economy and with more general econometric models. In this regard, macroeconomic models provide consistency by linking short-term economic and financial developments with long-term assessments. A structural approach to forecasting depicting a comprehensive view of economic performance would typically include an open economy IS curve, a Phillips curve, an international asset market equilibrium condition, and a monetary policy reaction function.[10] All these techniques have been used in empirical work in central bank behavior, in modeling monetary policy rules, and in analyzing sacrifice ratios. At the same time, these elements constitute the core of some large macroeconometric models such as the Bank of Canada's ToTEM introduced in December 2005, and the U.S. Federal Reserve Board's FRB/U.S. model, among others.

Different models used at central banks are considered as complements, not competitors. Table 3 shows a range of models and equations used to build models for forecasting and economic analysis at selected central banks. Bank of England (1999) provides an extensive discussion on the use of different models for forecasting and policy analysis, including detailed explanations of pros and cons of different types of models that the Bank of England employs.[11]

C. Medium-Term Forecasting—The Core Model

A core (semi)structural model with strong theoretical foundations is a reference point for discussions about inflation dynamics. Industrial economies have relied on large-scale macroeconomic models for many years as a guide for their decision-making processes in monetary policy. It is now the case that several emerging market economies have successfully developed quantitative models that also guide their decision-making process. Table 4 presents some evidence for a selected group of countries on core macro and other models. The core model represents the central bank's view of the monetary transmission mechanism. Such a model usually consists of several behavioral equations in which important variables converge to a well-behaved steady state. By construction, the model is

[10] See for example, Bogdanski, Tombini, and Werlang (2000), Clinton (2000), Bank of England (1999), Fair (1994), Hunt, Rose, and Scott (2000), and Pesenti (2002).

[11] More on this issue can be found at www.bankofengland.co.uk/publications/other/monetary.htm

internally consistent, which helps the bank to provide a coherent story about how it sees the economy evolving. In that capacity, the model is also a communication device.

Table 3. Expectations, Equations, and Models

	Expectations Adaptive/Forward-Looking	Number of Behavioral Equations in a Core Model	Number of Models (if a suite of models used)
Brazil	A mix of the two	2	3
Chile	A mix of the two	10	15
Colombia	A mix of the two	6	30
Mexico	A mix of the two	9	3
Peru	A mix of the two	4	8
Israel	A mix of the two	10	2
South Africa	Adaptive	28	6
Hungary	Adaptive	17	3
Poland	No core model used	..	2
Czech Republic	A mix of the two	11	..
Korea	Adaptive	50	3
Philippines	Adaptive	45	2
Thailand	A mix of the two	24	1
Canada	Forward-looking	45	2
Iceland	Adaptive	15	3 to 5
New Zealand	A mix of the two	25	3
Norway	A mix of the two	4	15
Sweden	Forward-looking	25	3 to 5
Switzerland	Adaptive	30	5

Source: Central banks' self-assessments as part of the underlying survey of the WEO, September 2005.

Table 4. Forecasting Skills and Resources

	Inflation Forecast		
	Single Core Macro Model	Suite of Different Models	Other
New Zealand	Single core model for medium-term projections		Satellite models for short-term forecasting and other models used to produce competing forecasts (e.g., VARs, Factor Models)
Norway	Single core macro model		Core model, satellite models and empirical models
Sweden	Core Dynamic Stochastic General Equilibrium Model	A suite of different models	Bayesian VARs, a Component CPI model
Switzerland		i) Structural econometric models; ii) Nonstructural and structural VARs; and iii) An M3 Vector Error Correction Model	
United Kingdom		A suite of models, with a large weight placed on the Bank of England Quarterly Model (BEQM), a core model	

Source: Central banks' self-assessments as part of the underlying survey of the WEO, September 2005.

Macroeconomic modeling encompasses a minimum set of requirements such as an exchange rate arrangement consistent with the inflation objective and the characterization of monetary policy consistent with the inflation target. Small, semi-structural, New-Keynesian representations of economic fluctuations consist of multiple equations representing a set of long-run structural relationships, which is usually supplemented by identities, transformations, and linking equations. The strengths of these models rest in their much richer account of the economic fundamentals than smaller-scale models. In addition, and given knowledge of the kind of shocks to which an economy is exposed, macroeconometric models can be run and calibrated on a set of different alternative assumptions. However, as in any large set of equations involving so many different behavior relationships, macroeconometric models tend to be very complex.

The forecasting framework should produce a forecast based on a structural picture of the transmission mechanism. In this regard, methodologies are usually chosen according to the specificity of the transmission mechanism and they need to provide a consistent medium-term horizon for assessing policy options. The parameters of structural forecast models can be calibrated, most importantly in countries where data sets are small and structural breaks prevail. A forward-looking transmission mechanism incorporates the following elements:

- Assessing the impact of real interest rates on domestic absorption (at higher frequency level to be incorporated in models of inflation).
- Determining whether a credit channel exists either as a bank credit channel which relies on banks as holders of deposits and originators of loans or as a broader approach focusing on the supply of funds from all financial intermediaries (including all forms of external finance).
- Evaluating the pass-through effect of the exchange rate to inflation (is there a sufficiently ample time series for the exchange rate?).
- Analyzing different types of monetary disturbances: permanent monetary policy shocks to be distinguished from temporary shocks; and velocity, financial intermediation shock, and money demand shock, for instance.

A methodology for combining core models with expert judgment has recently been advanced at the IMF.[12] The starting point is a small core macroeconomic model that establishes aggregate relationships between the main macroeconomic variables (in terms of deviations from equilibrium levels) in the medium term. The core model, which includes a monetary policy reaction function, allows the formulation of model-consistent forecasts of the impact of monetary policy decisions on inflation and identifies the risks to the inflation forecasts in terms of shocks affecting the economy. The expert judgment involves the calibration of model parameters, the assumed equilibrium path of the main macro variables, and exogenous inputs into the model, partly reflecting the evolution of variables outside the model (most notably fiscal variables in the simplified version of their model).

[12] See Berg, Karam, and Laxton (2006).

The core model should be transformed into a functional tool for the decision-making process. As such, it should be used as a vehicle for policy analysis in board meetings and as an underlying device in inflation reports. Given that the core model should be adequately understood by the forecasting team throughout a central bank, it also becomes the familiar locus around which information is exchanged, the debate takes place, and consistency is safeguarded.

D. Involving the Private Sector and Other External Expertise

Involving the private sector in the forecasting exercise can enhance trust in the inflation targeting framework. The inflation targeting approach to monetary policy relies on private sector trust. The private sector must be convinced that the central bank will adjust policies when inflation forecasts deviate from the targeted point or range. To boost confidence, the private sector may be involved in the production of inflation forecasts and participate in central bank-sponsored fora for discussing the best inflation forecasting techniques available and the judgmental factors that need to be considered. By directly participating in the process, the private sector can be reassured that predictable inflationary pressures will not go undetected. The private sector may also increase its awareness of the uncertainty in making forecasts and the need for judgment even after using the most sophisticated techniques.

Private sector entities may assist the central bank in producing its inflation forecast. Many private sector individuals and institutions in the academic and research communities are prospective partners in the production of inflation forecasts. They include economic think tanks, professional forecasting associations, and university students and professors, among others. The central bank may periodically open its forecasting methodology for review by reputable experts. In particular, the central bank may commission an independent study from the private sector or reputable international experts assessing the forecasting systems and methodologies employed by the central bank in forecasting inflation. These assessments regularly include an opinion about the procedures for judgmental adjustments to the forecasts from a benchmark forecasting model.

The private sector may also provide alternative forecasts for comparison. The central bank could create an electronic billboard where alternative inflation forecasts from the private sector are centralized, including forecasts produced with alternative methodologies and a survey of inflation expectations. For encouraging responsible forecasts, the central bank billboard should keep track of the forecasting accuracy of the contributors, including its own. The central bank could then compare the accuracy of its predictions not only with those of other local forecasters, but also with other inflation targeting central banks.[13] The private sector would benefit from the advertisement received from this platform. For-profit organizations with a successful track record in forecasting may benefit by attracting clients. University students would advertise their professional services or academic expertise. Moreover, the central bank may offer privileged access to readily usable databases to its

[13] For methodological issues, see for example, Albagli and others (2003); Oller and Barot (2000); and Loungani (2001).

partners in forecasting. The detailed databases could allow central bank partners to provide detailed forecasts to their clients on microeconomic aspects in which the central bank might not be interested.[14] The billboard may alert the central bank of new developments in forecasting techniques and benefit from a variety of points of view. In addition, as proposed in the discussion about databases, the central bank may conduct surveys of inflation expectations among the main actors in the financial and corporate sectors and publish the results on its Web site (Bank of England, Central Bank of Brazil, Banco de México, Reserve Bank of New Zealand, Kyrgyz Republic, among others, do this).

The central bank may establish a forum for discussing inflation forecasting techniques. Among the possible activities, it could organize a yearly conference on inflation targeting open to the public at large, but focused on attracting participants from economic think tanks and universities. To increase participation, reputable presenters may be invited and the central bank may choose to publish the best papers. The central bank could also organize periodic meetings for discussing with selected representatives of the private sector (by invitation only) the implications of new data releases on inflation prospects. The frequency of these meetings may coincide with that of the forecasting cycle. A selection of participants may include the main partners of the central bank in forecasting inflation. The central bank may establish a research agenda that supports its policy and operational decisions, providing the data to its partners in forecasting.

Involving the private sector in forecasting may involve some costs and risks. Investors may use any inside information revealed through interaction with the private sector for their own profit. Forecasts reveal what policymakers believe. In studying central bank forecasts, investors may detect weaknesses in the authorities' forecasting framework and use this information for their own benefit. Some central banks may feel that they do not significantly benefit from private sector involvement as the central bank often has privileged information and attracts high-caliber personnel. Some country authorities may also be concerned about revealing their weaknesses in forecasting and exposing themselves to personal embarrassment, which may reduce (rather than increase) the credibility of the regime. The authorities may fear that the public at large may attribute to incompetence the natural difficulties in forecasting.

The net benefit of private sector involvement is likely to vary over time and among countries. The benefits of private sector involvement are difficult to measure because they are associated with the psychological effects of higher credibility. Yet, these effects can be strong and can help anchor inflation expectations. The private sector abuse of privileged information may reflect deficiencies in the transparency framework rather than in the monetary regime. Transparency is a lynchpin of the inflation targeting framework and the authorities might find it useful to reveal information about their policy actions simultaneously to all market participants. Thus, central bank partners in inflation forecasting would not get access to information about policy decisions not already available in the

[14] For example, the central bank could compile and grant access in electronic form to each of the components of the CPI: allowing the private sector to conduct bottom up analysis as well as aggregate level analysis.

market. Moreover, the administrative costs of coordinating the effort are likely to be small compared to the benefits of increased private sector trust. These costs, however, are likely to vary by country and over time.

Involving the private sector requires the central bank to choose, carefully, the timing of different strategies. For example, it should have already prepared a solid forecasting methodology, perhaps initially with the support of external expert advice, before inviting the private sector to prepare alternative forecasts for comparison with those of the central bank in the central bank's Web site.

E. How Does It All Fit Together?—The Decision-Making Process

Synthesizing all the information and reaching a policy decision is an important element of the art of central banking. There is no single best or common approach to reach the policy decision; each central bank has its own way. The important point is to institutionalize the decision making process. Fortunately, in recent years some central bankers published the details of their decision-making process to shed light on the internal workings of their respective institutions.[15]

A reliable official forecast is based on all available forecasting tools. It should not be based only on the predictions of a core model. It should translate a mixture of statistics, model predictions, institutional knowledge, economic theory, and the judgment of the forecasting team into a wide-ranging, reliable, and understandable chronicle of the inflation outlook that would serve as a nexus between the central bank's policy decisions and goals and external communication. The essential aspect is to have a structured framework that allows the central bank to think systematically about the monetary transmission mechanism and produce inflation forecasts.

Many central banks have a regular schedule for policy meetings and announcements. There are several benefits to doing so. First, a schedule provides a regular opportunity for the central bank to explain its views and actions to the public, and to draw attention away from daily news toward longer-term fundamental developments in the economy. Second, with regular meetings, the central bank communicates with the public even when it does not change the policy variable. A decision not to change the policy variable rate is often as important as a decision to do so, and warrants an explanation. For example, when several minor shocks hit the economy that on balance do not require a change in the policy stance, the public may still benefit from the bank's assessment of the balance of forces that influence the inflation process in the country. Third, fixed announcements reduce the uncertainty about when the bank will inform the public about any change in the policy rate. Elimination of this risk would encourage financial market participants to shift their focus away from the central bank, and toward economic developments, and to plan ahead of meetings.

[15] Lambert (2005) explains how decisions are made by the Bank of England's Monetary Policy Committee. See Heikenstein and Vredin (2002) for Sweden, and Reserve Bank of New Zealand (2001).

A regular schedule is useful for operational purposes as well. A detailed timetable is essential for effective coordination of the forecasting process, as it specifies the timing of the required actions, inputs, and outputs and hence puts a structure on the process. A quarterly forecasting cycle in line with the natural accretion of data is common in many central banks. Each quarter, staff responsible for the inflation forecast could present their forecasts to a technical committee or monetary policy committee, discuss scenarios under different assumptions about exogenous variables, and assess risks and uncertainties in the forecast. The timing of quarterly projections is generally synchronized with the publishing of an inflation report. An interim assessment of the inflation outlook can be done four or six weeks after a quarterly forecasting cycle, but it is important that frequent analysis does not absorb time from the more thorough quarterly reviews and detailed analyses.

Quarterly forecasting cycle

A full-scale forecasting exercise typically starts right after the quarterly national income accounts are announced. At this early stage, the monetary policy committee and the forecasting team meet to discuss and agree on the basic assumptions of the forecast. The monetary policy committee may also identify some key issues to focus on during the forecasting process, as well as to alternative risk scenarios. Staff then begins to prepare the new quarterly projection, and also to undertake work on the important issues identified by the monetary policy committee.

One or two weeks before the policy decision day, the central bank staff starts to inform the monetary policy committee through a series of presentations. The process could start with a "draft" presentation of the core model forecast, also explaining how the economic outlook might have changed since the last cycle. At this stage, the monetary policy committee may provide feedback to forecasters and ask for some changes in the forecast. Forecasts produced by the private sector, academics, and think tanks are also presented to reflect alternative points of view. This is followed by briefings on international economic developments, domestic regional developments, money and credit analysis, and financial market developments. If there are reports written on these issues, they can be sent to the monetary policy committee a few days before the presentations allowing them some time to grasp the issues. The importance of sectoral analysis varies from one country to another. Countries that span a large geographical territory and that are possibly hit by asymmetric regional shocks may spend considerable time analyzing regional developments, whereas a small open economy may study international economic developments in more detail. Although monetary targeting as a monetary framework has been abandoned by many central banks, money and credit aggregate developments are still closely monitored.

A few days before the decision date, finalized projections are presented to the monetary policy committee. After economists' analyses are presented, advisors and monetary policy committee members could present their own individual analyses about the current condition of the economy. Alternatively, the monetary policy committee and advisors could engage in a wide-ranging discussion, instead of providing individual analyses. The presentations focus on the current state of the economy, alternative policy paths and their impact on the economy, risks, and uncertainties. The forecasting team could present a few alternative

scenarios to the monetary policy committee, based on the core model under different assumptions about the exogenous variables and the interest rate path. Then the committee recesses for a few days just before the decision date to digest all the analyses and think about the policy decision. It reconvenes to take a decision and makes the policy announcement.

The decision on the policy rate is necessarily judgmental. No model, survey, or indicator would by itself provide a sufficient picture of the economy. Models, however sophisticated, are highly stylized and simplified characterizations of the economy. In fact, a substantial amount of judgment is exercised on the model's assumptions and projections. Other tools such as leading indicators, surveys, or anecdotal evidence could give a feel about where the economy stands, but a conceptual framework is required to make sense of the wealth of data available. Unfortunately, there is no foolproof mechanical way of putting all the information together; ultimately it is the decision makers' responsibility to assess all the information and reach a common view on the likely path of inflation and the economy, as well as the policy variable consistent with the central bank's objective.

Interim meetings

The meetings in between the quarterly forecasting cycle involve reviewing progress and analyzing the new information that has accumulated. Accordingly, the monetary policy committee takes into account all the relevant information for assessing its policy stance, but it is more likely that major changes in the policy stance overlap with the quarterly cycle. Because a change in the monetary policy stance is executed in small steps (the so-called principle of gradualism), the policy rate is likely to be changed consistently in one direction in a series of meetings. There is less new information at the interim meetings owing primarily to the lack of new national income accounts data, and so short-term forecasts have a greater weight in interim assessment compared to the quarterly cycle. The interim meetings could also be used to discuss the approach to monetary policy in general.

Gomez, Uribe, and Vargas (2002) explain the process behind the forecasting procedure at the Banco de la República de Colombia. The inflation forecasting system (Figure 1) consists of a forecasting model (MMT) used for policy analysis, a combination of Structural (single equation) Models (CSM), a model of food inflation by type of product, a neoclassical growth model used for forecasting potential output and for analysis, a supply-side output forecasting system (OFS), and a set of auto-regressive models. The monthly forecasting procedure starts with the release of statistics on inflation used to run the neoclassical growth model, the auto-regressive models, and the food inflation model. The results are subsequently evaluated and used as input to the CSM and the OFS. Then, in the second forecasting round, the resulting output is used to feed the adjustments and the asymmetry of the inflation and output fan charts. The forecasting process takes a week until the inflation report is presented to the board of the Banco de la República. The projections for output, inflation, and interest rates from the MMT are also used as inputs for estimating of the demand of monetary base.

IV. MISCELLANEOUS TOPICS

A. Communicating the Forecast

Inflation forecasts are the centerpiece of any monetary policy framework, especially in inflation targeting countries. Deviations from the inflation target can become a signal for adjustment of inflation expectations. Consequently, the credibility of any central bank and the success of the monetary policy strategy hinges on the quality and reliability of its inflation forecast.

The need for legitimacy induces an inflation targeting central bank to continually demonstrate that it owns the expertise, resources, and instruments to achieve the goal of price stability. It is in this setting that a central bank must communicate clearly how its goals are to be achieved. Given that the target audience is the entire society, communication devices and their characteristics must be tailored accordingly. In this regard, the monetary authority must spell out not only its goals, but the strategy, its justification and rationale, and the way by which resources—both human and technical—will be used to achieve those goals. Effective and timely communication may strengthen the institutional independence of central banks and enhance the effectiveness of monetary policy.

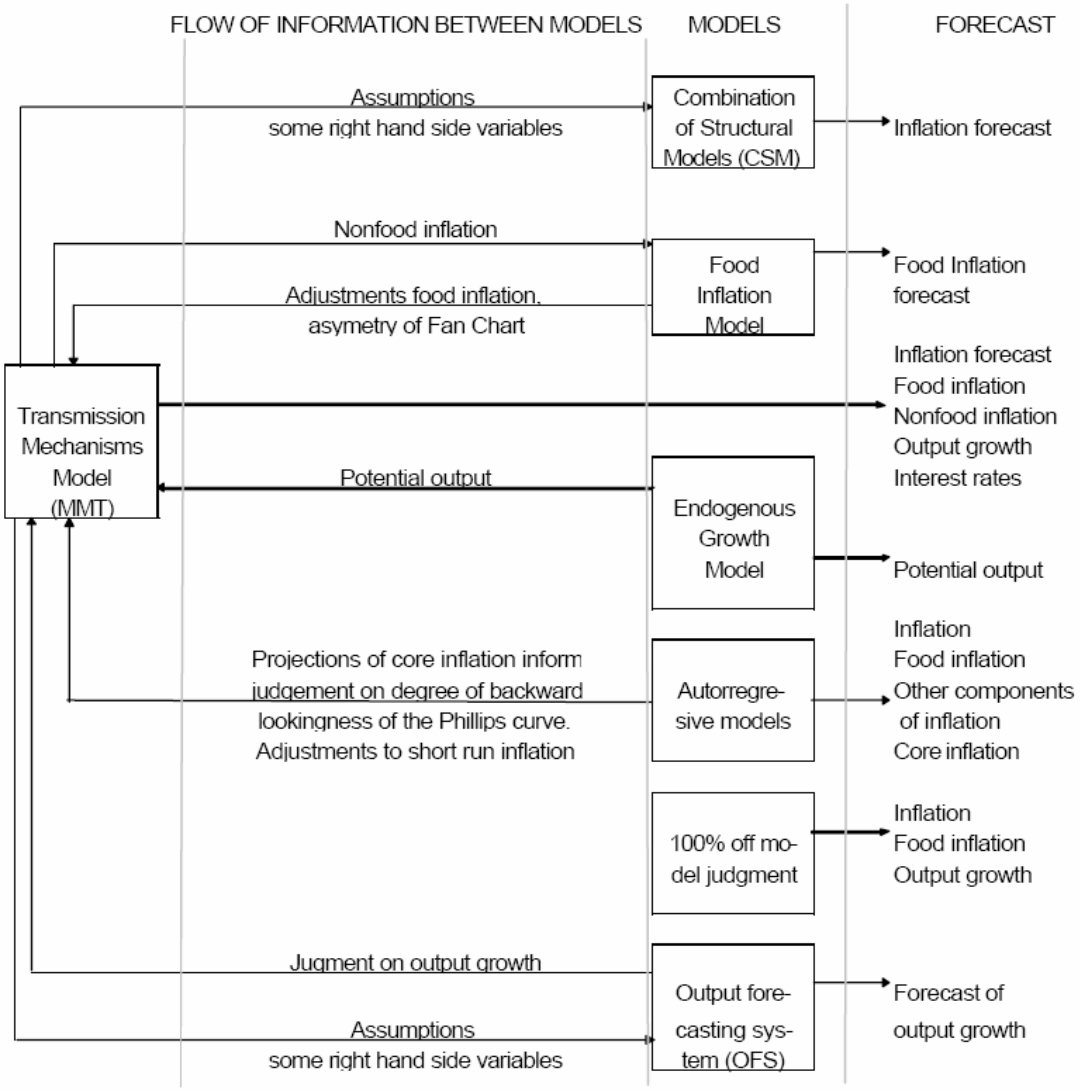
Accountability induces the monetary authority to communicate clearly what the objectives are, thereby suggesting that the publication of inflation forecasts is crucial to an efficient monitoring process. One of the main features of such communication is the analytical framework and the statistical support infrastructure used to generate inflation forecasts. The predictability of policy actions can be enhanced by adequate communication of the analytical tools—models, statistics, information, and framework—used. The objective is to communicate appropriately so that the private sector can replicate the exercise and obtain similar inflation forecasts as the central bank.

Timely communication of an inflation forecast enhances the clarity of the decision-making process and the capacity of the public to comprehend and appraise the performance of a central bank. Inflation reports are the proper vehicles for sharing the value judgments used by the central bank and for understanding the reactions by the monetary policy committee members whenever deviations from the inflation forecasts take place. The production of reliable forecasts is a learning-by-doing procedure by which a central bank aims at building up a consistent track record. In doing so, central banks usually opt to compare their own inflation forecasts against others produced by the private sector and the market, explaining and interpreting past forecast errors.

Communication becomes crucial to increasing transparency. However, the release of more information does not automatically imply more transparency. It is vital to gauge the information to be released. In this regard, there are key elements of the forecast process that central banks may wish to share with the market. The central bank must provide enough information to let market participants understand and monitor its decisions in an effort to convince them that it behaves in a way consistent with its commitment to medium-term inflation target. Likewise, effective communication and transparency enhance the central bank’s ability to build up and reinforce credibility. A central bank may gain credibility by

sharing information with the market. Timely provision of information concerning both forecasts and the model behind them may foster credibility by allowing the public to assess policy consistency. Table 5 shows how inflation targeting central banks have been gradually adding information into their inflation reports.

Figure 1. Colombia: The Inflation Forecasting System



Source: Gomez, Uribe, and Vargas (2002).

Table 5. Forecasts and Fan Charts

	Quantitative Forecast				Fan Chart			
	1998	2000	2002	2004	1998	2000	2002	2004
New Zealand	Yes	Yes	Yes	Yes	No	No	No	No
Canada	Yes	Yes	Yes	Yes	No	No	No	No
United Kingdom	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sweden	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Australia	Yes	Yes	Yes	Yes	No	No	No	No
Israel	No	No	Yes	Yes	No	No	Yes	Yes
Czech Republic	Yes	Yes	Yes	Yes	No	No	No	No
Poland		No	Yes	Yes		No	No	Yes
Brazil		Yes	Yes	Yes		Yes	Yes	Yes
Chile		Yes	Yes	Yes		Yes	Yes	Yes
Colombia		Yes	Yes	Yes		No	Yes	Yes
South Africa			No	No		...	Yes	Yes
Thailand	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Korea			Yes	Yes			Yes	Yes
Mexico			Yes	Yes			No	No
Iceland			Yes	Yes			Yes	No
Norway			Yes	Yes			Yes	Yes
Hungary		No	Yes	Yes		No	Yes	Yes
Peru			Yes	Yes			Yes	Yes
Philippines			Yes	Yes			No	Yes

Source: Roger and Stone (2005).

Fan charts, exhibiting the probability distribution of inflation forecasts over a range of outcomes have become a prevalent tool to present forecasts based on quantitative models.[16]

Disclosing the inflation forecast has many benefits. If the central bank promises to adjust interest rates when the inflation forecast is to be out of the range, the market would want to see this forecast. The advantages of publishing forecasts, in general, include: (i) increasing the public understanding of central bank actions, and consequently, its ability to assess the credibility of the monetary authority to control inflation; and (ii) improving the quality of these forecasts because they are under scrutiny by the public. Therefore, besides higher accountability, the public release of inflation forecasts is crucial to influence public expectations and enhance the effectiveness of central bank decisions. In addition, the credibility of the inflation forecast is supported by (i) a transparent and clear transmission of the forecast and its assumptions; (ii) a monetary policy stance consistent with the inflation forecast in the policy horizon; and (iii) an inflation forecast in the policy horizon in close proximity to the inflation target.

There are several means of communicating the inflation forecast and its assumptions. In this regard, inflation reports have emerged as an efficient method to convey the necessary information on inflation forecasting to the public at large. These reports not only facilitate the necessary transparency but also provide relevant information at the exact time to enhance the

[16] See Allen (1999).

predictability of central banks. Additionally, most inflation targeting central banks provide to a more specialized audience detailed quantitative aspects and formal characteristics of the analytical process used to derive the inflation forecast. Specific communication is usually transmitted through the publication of research pieces, conferences, and speeches that help shed further light on the statistical procedures, assumptions, and methods.

B. Conditional or Unconditional Forecast?

The assumed path of policy interest rates over the forecasting period is crucial in preparing an inflation forecast. In unconditional forecasting, no explicit assumption is made about a specific interest rate path, while in conditional forecasting the forecast is based on a specific interest rate path. A basic premise of the inflation targeting framework is that the central bank can affect inflation by modifying its short-term policy interest rates. This also implies, however, that the future evolution of policy interest rates affects the inflation forecast and that the conditional forecasts are to be preferred.

Central banks have considered four types of explicit interest rates paths: (i) a constant interest rate path; (ii) market forecasts of the future policy rates; (iii) a central bank *discretionary* projection of the policy interest rate path; and (iv) the interest rate path that would result from following the central bank's policy reaction function.

A constant interest rate path is appealing, but may be misleading. As reported in Table 6, the evidence shows the existence of different approaches to this issue. An inflation forecast under constant interest rates answers the question of what inflation would look like over the forecasting period in the absence of any policy action of the central bank for the indefinite future. While it can provide a useful benchmark, a constant interest rate path is inappropriate because it could imply unreasonably high or low real interest rates based on the projected evolution of inflation. Future projected changes in interest rates will be necessary to keep inflation on the target path. Presenting forecasts based on unreasonable assumptions does not contribute to the objectives behind making the forecasts available.

Market forecasts of future policy rates could give rise to circularity if the central bank sets its policy rate on the basis of market forecasts.[17] Expectations can become self-fulfilling if the central bank sets its policy rate on the basis of market forecasts. Yet, if the central bank does not plan to always validate those forecasts, it may be misleading the market by basing its inflation forecasts on the market projections.

A central bank *discretionary* projection of the policy interest rate path implies a forward-looking approach to monetary policy. However, it would complicate the decision-making process of the committee that makes monetary policy decisions. If a policy projection is used for producing the inflation forecast, this would require that the monetary policy committee come to an agreement on this path. Goodhart (2001), and more recently Mishkin

[17] See Bernanke and Woodford (1997).

(2004), argue that it is better that central banks decide only the present policy rate and not the policy interest rate path.

The use of a policy reaction function for the production of inflation forecasts is a useful-approximation to the forward-looking behavior of the monetary policy committee. A policy reaction function would identify a particular path of interest rates given the expected developments in the economy, based on the likely behavior of the decision maker in response to shocks to the economy. While it is unlikely that country authorities will follow a rule in making their decisions, they are likely to make their judgmental decisions on the basis of applying a heavier weighting to the variables that have been historically relevant.

We argue that the best, most consistent, and technically sound option for a professional inflation forecast is the use of a policy reaction function. Having evaluated the pros and cons of these options, staff from a central bank might find it useful to forecast inflation considering a policy reaction function. This, however, requires that it be discussed and analyzed with the authorities to check whether they can agree with the historical reaction in the policy stance and current objectives and their relative weights. This will avoid significant differences between staff forecasts and the authorities' view on the interest rate path.

However, the central bank need not disclose the underlying policy interest rate path. On the one hand, there is the view held by Svensson (2002) that central bank inflation forecasts should be complemented with the public release of the projected policy interest rate path. He argues that if inflation forecasts are based on the authorities' policy interest rate path, it is very likely that the market would demand those forecasts or try to estimate them. On the other hand, releasing the associated future policy interest rate path implicit in the central bank inflation forecast might complicate communication with the public. If the interest rate path is forecasted, future deviations from the projected policy path may be viewed by the public as central bank failure and could harm the central bank's credibility. A way to combine these two opposite views is to release the expectations of the market regarding interest rates and to send official message about the future policy stance. In this way, central banks do not need to be specific on the policy path (avoiding a loss of credibility because of unexpected adjustments), but can express the general trend of their policy depending on the inflation forecast and the factors that could deviate from the inflation target.

Almost all inflation targeting central banks publish their inflation forecasts, but almost none discloses projections of the future path for the interest rate policy instrument (or projections for output).[18] All inflation targeting central banks have engaged in publication of inflation reports. These reports describe and explain the goals of monetary policy, the numerical values of the inflation targets, projections of inflation and other relevant variables, risks to

[18] Except for the Reserve Bank of New Zealand and the Norges Bank.

achieve the targets, etc. Most of the projections are based on the assumption of a constant interest rate.

Table 6. Selected Countries: Assumptions, Publication, and Communication

	Assumptions on Inflation Forecasts	Publication of Cross-Market Comparison of Inflation Projections/ Use of Inflation Expectations Surveys (IES)	Publication of Inflation Forecasting Models/ Internet Access	Revision of Inflation Forecasts/ Is the Inflation Forecast Horizon Constant?	Board Influence on Preparation of Inflation Projections/ Who Participates in the Discussions on Inflation Forecasting?
Australia	Constant interest/exchange rates	No/ Monitor IESs	No/ Available on request	8 times a year/ ..	No/ Staff
Chile	Interest rates based on forward curve	Yes/ Yes	Yes/ Yes	3 times a year/ Yes	Yes/ Board and staff
Colombia	Interest rates based on policy rule	No, but publish a summary of market projections/ Monthly and quarterly IES's	Yes/ Available on request	Monthly updates and a major revision every quarter/ Yes, 8 quarters	Yes (as an alternative to the base scenario)/ Technical staff and representatives from the ministry of finance
Czech Republic	Interest rates based on policy rule and the yield curve; exchange rates based on uncovered interest rate parity approach and backward- and forward-looking elements of FX market	No, but use for internal purposes/ Yes	Yes/ Yes (but not the databases)	Quarterly/ Yes, 8 quarters (a detailed time schedule is used)	Yes/ Board and staff
Peru	Constant interest rate, or a path that corresponds to a future inflation target	No/ Use surveys as an indicator variable	Yes/ Yes	3 times a year for published forecasts and monthly for internal/ One or two calendar years	No/ Board and staff
Turkey	Interest rates based on policy rule, and constant interest rate.	No, only internal comparisons are done/ Yes	No/ Yes	Quarterly / Yes. 6 quarters.	Yes / Board and staff.

Source: National authorities.

Notwithstanding that inflation forecasts are usually publicly released, projections of the policy interest rate path remain private to the central bank. Following the practice of several inflation targeting countries, it would be advisable to simply focus on the inflation forecast and its target and not on the policy rate path. The latter might complicate the communication process and the central bank's accountability.

C. Improving the Framework over Time

Some central banks opened their doors to independent reviews. The Bank of England invited Donald Kohn of the Board of Governors of the Federal Reserve System, who was then the Director of Monetary Affairs, for a review of the MPC procedures. Kohn was asked to assess the material presented to the MPC, the work of the staff team that provides these materials, the efficiency and effectiveness of the forecast process, and the contribution of the inflation report to enhancing the transparency of monetary policy. Kohn's report and the staff's response to it were later published (Bank of England, 2001). Later on, the Bank of England invited Prof. Adrian Pagan, a noted econometrician and a former Reserve Bank of Australia Board Member, for a review of its modeling and forecasting techniques (Bank of England, 2003).

The Government of New Zealand initiated a comprehensive review of New Zealand's monetary policy framework in May 2000. Professor Lars Svensson's report, its terms of reference, several supporting documents, and reactions were published on the Reserve Bank of New Zealand Web site.[19] In Norway, the Centre for Monetary Economics[20] (CME) each year asks a committee of independent economists to assess Norges Bank's monetary policy. The annual CME reports not only evaluate the decisions taken by the Norges Bank in the preceding year, but also address some specific issues related to the monetary policy framework. For example, the 2004 and 2005 reports contain comments on the role of exchange rates under inflation targeting, on the new calibrated macroeconomic model of the bank, and on escape clauses.

Flexibility of the forecasting framework is required to allow the use of different techniques over time. The forecasting team's understanding of the transmission mechanism is likely to change with innovations in theory, data management techniques and instruments, and, of course, structural changes in the economy that affect the transmission mechanism. The forecasting team is also likely to learn from its mistakes. The forecasting methodology must be flexible enough so as to benefit from lessons learned by doing.

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[19] http://www.rbnz.govt.nz/monpol/review/index.html.

[20] The CME is affiliated with the Norwegian School of Management, and is privately funded. See www.bi.no for CME reports.

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Data Availability

Country	Vital Data for Monetary Policy Formulation	Initial Shortage of Data (Right after Adopting IT)	Improved Data Availability	Is the IT Regime More Data Intensive	Data/Indicators Constructed Within the CB	Developing Internal Data (or looking for New External Data Sources) after Adopting IT	Data Reliability Issues	Monitoring of the Market (Private Sector) Forecasts
Brazil	**Real**: GDP; Industrial Production; Consumer Expenditure; Business Investment; Trade Volumes; Gov't Expenditure; Gov't Revenues; Real Exchange Rate; Terms of Trade; Unemployment; **Nominal**: CPI; PPI; WPI; Admin. Prices; Money Wages; Nominal Exchange Rate; Oil Prices; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices; Credit Aggregates	Unit labor costs and productivity. Important issue was extremely short period of low inflation before the adoption of IT. To estimate the Phillips curve, the sample size was less than five years	Yes. The customer relationship with the statistical agency (IBGE) has improved. For example, for IPCA we now have breakdowns into tradables/ nontradables, relative prices, administered prices, indexed prices, etc.	Yes	BOP; monetary aggregates; fiscal statistics; administered prices; core inflation	Administered prices; surveys of inflation expectations; core inflation series	Problems with the length of data series due to the inflation. In addition, the IBGE has changed the way it produces unemployment data, as well as retail and wholesale sales data, which created breaks that complicate our estimation. Need of more exhaustive national coverage of money wages and unemployment data.	Yes, the CB surveys market forecasts of inflation. These are used as additional information about future inflation and in the forecast models. It started after IT adoption, since there were no surveys of inflation expectations before
Chile	**Real**: GDP; Business Investment; Real Exchange Rate; Terms of Trade; Foreign GDP; **Nominal**: CPI; Money Wages; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Commodity Prices (e.g. copper)	No	The quality of the data and the way we process the data have improved enormously (including seasonal adjustment, the construction of meaningful ratios etc). We are pushing for improvements regarding labor market data. National accounts are produced at the CB. From outside we get prices and all other data that is not national accounts. E.g., in the construction of CPI we now make the weights dependent	Yes. E.g., we now need to decompose production and inflationary pressures from the mining sector, as opposed to other sectors. This is necessary because price developments in this sector are so different from price developments and market structures in other sectors of the economy	National accounts; BOP; monetary aggregates; bank loans and deposits; and interest rates	Yes (see data availability)	Labor market data, splitting metal mining sector from rest of the economy in the models and thus in the data are examples of data problems/issues we face. The quality of data keeps being poor, especially national accounts data. Trying to improve these data by introducing official quarterly GDP data, which we did not have before. Face a number of other data issues. For example, we can only build GDP data from the output (supply-side) side. So we cannot distinguish movements to GDP from consumption expenditure or from inventories. On the supply side we miss data on sector GDP (we only have yearly data and with a long lag) so we cannot isolate changes in GDP output from mining say or agriculture. This is problematic because sometimes these sectors	Yes. We collect this information via official CB surveys. It is shown to the Board and used to cross-check the forecasts from our models. We also look at consensus forecast and at information on inflation expectations from asset prices. We also look at what individual (hand-picked) market analysts say. Surveys of inflation expectations or information from asset prices was not available before IT adoption

Country	Vital Data for Monetary Policy Formulation	Initial Shortage of Data (Right after Adopting IT)	Improved Data Availability	Is the IT Regime More Data Intensive	Data/Indicators Constructed Within the CB	Developing Internal Data (or looking for New External Data Sources) after Adopting IT	Data Reliability Issues	Monitoring of the Market (Private Sector) Forecasts
			on price elasticities. The bias to CPI from leaving this out is something we noted because we do IT and we monitor CPI and its components so closely now				behave very different from more mainstream sectors and their cycles are not synchronized with the business cycle. We also miss high-frequency conjunctural data on employment, participation and so forth. All we have are from household surveys but these are often very volatile and/or unreliable	
Colombia	**Real**: GDP; Consumer Expenditure; Business Investment; Inventories; Gov't Expenditure; Real Exchange Rate; Terms of Trade; Foreign GDP; **Nominal**: CPI; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Foreign Interest Rates; Commodity Prices; House Prices	No	Yes , and also how we manage the data internally has improved enormously	No	Output and real exchange rate gap; PPI; BOP statistics	No	Consumption is not very reliable because it is calculated as a residual	..
Mexico	**Real**: GDP; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't Transfers; Real Exchange Rate; Terms of Trade; Employment; **Nominal**: CPI; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices (agricultural, metals)	No	Yes (e.g. seasonally adjusted data). Another improvement is related to data releases. As of today, most data is released according to the previously announced calendar	Yes. We now have more data and have more resources dedicated to analyzing and producing the data. The forward-looking information receives much more attention than 10 years ago	Price indices; monetary aggregates; public sector data; financial sector data	Yes	Minor	Yes. The CB monthly survey includes inflation and GDP expectations
Peru	**Real**: GDP; Consumer Expenditure; Business Investment; Gov't Expenditure; Gov't Revenues; Real Exchange Rate; Terms of	Several T-bill rates, long-term interest rates and interbank rates, which are	No	Yes, we now use surveys of macroeconomic expectations and indicators for	Core inflation; quarterly GDP derived from monthly data on industrial	Core inflation measures	Problems with collection of GDP (index of national production) statistics	The CB conducts monthly surveys of macro expectations (about inflation, GDP, growth, interest rates, depreciation) among financial and nonfinancial institutions

Country	Vital Data for Monetary Policy Formulation	Initial Shortage of Data (Right after Adopting IT)	Improved Data Availability	Is the IT Regime More Data Intensive	Data/Indicators Constructed Within the CB	Developing Internal Data (or looking for New External Data Sources) after Adopting IT	Data Reliability Issues	Monitoring of the Market (Private Sector) Forecasts
	Trade; Foreign GDP; Consumer Confidence Index; **Nominal**: CPI; WPI; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices (metals, soybeans, wheat, oil); Money Aggregates; Expectation Surveys. The data are available monthly, starting from 1994.	available only since 1995		inflationary pressures in a more intensive way	production; survey of expectations			
Israel	**Real**: GDP; Industrial Production; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't Transfers; Real Exchange Rate; Terms of Trade; Employment; Unemployment; **Nominal**: CPI; WPI; Consumption Deflator; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices; Money Aggregates; Credit Aggregates; House Prices; Asset Prices; Market-based data including break-even inflation expectations and information from option prices	Forex options (coped by increasing flexibility of exchange rate and maturing development of options)	Not meaningfully	Yes	Yes, primarily market-derived information	Market-derived information	..	Yes. This was done on very small scale prior to IT
South Africa	**Real**: GDP; GNE; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP;	Inflation expectations survey data. The central bank commissioned an independent research institution to survey inflation	Yes, inflation expectations survey data	Yes	Monetary and credit aggregates; BOP; the expenditure side of the national accounts; certain government finance statistics	Yes, inflation expectations survey	Revision of credit aggregates to remove excess volatility associated with derivatives treatment under the new accounting standards	Yes. The information was monitored prior to IT adoption

Country	Vital Data for Monetary Policy Formulation	Initial Shortage of Data (Right after Adopting IT)	Improved Data Availability	Is the IT Regime More Data Intensive	Data/Indicators Constructed Within the CB	Developing Internal Data (or looking for New External Data Sources) after Adopting IT	Data Reliability Issues	Monitoring of the Market (Private Sector) Forecasts
	Nominal: CPI; PPI; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Commodity Prices (agricultural and mining); Money Aggregates; Credit Aggregates; House Prices; Asset Prices; Inflation Expectations Survey; Unit Labor Costs; Balance of Payments Current and Financial Accounts	expectations						
Hungary	**Real**: GDP; Industrial Production; Consumer Expenditure; Business Investment; Trade Volumes; Real Exchange Rate; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; House Prices	No	No	Yes. More sectoral information is used	Nominal wage data correction for minimum wage changes; sectoral investment data	No	Data revisions are frequent (also revisions of seasonal adjustments)	The CB funds a survey on inflation expectations. The Inflation Report contains a scenario calculated with market interest and exchange rate forecast. The surveys were analyzed before IT adoption.
Poland	**Real**: GDP; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't Transfers; Real Exchange Rate; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; PPI; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates;	Wage settlements; house prices; consumption deflator	No	Yes. Confidence indicators (including inflationary expectations); core inflation indicators	Core inflation; inflationary expectations of private individuals	Yes. Core inflation; inflationary expectations	Low reliability of quarterly national accounts data. Also, data is released with a long time lag	Yes, market forecasts of GDP and inflation are monitored

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	Commodity Prices (food prices)							
Czech Republic	**Real**: GDP; GNE; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't Transfers; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; PPI; Consumption Deflator; Admin. Prices; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices (natural gas); Money Aggregates; Credit Aggregates	No	Yes	No	Net inflation; adjusted inflation; regulated prices (definition)	Consensus forecast publication	No	Yes. Qualitative assessment in Situation report, collection by CNB statistics department (inflation expectations), monitor of market forecasts (inflation) and EU, OECD, IMF forecast (for consistency check)
Korea	**Real**: GDP; GNE; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; PPI; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices; Money Aggregates; Credit Aggregates; House Prices; Asset Prices	No	No	Yes. Vast range of data is needed to formulate inflation forecast	GDP series; monetary aggregates; flow of funds; PPI; import and export price indices; BOP statistics; input-output table	Inflation expectations	Statistics Dept. of the CB is taking the lead role in improving data reliability (data accuracy and timeliness, better data compilation methods, etc.)	Yes. Outside forecasts are compared with the CB's internal forecasts and discrepancies are carefully analyzed

Country	Vital Data for Monetary Policy Formulation	Initial Shortage of Data (Right after Adopting IT)	Improved Data Availability	Is the IT Regime More Data Intensive	Data/Indicators Constructed Within the CB	Developing Internal Data (or looking for New External Data Sources) after Adopting IT	Data Reliability Issues	Monitoring of the Market (Private Sector) Forecasts
Philippines	**Real**: GDP; GNE; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't Transfers; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; PPI; WPI; Urban CPI; Rural CPI; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices (rice, corn, selected vegetables); Money Aggregates; Credit Aggregates; House Prices; Asset Prices; Other: transport fares; utilities (electricity and water); energy sales; car sales; corporate profits; domestic and international oil prices, business expectations; consumer expectations; private sector inflation and GDP forecasts	Core inflation measure; survey-based inflation expectations measure; housing prices; transport fares; utilities; energy sales; car sales; corporate profits; business expectations; consumer expectations	Yes	Yes	Core inflation (trimmed mean; weighted mean; net of volatile items); BOP; business expectations survey and consumer expectations survey	Indices of business and consumer confidence, based on surveys conducted by the CB	Rebasing the CPI data from 1994 to 2000	Yes, the CB conducts a quarterly survey of the private sector GDP and inflation forecasts (used as indicators of inflation expectations). This information has been collected since the adoption of IT
Thailand	**Real**: GDP; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Terms of Trade; Foreign GDP; **Nominal**: CPI; PPI; Consumption Deflator; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Foreign Interest Rates; Commodity Prices; Money Aggregates; Credit	Labor market data, property prices and capital stock needed to formulate potential output	Yes. In addition, an asset price equation has been incorporated into the macroeconometric model since October 2005	Yes (more organized)	M2; interest rates; bank lending, etc.	The CB requested the Ministry of Commerce to provide core inflation data and the NESDB to provide quarterly GDP data	No	Yes, the Inflation Report includes inflation forecasts provided by various research houses

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	Aggregates							
Australia	**Real**: GDP; GNE; Consumer Expenditure; Business Investment; Trade Volumes; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; PPI; WPI; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices; Credit Aggregates; House Prices; Asset Prices	No	No	No	Yes, financial aggregates; commodity price index; trade-weighted exchange rate	No	Housing price data are of poor quality	Yes, information on inflation expectations from private sources is included in the briefing material for the Board and in the monetary policy statements
Canada	**Real**: GDP; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't Transfers; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; Consumption Deflator; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices; Money Aggregates; Credit Aggregates; House Prices; Asset Prices	No	No	Yes, there is a greater demand for in depth analysis of disaggregated data (e.g. CPI components)	Money data, credit data, measures of core inflation	Compile a database for the Business Outlook Survey (a quarterly survey of Canadian businesses)	i) The volatility and large revisions of monthly international trade data; ii) the quality of prices of services data. The Bank is currently consulting with Statistics Canada regarding ways to improve these data	Yes, the Staff projection is compared to the average private sector forecast. The inflation forecast data is used as a measure of inflation expectations. This information was also collected prior to IT
Iceland	**Real**: GDP; GNE; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure;	Lack of high frequency data on leading indicators, such as inventories	Yes	Yes. More comprehensive data on prices (e.g. measures of core inflation)	BOP; monetary aggregates; credit, interest rates and exchange rates. The Bank also	Examples of new data from outside sources are different measures of	Issues concerning the reliability of the quarterly national accounts. To address issues a series of meetings with other end-users and Statistics Iceland is being set up	Yes, the CB surveys private banks forecasts of inflation, output and other key economic variables - among them the Bank's policy rate. These forecasts are compared to the Bank's forecast to

Country	Vital Data for Monetary Policy Formulation	Initial Shortage of Data (Right after Adopting IT)	Improved Data Availability	Is the IT Regime More Data Intensive	Data/Indicators Constructed Within the CB	Developing Internal Data (or looking for New External Data Sources) after Adopting IT	Data Reliability Issues	Monitoring of the Market (Private Sector) Forecasts
	Gov't Revenues; Gov't Transfers; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; Other: real interest rates; productivity; unit labor costs; conditions of fishing stocks; fishing quota allocation; **Nominal**: CPI; Consumption Deflator; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices (fish, aluminum, international non-oil prices); Money Aggregates; Credit Aggregates; House Prices; Asset Prices	and industrial production. Data on inventories are restricted to goods for exports. This data are available at an annual frequency. Data on industrial production only available annually, and with an 18 months lag.			constructs measures of the output gap	core inflation. An example of internally generated data is implied forward interest rates to give a path for the policy rate used in forecasting		try to understand reasons for deviations. This information was not collected prior to IT

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New Zealand	**Real**: GDP; GNE; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't Transfers; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; PPI; Consumption Deflator; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices; Money Aggregates; Credit Aggregates; House Prices; Asset Prices	Difficulties with seasonal adjustment around extreme outliers (e.g. power crises). Good measures of unit labor costs were not available	Yes	Yes	Output gap; several missing variables from the national accounts; several inflation measures; credit and financial data	Yes	..	Yes. Divergences between the Bank's forecasts and those of the private sector are monitored and the reasons for those divergences are closely scrutinized and assessed
Norway	**Real**: GDP; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't Transfers; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; PPI; WPI; Consumption Deflator; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices; Credit Aggregates; House Prices; Other: inflation expectations data	Inflation expectations survey data, measures of underlying inflation; output gap	No	No	Credit aggregates; output gap; data based on the Regional Network	Yes. Output gap; inflation expectations; data based on the Regional Network	Dialog with Statistics Norway on improving certain elements of the CPI and expectations surveys	Yes, for cross-check with the Bank's forecasts purposes. The data was collected prior to IT adoption

Country	Vital Data for Monetary Policy Formulation	Initial Shortage of Data (Right after Adopting IT)	Improved Data Availability	Is the IT Regime More Data Intensive	Data/Indicators Constructed Within the CB	Developing Internal Data (or looking for New External Data Sources) after Adopting IT	Data Reliability Issues	Monitoring of the Market (Private Sector) Forecasts
Sweden	**Real**: GDP; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't Transfers; Real Exchange Rate; Terms of Trade; Employment; Foreign GDP; **Nominal**: CPI; PPI; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices; Money Aggregates; Credit Aggregates; House Prices; Asset Prices; Other: inflation expectations	Survey-based data on long-term inflation expectations	Yes	Yes	Several measures of underlying inflation	Yes, survey on inflation and wage expectations	..	Yes, as a check of our own forecasts and when assessing the outcome of the forecast
Switzerland	**Real**: GDP; Industrial Production; Consumer Expenditure; Business Investment; Trade Volumes; Gov't Expenditure; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; WPI; Consumption Deflator; Admin. Prices; Money Wages; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Money Aggregates; Credit Aggregates; House Prices	Problems with quarterly estimation of the GDP and money wages, late arrival of official national-accounting data, etc.	No	Yes. The new strategy involves more complete models of the economy and requires more data series that are econometrically suitable (long series, if not available construction of longer series, need identification of structural breaks, etc.)	Monetary aggregates and credit series; trade-weighted nominal and real exchange rate series; estimation of potential output and output gap; some core inflation measures	Yes, new core inflation indices (e.g. a trimmed-mean core inflation). As external source of data, a more extensive use of data downloaded from Datastream, Reuters, etc.	Estimates of national-accounting quarterly data may raise reliability issues. Data on national accounts are collected only at a yearly frequency in Switzerland. However, quarterly estimates exist computed by the Confederation. A collaboration of our economists and those of the Federal Statistical Office and the State Secretariat for Economic Affairs help to tackle with these problems	Yes, the forecasts were already monitored with the monetary targeting strategy
U.K.	**Real**: GDP; GNE; Industrial Production; Consumer Expenditure; Business Investment; Inventories; Trade Volumes; Gov't Expenditure; Gov't Revenues; Gov't	No	Yes	Some more data are available, although this is not necessarily related to inflation targeting	The Bank of England compiles money and credit statistics. In addition, for many data series used in	No	Bank Staff continually assess the quality of official and other statistics in all areas relevant to monetary policy. Issues of reliability - of varying degrees of importance - arise regularly, and Bank Staff have	Yes, these data are collected and presented to the MPC at monthly meetings in advance of their policy decision and also during the forecast round, at the stage where a draft forecast has been prepared; the staff

Country	Vital Data for Monetary Policy Formulation	Initial Shortage of Data (Right after Adopting IT)	Improved Data Availability	Is the IT Regime More Data Intensive	Data/Indicators Constructed Within the CB	Developing Internal Data (or looking for New External Data Sources) after Adopting IT	Data Reliability Issues	Monitoring of the Market (Private Sector) Forecasts
	Transfers; Real Exchange Rate; Terms of Trade; Employment; Unemployment; Foreign GDP; **Nominal**: CPI; PPI; WPI; Consumption Deflator; Admin. Prices; Money Wages; Wage Settlements; Nominal Exchange Rate; Oil Prices; T-Bill/Money Market Rates; Long-term Interest Rates; Foreign Interest Rates; Commodity Prices; Money Aggregates; Credit Aggregates; House Prices; Asset Prices; Other: Business Surveys and Indicators and Agents' reports				policy formulation we make various transformations of published data from other sources; we refer to as complex variables.		an ongoing dialogue with the Office for National Statistics and other data providers. The ONS consults closely with Bank staff on proposed changes/improvements to official data. And as part of the Service Level Agreement between the Bank and the ONS, the Monetary Policy Committee provides a formal annual assessment of the ONS's performance. Specific areas of improvement that the Bank has encouraged the ONS to focus resources on are: improved measures of service sector output; the development of a measure of private sector output; the development of a survey of household wealth; improved estimates of the capital stock; further development of corporate services price indices; and chain-linking of PPIs.	provides systematic comparisons with forecasts produced using other models in the Bank's suite and with the forecasts of outside bodies. These comparisons help the Committee to take a 'top-down' perspective, and assess whether the overall shape of the forecast and the attendant risks is plausible. Sometimes, as a result of this process, the Committee asks for further adjustments to the projections, and the timetable makes provision for a further meeting if necessary

Source: Central banks' self assessments as part of the underlying survey of the WEO, September 2005.

Competing Empirical Forecasting Approaches

Forecasting methods might be applied to activity series and to lower levels of data aggregation, such as CPI subcomponents and sectoral industrial production indicators. Following Marcellino, Stock and Watson (2003), it is possible to review competing forecasting approaches and the criteria to evaluate their comparative merits. Competing forecasting approaches can be characterized, specified and estimated as a linear projection of an h-step-ahead variable, y_{t+h}^{h}, onto t-dated predictors, including lagged transformed values of the series under study. In general, forecasting models might adopt the following specification:

$$y_{t+h}^{h} = \mu + \alpha(L)y_t + \beta(L)'Z_t + \varepsilon_{t+h}^{h} \qquad (1)$$

where $\alpha(L)$ represents a scalar lag polynomial, $\beta(L)$ is a vector lag polynomial, μ is a constant, and Z_t is a vector of predictor variables. Forecasting models differ in their specification, design and choice of vector Z_t:

Autoregressive forecast: Univariate autoregressive (AR) forecast excluding choosing the lag length using an information criterion such as Bayesian Information Criteria.

Autoregressive forecast with second differencing: When structural breaks are present—as it is the case in several emerging economies subject to economic and institutional shocks—Clements and Hendry (1999) showed that second differencing the variable of interest (i.e., excluding and treating the variable of interest as I(2)) improves the forecasting abilities of AR models.

Autoregressive forecast with intercept correction: Clements and Hendry (1999) and Artis and Marcellino (2001) showed that adding the h-step ahead forecast error when structural breaks are present, improves the forecasting performance of AR models.

Autoregressive forecasts with exogenous regressors: Exogenous regressors can be added to AR models to improve predictive performance. The forecasts are based on fixed lag structure and BIC selected model.

VAR forecasts: Constructed with chosen regressors. Among their strengths, VAR models represent dynamic systems using minimal assumptions about underlying structure of the economy. They do not impose many conditions except for a minimum of linearity, and an optimal lag length. Structural VARs are a step towards more comprehensive structural models. However, there are some vulnerabilities. Estimation problems increase as the number of variables and lags included in the system rises (overfitting).

Factor-based forecasts: Following Stock and Watson (2003), these models are based on estimated factors from a large data set. Factors should be extracted from the information data set under consideration.

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