Box IX-1

Calculation of confidence intervals

Forecasts for the main economic variables are fraught with uncertainty. Central banks therefore frequently publish forecasts with confidence intervals. The Central Bank of Iceland has published its inflation forecast with confidence intervals in the past, but in this issue of *Monetary Bulletin* it also publishes forecasts for the policy rate, output gap and exchange rate with confidence intervals, as seen in Charts XI-7 to XI-11.
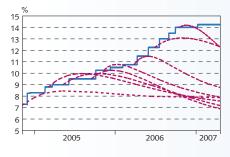
When computing the uncertainty underlying a forecast, an assessment is first made of the underlying factors in the development of inflation, including the exchange rate and the output gap. This involves evaluating the size of the uncertainty and the probability of risk being upwards or downwards, in order to yield the confidence intervals and the probability distribution of the inflation forecast.[1] Finally, an assessment of the probability distribution of the baseline forecast policy rate path is made, based on the probability distribution of the inflation forecast.

Estimation of the probability distributions of these four economic variables is based on the assumption that the forecast errors are normally distributed, but to allow for asymmetric probability distribution the risk profile is based on a two-piece normal distribution for each quarter.[2] An asymmetric distribution allows more than 50% of the outcomes to be on either side of the mode, i.e. the probability distribution can be skewed either upwards or downwards. When the probability distribution is symmetric, as in the case of a normal distribution, the probability of the outcome being above or below the mode is identical. The skewness of the probability distribution is not estimated from historical data but assessed by the Central Bank's staff.

Calculation of the uncertainty surrounding the output gap is based on historical forecast errors.[3] An assessment of historical forecast errors for the exchange rate is difficult since it has only been forecast by the Central Bank for a short time – baseline forecasts were previously based on the assumption of an unchanged effective exchange rate from the day of the forecast. The forecast errors for the exchange rate are therefore based on historical standard deviations of the exchange rate for 1-3 years.[4] The probability distribution of the inflation forecast is then a weighted probability distribution of the underlying factors. The standard deviation and the skewness of the underlying factors are reflected in the inflation forecast.

The uncertainty in the policy rate path needs to reflect the uncertainty in the inflation forecast. Accordingly, the shape of the probability distribution of the inflation forecast affects the shape of the policy rate probability distribution. If, for example, the probability distribution of inflation has an upward skew (which means that it is more likely that inflation will be above the baseline forecast than below) the policy rate will also have an upward skew (which means that it is more likely that the policy rate will be above the baseline forecast than below). It is not as straightforward to assess the standard deviation of the policy rate distribution. Normally the historical forecast errors would be used, but the baseline forecast with variable policy rate has hitherto been based on forward rates

Chart 1

Policy rate and market expectations in
Monetary Bulletin 2004/4-2006/3[1]

— Policy rate
--- Market expectations

1. Market expectations are based only on implied forward rates until *Monetary Bulletin* 2005/3 but after that also on survey results.
Source: Central Bank of Iceland.

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1. Uncertainty in the Central Bank's inflation forecast is described in detail in Appendix 3 of *Monetary Bulletin* 2005/1, pp. 60-63.

2. See *Monetary Bulletin* 2005/1, pp. 60-63.

3. In estimating forecast errors for the output gap, it should be borne in mind that historical data on GDP and the output are often revised, which also affects later forecasts.

4. In fact, the size of standard deviations in exchange rate movements generally tends to be close to forecast errors for the exchange rate, given the difficulty of forecasting exchange rates.

and analysts' projections.[5] Chart 1 presents these interest rate fore-
casts along with the actual policy rate. The forecast errors are large,
although this period can hardly be indicative of future forecast errors
since the economy has been overheated and monetary policy con-
tinuously tightened. Also, excess demand for nominal bonds, which
are used to compute the implied forward rates, has kept the yield
curve low. Implied forward rates contain a risk premium, which im-
plies that even if the economy had not been overheated, this would
have added to the policy rate forecast error. Historical forecast er-
rors based on forward rates and analysts' projections are no longer
relevant either, since the Bank's own published interest rate path is
based on different assumptions. Finally, it should be kept in mind
that there are very few observations behind historical forecast errors.
The standard deviation of the policy rate's probability distribution is
therefore based on historical forecast errors, but taking into account
the policy rate paths of the alternative scenarios.

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5. The Central Bank has published alternative scenarios based on its own policy rate
    forecast since *Monetary Bulletin* 2004/4. However, until now the baseline forecast has
    assumed an unchanged policy rate from the day of forecast, or expectations of market
    agents and financial market analysts based on the average of forward rates and fore-
    casts by four Icelandic analysts.