The Uncertainty of the Economic Outlook and Central Banks' Communications

Monetary Affairs Department
Koji Nakamura and Shinichiro Nagae

June 2008

Central Banks make policy decisions based on their outlook for economic activity and prices. They pay attention not only to central projections, but also to the projection uncertainty and the balance of risks. Central banks place importance on evaluations of the uncertainty and the balance of risks in their communications. They use various methods suitable to each bank's situation, such as the Bank of Japan's "Risk Balance Chart" published this April. When evaluating the uncertainty of economic projections, the historical forecast error is one reference. The real GDP growth and CPI inflation forecast errors for one year ahead are large in each economy, at about one percent for real GDP growth and 0.5 percent to one percent for CPI inflation.

1. Introduction

Central banks make policy decisions based on their outlook for economic activity and prices. Since there is a considerable lag between the implementation of monetary policy decisions and their effect on real GDP and prices, central banks need to evaluate the impacts of their policy decisions on the economy and prices from a long-term perspective. In view of this, many central banks publish economic projections of real GDP growth and inflation. Central banks publish not only the most likely projections, but also the uncertainty surrounding them and the balance of risks for upward and downward deviations.

In this review, we survey the communications strategies of central banks regarding the uncertainty surrounding economic projections and the balance of risks. In addition, we survey the forecast errors of real GDP growth and CPI inflation for each economy as references for future forecast errors.

2. Communications regarding the Uncertainty of Economic and Price Projections

In this section, we survey the communications strategies of central banks regarding the forecast uncertainty and the balance of risks.

(1) Bank of England

The Bank of England is a pioneer in publishing probability distributions of real GDP growth and consumer inflation as fan charts, indicating the uncertainty surrounding economic projections and the balance of risks (Chart 1). The Bank of England has been publishing fan charts of real GDP growth and consumer inflation projections four times a year since 1996 in its Inflation Report. When drawing fan charts, Monetary Policy Committee (MPC) members agree on the probability distributions with their best collective judgment. MPC members need to agree on the three parameters of the probability density functions: mode, standard deviation, and skewness. When deciding the standard deviations of the fan charts, MPC members generally consider historical forecast errors as a reference.

Chart 1: Bank of England's Fan Charts

Real GDP growth (y/y % chg.)
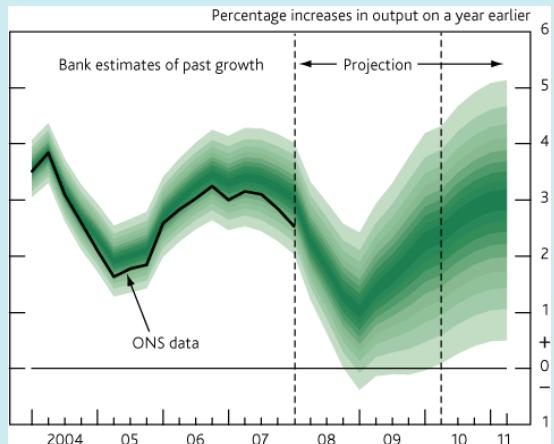
Consumer Price Index (y/y % chg.)
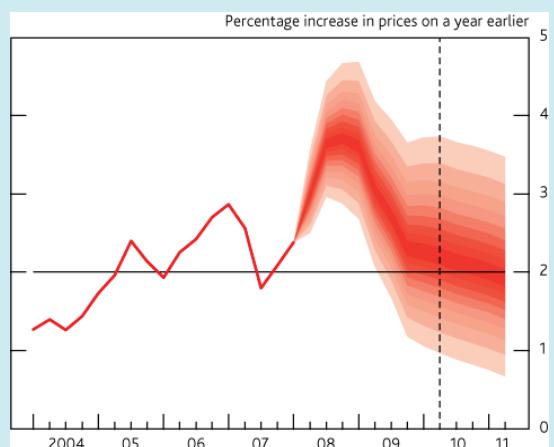
Source: Bank of England.

However, MPC members may use different standard deviations than the historical forecast errors, taking into account the economic situation going forward. MPC members also need to decide the balance of risks, giving due consideration to current and future economic conditions. If the balance of risks is considered to be even, a symmetric distribution such as a normal distribution is assumed. However, if MPC members believe there are larger downside risks of exogenous shocks (such as developments in the overseas economy), the likely distributions of real GDP growth and inflation may be skewed downwards.

(2) Federal Reserve

The Federal Open Market Committee (FOMC) of the Federal Reserve announced a new communication strategy to increase transparency in November 2007. This included extension of the projection horizon, increase in the frequency of projections, and publication of fuller discussions on the projections in the FOMC meeting minutes. The FOMC minutes contain participants' discussions regarding: (1) the most likely projections for the economic outlook, (2) the risks to the outlook and the balance of risks, and (3) the diversity of FOMC participants' views on the economic outlook.

The outlook gives the range of the participants' projections and the central tendency excluding the three highest and three lowest projections. In addition, the distributions of FOMC participants' projections are shown with bar charts, indicating the diversity of participants' views on real GDP growth and inflation (Chart 2). The bar charts show the different central projections of individual FOMC participants, but do not indicate the balance of risks regarding those central projections. The minutes include qualitative discussions on the uncertainty of the projections and the balance of risks. They also include discussions on the potential forecast errors of the projections, which are compared with historical forecast errors.

Chart 2: Distribution of FOMC Participants' Projections

Real GDP Growth (y/y % chg.)
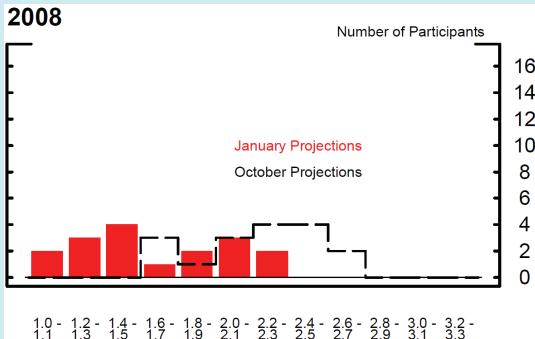
Core PCE Inflation (y/y % chg.)
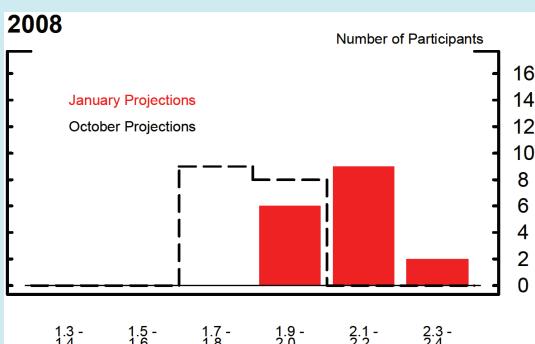

Source: Federal Reserve.

(3) Bank of Japan

The Bank of Japan publishes the "Outlook for Economic Activity and Prices" (Outlook Report) twice a year. The Outlook Report includes discussions on the most likely economic and price projections, and about the risks to those projections. Specifically, the Outlook Report presents the range of forecasts of the majority of Policy Board members (the highest and lowest projections are excluded), the median forecasts, and the range of forecasts of all Policy Board members for the year-on-year growth rates of real GDP, the domestic Corporate Goods Price Index (CGPI), and the CPI excluding fresh food. In April 2008, the Bank of Japan released the aggregated probability distributions of the annual growth rates of real GDP and the CPI excluding fresh food, complied from the distributions given by individual Policy Board members on the likelihood of divergence upward and downward from their most likely projections (Risk Balance Chart, Chart 3). The Risk Balance Chart quantitatively presents the uncertainty of the outlook and the balance of risks.

The MPC members of the Bank of England agree on a single fan chart based on their best collective judgment. In contrast, the Bank of Japan's Risk Balance Chart represents the average of the probability distributions assumed by individual Policy Board members. The aggregated distributions include information not only on the diversity of members' views regarding the most likely projections, but also on individual members' uncertainty regarding their own projections. Thus the probability distributions reflect various views of the Policy Board members, and show the average view on the balance of risks. The Risk Balance Chart is a device for expressing the collective view of the Policy Board regarding the uncertainty and the balance of risks under a committee structure.

When making monetary policy decisions, the Bank of Japan pays attention not only to the uncertainty of real GDP growth and CPI inflation as shown in the Risk Balance Chart, but also to other factors such as developments in asset prices and financial markets. Moreover, the Bank has to give due consideration to risks affecting the economy and inflation beyond the

Chart 3: Risk Balance Charts for FY 2008

Real GDP Growth (y/y % chg.)
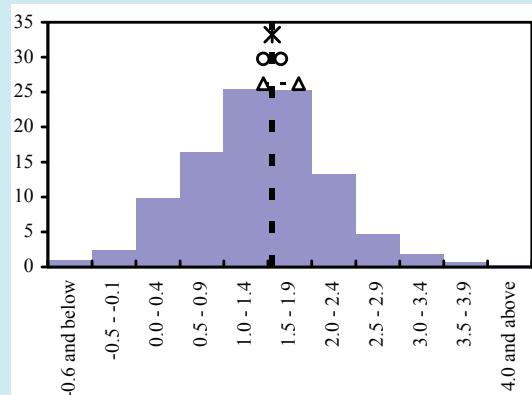
CPI (Excluding Fresh Food, y/y % chg.)
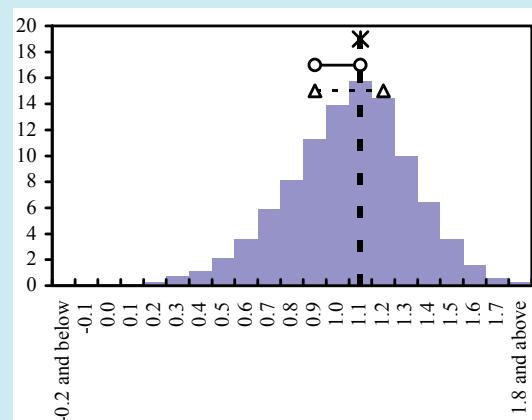
Notes: 1. Vertical axes in the charts represents probability (%), while horizontal axes represent the year-on-year percentage changes in the respective indicators.
2. * on the dashed line indicates the median of the Policy Board members' forecast (point estimates).
3. o——o indicates the range of the forecasts of the majority of Policy Board members.
4. △·····△ indicates the range of the forecasts of all Policy Board members.

Source: Bank of Japan.

two-year forecast horizon. The Outlook Report analyzes those factors in detail in its main text. The comprehensive qualitative assessments in the Outlook Report complemented by the quantitative information in the Risk Balance Chart provide appropriate information for the public to accurately grasp the Bank's evaluation of uncertainty and the balance of risks.

(4) Other Central Banks

The European Central Bank (ECB) publishes ranges of projections for the annual growth rates of real GDP and HICP inflation. These ranges are decided based on the historical forecast errors. The

Chart 4: Riksbank's Fan Charts

Real GDP Growth (y/y % chg.)
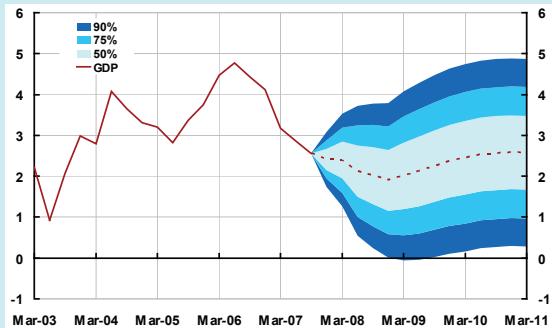
Consumer Price Index (y/y % chg.)
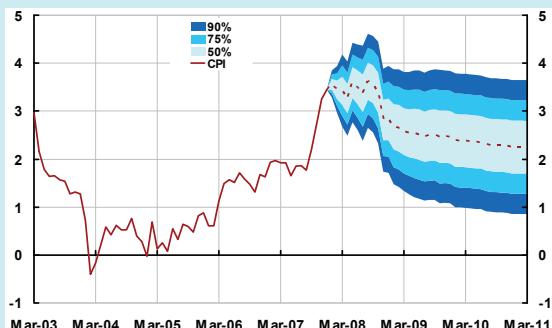
Source: Riksbank.

ECB's projections are staff projections, and neither the Governing Council nor its members are involved. Sweden's Riksbank and Norway's Norges Bank publish fan charts to express the uncertainty and the balance of risks, like the Bank of England (Chart 4). Riksbank also publishes alternative projections in addition to fan charts. In April 2006, the International Monetary Fund (IMF) began to include fan charts of world real GDP growth projections in its World Economic Outlook (Chart 5). The IMF and the above-mentioned central banks provide qualitative assessments of the uncertainty surrounding their projections and the balance of risks in addition to

Chart 5: IMF's Fan Chart

Real GDP Growth (y/y % chg.)
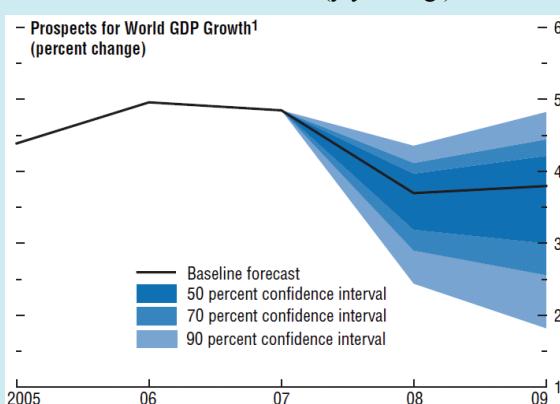
Source: IMF.

employing the visual expression of fan charts.

3. Forecast Errors of Economic Projections

Historical forecast errors provide a good reference for assessing future uncertainty surrounding economic and inflation projections. Accordingly, central banks study the historical forecast errors of their economic projections and use them for evaluation of future forecasts.

Based on empirical studies of each economy, the historical forecast errors for the annual growth rate of real GDP are about one percent for one year ahead and range from one to 1.5 percent for two years ahead. If we assume a normal distribution for the forecast errors with a standard deviation equivalent to the historical forecast error, one percent in this case, the realized outcomes fall within a range of the central projection plus or minus one percent with a probability of about 70 percent, and within the range of the central projection plus or minus two percent with a probability of about 90 percent (Chart 6).[1]

Chart 6: Forecast Error Distribution
(A case of normal distribution with 1% standard deviation)

The realized outcomes fall within a range of the central projection plus or minus one percent with a probability of about 70%

The realized outcomes fall within a range of the central projection plus or minus two percent with a probability of about 90%
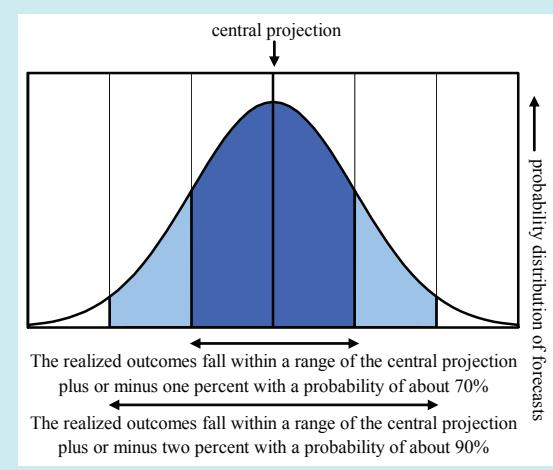
The forecast errors for the annual inflation rate of consumer prices range from 0.5 to one percent for both one and two years ahead. These are smaller than the forecast errors for the annual growth rates of real GDP, with some differences among economies.

In the rest of this section we survey the forecast errors for major overseas economies, examine forecast errors in Japan, and finally consider the sources of the forecast errors.

Bank of Japan June 2008

Table 1: Forecast Errors for Real GDP Growth and CPI in Overseas Economies

(y/y % chg.)

	Real GDP Growth			Consumer Price Index		
	1 year ahead	2 years ahead	3 years ahead	1 year ahead	2 years ahead	3 years ahead
United States	1.2	1.4	1.4	1.0	1.0	0.9
Euro Area	1.0	1.3	----	0.6	0.5	----
United Kingdom	0.9	1.3	1.4	0.6	0.8	0.8
Sweden	1.2	1.4	1.4	0.7	0.8	0.9
Norway	1.1	1.2	1.3	0.9	1.0	1.1

(1) Forecast Errors in Major Economies (Table 1) [2]

Reifschneider and Tulip (2007) conducted a comprehensive empirical analysis on the forecast errors of the U.S. economy, including private sector forecasts, in conjunction with the FOMC's new communication strategy instituted in November 2007.[3] Their analysis shows that the forecast error for the annual growth rate of real GDP is 1.2 percent for one year ahead, 1.4 percent for two years ahead, and 1.4 percent for three years ahead, and that the forecast error for the annual CPI inflation rate is 1.0 percent for one year ahead, 1.0 percent for two years ahead, and 0.9 percent for three years ahead.[4] Moreover, they confirm that the realized values are within a range equal to zero plus or minus one RMSE with a probability of about 70 percent. Thus it may be considered appropriate to evaluate forecast errors based on a normal distribution with a standard deviation of one RMSE.

The forecast error for the annual growth rate of real GDP in the euro area is 1.0 percent for one year ahead, and 1.3 percent for two years ahead. The forecast error for the HICP inflation rate in the euro area is 0.6 percent for one year ahead and 0.5 percent for two years ahead. The forecast error for the annual growth rate of real GDP in the United Kingdom is 0.9 percent for one year ahead and 1.3 percent for two years ahead. The forecast error for the annual CPI inflation rate in the United Kingdom is 0.6 percent for one year ahead and 0.8 percent for two years ahead.[5] Similar results are obtained for other countries.

(2) Japan

The Bank of Japan (BOJ) started to publish forecasts of the annual growth rate of real GDP, the annual inflation rate of domestic CGPI, and the annual CPI inflation rate in October 2000. Although sufficient data have not accumulated for reliable quantitative analysis, we still review the historical forecast errors.[6] The BOJ forecast error for one year ahead is 1.0 percent for the annual growth rate of real GDP (Table 2) and 0.2 percent for CPI inflation, which is quite small reflecting the low level of inflation during the analysis period. The forecast error of the average of the private forecasters is 1.2 percent for the annual growth rate of real GDP and 0.2 percent for CPI inflation.[7]

Table 2: Forecast Errors in Japan
(Spring Projections for FY 2001-2007)

Real GDP Growth (y/y % chg.)[1]

	RMSE	MAE
Bank of Japan	1.0	1.0
Private Average[2]	1.2	1.0

CPI (Excluding Fresh Food, y/y % chg.)

	RMSE	MAE
Bank of Japan	0.2	0.2
Private Average[2]	0.2	0.2

Notes: 1. Actual figures are based on the latest available data.
2. Average of private sector forecasts. Data for CPI (excluding fresh food) are for FY 2004-2007.

Next, we look at the forecast errors using longer term time series data on forecasts by the private forecasters.[8] Here the average forecast error for one year ahead is 1.7 percent for the annual growth rate of real GDP and 0.7 percent for CPI inflation (Table 3). Using all the sample data rather than the average data, the forecast error for one year ahead is 1.8 percent for real GDP and 0.8 percent for CPI inflation.

Table 4 shows the percent of errors falling within bands equal to zero plus or minus one or two RMSEs. The table indicates that about 60 to 70 percent of the

Table 3: Forecast Errors in Japan
(Winter Projections for FY 1982-2007)

Real GDP Growth[1]

	Samples	RMSE	MAE
Average[2]	26	1.7	1.4
All Samples[3]	1030	1.8	1.5

Consumer Price Index

	Samples	RMSE	MAE
Average[2]	26	0.7	0.6
All Samples[3]	984	0.8	0.6

Notes: 1. Actual values are based on the latest available data.
        2. Average of private sector forecasts.
        3. All private sector forecasts.

Table 4: Percent of Outcomes Falling Within One or Two RMSE(s) of Forecasts
(FY 1982-2007 projections)

Real GDP Growth

	1RMSE	2RMSEs
Average	62%	96%
All Samples	65%	97%

Consumer Price Index

	1RMSE	2RMSEs
Average	73%	88%
All Samples	77%	93%

forecast errors fall within a range equal to zero plus or minus one RMSE, while about 90 percent fall within a range equal to zero plus or minus two RMSEs. These findings are similar to those in the empirical analysis for the United States by Reifschneider and Tulip (2007).

(3) Sources of the Forecast Errors

There are three main sources of the forecast errors.

The first is uncertainty regarding exogenous shocks. Commodity prices are a typical example. When conducting forecast exercises, the future paths of commodity prices must be assumed as given. However, many commodity prices such as recent petroleum prices tend to show volatile movements even over a short time period. Changes in commodity prices may result in large forecast errors for real GDP growth and CPI inflation. If financial market indicators move more than initially expected, this may result in large forecast errors in real GDP growth and

CPI inflation.

The second source is uncertainty regarding economic structure. Since the actual economy is very complicated, it is not practical to take all economic factors into account for forecasting. Therefore, economists tend to assume simplified economic structures for forecasting purposes, focusing on the crucial factors. However, the omitted factors may sometimes play critical roles for economic developments. In addition, the structure of the economy may change over time, and it may take time for central banks to recognize such structural changes. In these cases, large forecast errors may occur.

The third source is uncertainty regarding economic statistics. For example, real GDP data in Japan are revised three times after the publication of the first estimate: the second estimate, the first final estimate, and the final estimate.[9] Revisions of GDP data also reflect changes in base data and estimation methodologies.[10] In fact, Japanese real GDP growth rate data have been revised in the past (Chart 7).

Chart 7: Revisions of Real GDP Statistics
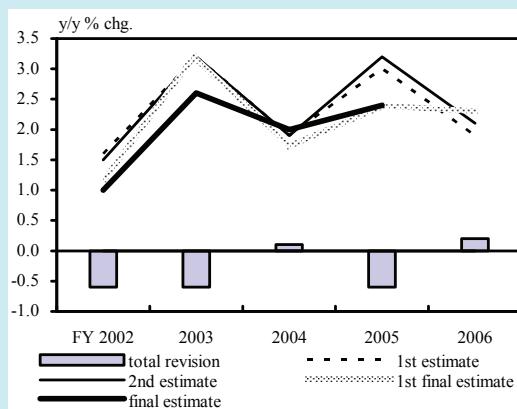
Note: Total revision is final estimate minus 1st estimate. The total revision for FY 2006 is 1st final estimate minus 1st estimate.

Source: Cabinet Office, "National Accounts."

4. Conclusion

Large forecast errors are observed in all economic forecasts since there is uncertainty regarding the economic outlook. The margins of error are large; the forecast errors one year ahead are about one percent for the annual growth rates of real GDP and range from 0.5 to one percent for CPI inflation, based on empirical analyses of forecasts for major economies. Since central bank forecasts are conditional forecasts

based on various assumptions, they are subject to uncertainty.[11] Central banks need to take into account the uncertainty of their economic forecasts and pay attention to the risk factors for upward and downward deviations from their central projections. In some cases, central banks also need to conduct monetary policy considering an asymmetric balance of risks. To communicate the uncertainty and the balance of risks effectively to the public, central banks contrive various methods to visually assist the public's understanding of the central banks' risk assessments such as the fan charts used by the Bank of England and the Bank of Japan's Risk Balance Chart.

In addition to using such visual expressions, central banks also need to communicate their assessments of the uncertainty of economic projections and the balance of risks to the public via qualitative assessments. Central banks constantly review their communications strategies to attain the right balance between quantitative and qualitative assessments of the risks affecting future forecasts. Such efforts should promote better communication between central banks and the public and contribute to increased transparency. Central banks must continue refining various aspects of their communications with the public and stabilize public expectations regarding future policy actions, as stable expectations contribute to long-term economic and price stability.

---

[1] If a forecast-error distribution is assumed to be normal, the realized values will fall within a range of the central projection plus or minus 1 standard deviation with a probability of 68 percent, and within 2 standard deviations with a probability of 95 percent.

[2] The root mean squared error (RMSE) and the mean absolute error (MAE) are used as indicators for forecast errors. The RMSE and MAE are calculated as follows:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(A_i - F_i)^2}$$

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|A_i - F_i|$$

where A_i is the realized value, F_i the forecast value, and n the number of samples, respectively. The forecast error in terms of the RMSE is larger than or equal to that in terms of the MAE. In general, forecast error is usually expressed in terms of the RMSE.

[3] David Reifschneider and Peter Tulip (2007), "Gauging the Uncertainty of the Economic Outlook from Historical Forecasting Errors," Finance and Economics Discussion Series, 2007-60, Federal Reserve Board. They use RMSEs for the forecast errors. The authors calculate RMSEs for each

quarter in which projections are published.

[4] Percent change, fourth quarter of the current year from fourth quarter of the previous year.

[5] The data sources are as follows.

United States: Reifschneider and Tulip (2007).

Euro area: Carlos Bowles et al (2007), "The ECB Survey of Professional Forecasters (SPF) A Review after Eight Years' Experience," ECB Occasional Paper Series No. 59 / April 2007. The RMSEs are used.

United Kingdom: The values of the "uncertainty" with which the fan charts were prepared are from the Bank of England's February 2008 Inflation Report. Historical forecast errors provide reference when "uncertainty" is evaluated.

Sweden: The values of the forecast error with which the fan charts were prepared are from the Riksbank's February 2008 Monetary Policy Report. These values are calculated based on the historical forecast errors.

Norway: The values of the forecast error with which the fan charts were prepared are from the Norges Bank's March 2008 Monetary Policy Report. These values are calculated based on the historical forecast errors.

[6] April projections from FY 2001 to FY 2007.

[7] Projections from about 30 private forecasters are available for each year.

[8] These private sector annual projections are generally compiled in December, and are thus based on less information than the Bank of Japan's April projections.

[9] In addition, differences in estimation methods or coverage may result in changes in real GDP growth figures. The base year of Japan's GDP statistics are revised once every five years reflecting new statistics such as the "Input-Output Table." The transition from 68SNA to 93SNA in 2000 involved significant changes in estimation methods, such as the addition of software investment to private investment.

[10] The Bank of England's fan charts also have distributions showing the likelihood of revisions to real GDP data in the past.

[11] Central banks emphasize that their outlooks are conditional forecasts prepared under a number of assumptions. This point is emphasized so that the public understands such outlooks are not commitments. Public misunderstanding of this point would result in poor communications.