

Bank of Finland's forecast errors in 2004–2010

The Bank of Finland's Monetary Policy and Research department prepares a macroeconomic forecast twice a year for the current calendar year and the following two years. The forecast describes the most probable developments in the economy at the forecast date. In addition to the Finnish economy, the forecast also examines international developments. However, interest and exchange rates are assumed to develop in line with financial market expectations, and no forecast is prepared for them.

This article examines the accuracy of forecasts with respect to GDP, inflation, unemployment and the components of GDP. An analysis of forecast errors is topical, as the Bank of Finland forecast model has recently been updated. In 2004–2009 the Bank prepared its forecasts using a general equilibrium model of the Finnish economy named Aino.¹ In spring 2010 the Bank introduced a new estimated version of the Aino model.²

The Bank of Finland forecasts are point estimates, ie the most probable single values of each economic variable, eg private consumption and investment. The forecasts are naturally conditioned on the underlying assumptions. The Bank's forecasts are also based on as accurate a picture of the present situation as possible. In addition to statistical data, the overall picture also relies on preliminary data and assumptions on a

number of variables. A high degree of uncertainty is associated eg with price forecasts, which are based on market assumptions for the forecast period. Assumptions for oil price movements, interest rates and exchange rates change daily. The forecast of exports, which is important for forecasting Finnish economic developments, is based on the best available projection for the global economy and developments in the key export countries.

Forecast errors are affected by revisions and errors in the available statistics and related preliminary data. The Bank of Finland forecasts draw on the latest releases and revisions to National Accounts published by Statistics Finland. In this forecast-error analysis, the annual forecasts for different variables are compared with the first preliminary data from the National Accounts published in the beginning of March of the following year. However, the National Accounts are revised on a number of occasions after the initial data have been published, and the time series are revised even many years after the first data release.

The Bank of Finland forecasts are prepared using the Aino stochastic general equilibrium model developed by the Bank. Economic models are always simplified descriptions of interdependencies between economic phenomena and cannot therefore include all the relevant factors. However, using of a general equilibrium model for forecasting guarantees that the projected economic developments are internally consistent. The forecasts also



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¹ The Aino model is presented in the article 'Aino: the Bank of Finland's new dynamic general equilibrium model of the Finnish economy' (Kilponen, J. – Ripatti, A. – Vilmunen, J., Bank of Finland Bulletin 3/2004).

² The new Aino model is discussed in this issue in the article 'A general equilibrium model for forecasting' by Elisa Newby, Jukka Railavo and Antti Ripatti.

draw on information not derived from the model, eg a large variety of economic sentiment indicators and information on economic structures. The forecasts are also always subjected to a good dose of deliberation.

Even though the economists' perspective plays a central role in the forecasts, the Bank of Finland forecasts are not actually scenarios. For instance, the Bank's economists do not try to anticipate the behaviour of economic policy decision-makers, but take account only of political decisions already made by the forecast date. Ongoing structural changes, such as the baby-boomers' retirement, are taken into account.

How are forecast errors measured?

This article uses a statistical approach to estimate the accuracy of forecasts and focuses on the analysis of forecast errors. The two key concepts in the measurement of forecast errors are unbiasedness and accuracy. An estimate is unbiased if it does not systematically over- or underestimate the true value of an economic variable – ie it is correct on average. Accuracy means that the predicted value is as close as possible to the actual outcome. A good prediction is therefore both accurate and unbiased.

A forecast error is the difference between the actual and predicted value of an economic variable. The closer the predicted value is to the actual outcome, the smaller the forecast error. Consequently, the forecast error for an exact prediction is zero. There is no unambiguously best measure for assessing forecast accuracy. In this analysis, forecast errors are measured

by three indicators: the mean of forecast errors, ie the mean error (ME), the mean of absolute forecast errors, ie the mean absolute error (MAE) and the root mean square error (RMSE).

A positive mean error indicates underestimation: the actual value of the economic variable has in most cases been higher than the predicted value. A negative ME denotes overestimation. The ME falls where the errors are concentrated, so that forecast accuracy may seem good on average even if up- and downside errors are substantial.

The mean absolute error (MAE) indicates whether forecasts have varied considerably around the actual outcome, without taking account of under- versus overestimation. The third statistical indicator is the root mean square error (RMSE), which is the mean of the squared forecast errors. The RMSE is sensitive to large individual forecast errors. The closer to zero the three error indicators are, the more accurate the forecast. This analysis cannot exhaustively assess systematic over- or underestimation in the Bank's forecasts, as this would require observations from more than the six years included here.

Of course, there are other metrics for the usefulness of macroeconomic forecasts in supporting economic policy besides statistical indicators and numeric data. A good forecast is also solidly based and internally consistent.

Growth and inflation forecasts for 2004–2010

The Bank of Finland publishes two forecasts every year. The forecasts

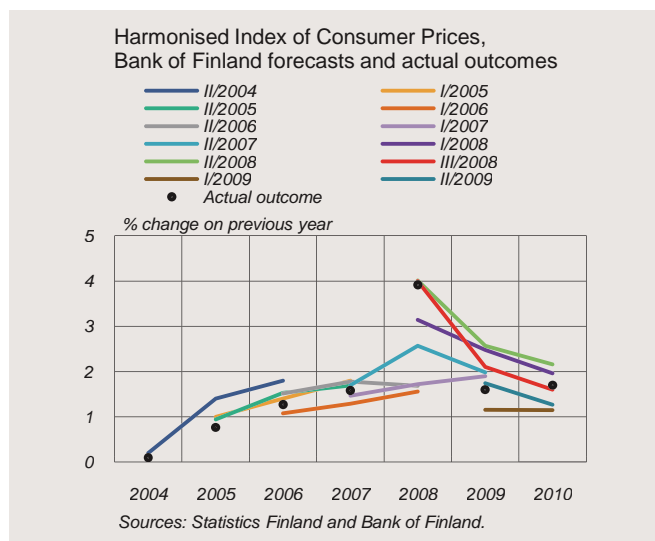
included in this analysis were prepared between September 2004 and September 2009. The variables discussed are the first growth forecast for GDP and its semiannual revisions from one forecast round to another (Chart 1) and, correspondingly, the development of inflation forecasts (Chart 2). Forecasts published each year are shown using curves of different colour, and the small circles indicate the growth rates in Statistics Finland's first preliminary data release for National Accounts. The smaller the difference between the circle and the curve, the more accurate the forecast. If GDP growth or inflation was underestimated (overestimated), the curve is below (above) the circle. The statistical forecast errors are presented in Tables 1 and 2, covering the periods 2004–2010 and 2004–2008. As the Tables show, an exceptionally sharp decline in GDP in 2009 led to considerably enlarged forecast errors.

In the period 2004–2010 GDP grew by 1.8% on average a year. The largest forecast error occurred in 2008. Even in early September, there were no signs of a sharp fall in output due to the global financial crisis, albeit growth was projected to moderate slightly in 2009. In the later forecast published at the end of 2008, however, growth was already expected to decline. The real situation became apparent in spring 2009 when output was already projected to contract strongly. Nevertheless, the contraction in output was still slightly underestimated. Revisions moved the predictions towards the actual outcomes only slowly, which

Chart 1.



Chart 2.



reflects the uncertainty of the economic situation. On the other hand, the recovery from the recession began sooner and was stronger than expected. The year-2009 forecasts for 2010 considerably underestimated output growth, and actual growth in 2010 was stronger than the forecasts for 2010 made prior to the recession.

Table 1.

Growth forecast errors, predicted percentage changes for 2004–2010								
Forecast error and horizon	GDP		HICP		Unemployment rate		Number of forecasts	
	2004–2010	2004–2008	2004–2010	2004–2008	2004–2010	2004–2008	2004–2010	2004–2008
Mean error, current year	-0.3	-0.1	0.0	0.0	0.0	0.0	12	10
Mean error, 1 year	-1.5	0.2	0.1	0.4	-0.1	-0.5	12	7
Mean error, 2 years	-1.4	0.4	0.2	0.7	0.3	-1.1	10	5
Root mean square error, current year	1.4	1.2	0.3	0.3	0.2	0.2		
Root mean square error, 1 year	4.9	1.8	0.9	1.0	1.2	0.6		
Root mean square error, 2 years	4.9	2.0	1.1	1.5	1.6	1.2		
Mean absolute error, current year	1.1	1.0	0.2	0.2	0.2	0.2		
Mean absolute error, 1 year	3.8	1.7	0.7	0.7	1.0	0.5		
Mean absolute error, 2 years	3.5	1.9	0.7	1.1	1.5	1.1		

Source: Bank of Finland calculations.

The indicators are calculated as follows (f denotes the forecast for period t , y the actual outcome and h the number of forecasts):

$$\text{Mean error (ME)} = \frac{\sum_{t=1}^h (y_t - f_t)}{h}, \text{ mean absolute error (MAE)} = \frac{\sum_{t=1}^h |y_t - f_t|}{h}, \text{ root mean square error (RMSE)} = \sqrt{\frac{\sum_{t=1}^h (y_t - f_t)^2}{h}}.$$

Table 2.

Growth forecast errors, predicted percentage changes for 2004–2010												
Forecast error and horizon	Imports		Exports		Private consumption		Private investment		Public consumption		Public investment	
	2004–2010	2004–2008	2004–2010	2004–2008	2004–2010	2004–2008	2004–2010	2004–2008	2004–2010	2004–2008	2004–2010	2004–2008
Mean error, current year	-0.5	-0.3	-1.1	-1.1	-0.1	-0.2	0.5	0.7	-0.1	0.2	-1.1	-1.6
Mean error, 1 year	-6.4	-2.3	-5.9	-1.1	-0.5	0.0	-1.4	0.5	-0.5	-0.2	-1.4	-2.7
Mean error, 2 years	-8.0	-3.7	-6.5	-2.0	-0.9	-0.2	-3.4	1.2	-0.7	-0.1	-0.4	0.4
Root mean square error, current year	3.6	3.6	3.3	3.2	0.9	1.0	2.2	2.4	0.8	0.5	3.3	3.6
Root mean square error, 1 year	13.3	4.8	13.8	4.5	2.3	0.7	9.1	2.6	0.7	0.4	4.6	5.3
Root mean square error, 2 years	13.0	4.8	13.9	5.0	2.1	0.9	8.5	2.5	1.0	0.4	2.9	2.4
Mean absolute error, current year	3.3	3.3	2.8	2.7	0.8	0.9	1.7	1.9	0.6	0.5	2.3	2.6
Mean absolute error, 1 year	9.6	4.1	9.9	3.9	1.7	0.6	6.9	2.2	0.6	0.4	3.4	4.2
Mean absolute error, 2 years	8.1	3.9	8.4	4.0	1.4	0.8	5.4	2.3	0.8	0.3	2.8	2.4

Source: Bank of Finland calculations.

Forecasts for 2004–2010 have overestimated GDP growth by 1 percentage point on average. However, forecasts for 2009 and 2010 have a significant impact on forecast errors. Excluding these forecasts, growth forecasts have underestimated the actual GDP outcome by 0.2 percentage point on average.

Looking at demand components, forecast errors diverge considerably. The contributions to GDP of individual components – private consumption and investment, public consumption and net exports – are of different magnitudes and react to cyclical changes in very different ways. Public consumption typically smoothens GDP fluctuations. Consequently, the recession is clearly reflected in the growth of the public-consumption contribution to GDP, which was 21% in 2004 and 25% in 2010. Public investment has remained above 2% of GDP.

Private consumption is the largest component of GDP in terms of value: its GDP contribution averaged 52% in the period studied. In 2004–2010 private consumption grew on average by 2.4 percentage points a year. Previous-year forecasts have overestimated private consumption growth by 0.5 percentage point on average. In current-year forecasts, the error was marginal.

Public consumption increased by 1.3% on average in 2004–2010. In 2008 the growth was 2.5% and has subsequently remained below 1%. Public consumption predictions have overestimated actual growth by an average of 0.4 percentage point. Excluding forecasts for 2009 and 2010,

the forecasts have been unbiased. The central government and local government municipalities were projected to initiate stimulus measures in 2009, and public consumption was generally anticipated to increase by almost 2%. However, local government spending decreased, and consequently public consumption only increased by 1% in 2009.

Since private investment is very sensitive to the business cycle and gyrates from year to year, it is a difficult component to forecast. The mean error for private investment growth forecasts was –1.3 percentage points, which indicates overestimation. The current-year forecasts underestimated private investment by an average of 0.5 percentage point. In the period studied, the contribution of private investment to GDP was 17% on average.

Public investment has also fluctuated greatly over the years: public investment increased by 7.9% in 2007, as opposed to a contraction of 11.3% in 2005. Public investment has proved challenging to forecast and has been subject to overestimation: the mean error for public investment growth forecasts is –1.0 percentage point. Individual forecast errors have been large, as is reflected in considerable root mean square errors for all the forecast horizons.

Annual changes in imports and exports fluctuate the most of all the GDP components, which makes prediction challenging. Imports have grown at an average annual rate of 3.6% in the period studied, and import forecasts have been 4.8 percentage

points higher on average than the actual outcomes. The annual growth rate of exports was about 3.8% in 2004–2010, and export forecasts have overestimated actual growth by 4.4 percentage point on average.

The unemployment rate averaged at 7.8% in the period studied. The Bank of Finland's unemployment-rate predictions have underestimated actual growth by just 0.1 percentage point. In addition, the current-year forecasts have deviated only marginally from the actual outcomes.

In 2004–2010 Finland's inflation rate averaged 1.6%. The Bank's forecasts have underestimated inflation by just 0.1 percentage point.

Chart 3 shows the Bank of Finland forecasts published in 2005–2010 for consumer price index, GDP and its components. In 2010 the forecasts were prepared using the new version of the Aino model. As the Chart shows, with new data for the forecasted year, revisions move the forecasts closer to the actual outcomes. The spring and autumn forecasts for the next year have not greatly deviated from each other. The current-year forecasts have drawn on indicators and preliminary National Accounts data. The September forecasts already come close to Statistics Finland's first preliminary data release. The Chart also shows the difference between the preliminary data and the final statistics. However, it is worth noting that growth figures for 2009 and 2010 will be revised in connection with the final National Accounts release.

Chart 3 also enables an examination of the larger-than-usual

forecast errors for 2009. GDP and its components were still assumed to grow almost normally in the September 2008 forecasts. Even though growth forecasts prepared in 2009 were revised towards the actual outcomes, these forecasts also had exceptionally large forecast errors. Excluding forecasts for 2009, a slightly different picture is gained from the Bank of Finland forecast errors. GDP and its components were often underestimated in the forecasts produced in the years of a relatively strong growth prior to 2009.

Conclusions

This forecast-error analysis does not compare the Bank's forecasts with macroeconomic forecasts of other institutions. In addition to the Bank of Finland, macroeconomic forecasts are published in Finland by the Ministry of Finance, commercial banks and research institutions. However, previous comparisons have shown how hard it is rank forecasters.³

As this forecast-error analysis shows, it is particularly difficult to predict cyclical turning points and to make forecasts around the time of such turning points, since these reversals are typically caused by an unanticipated change or shock in the economy. This is connected with a paradox known among forecasters: if markets are assumed to be efficient, a forecast that includes a cyclical reversal is internally inconsistent. A

³ Forecasts published by various institutions have been compared eg in the article 'Valtion talousarvioiden verotuloennusteiden osuvuus' (Accuracy of tax revenue forecasts in government budgets) (Lahtinen, M. – Mäki-Fränki, P. – Määttä, K. and Volk, R., Audit Committee of the Parliament publication 1/2009).

Chart 3.



surprise itself cannot be predicted. Nevertheless, it is possible to make forecasts, because economic agents and a number of variables react to economic disruptions with a time lag. Viewed from the perspective of those who develop models and other research tools, it is useful that forecasts are commonly known to be subject to uncertainty, but it is also important that explanations are found for the surprises that occur.⁴ Forecast errors were exceptionally large in 2009–2010. The financial crisis surprised domestic and global forecasters alike. The economic environment changed rapidly, and economic forecasts for 2009 and 2010 were revised gradually. A number of forecasting institutions – including the Bank of Finland – produced additional forecasts as the crisis became more severe.

⁴ Challenges of economic forecasting are discussed in separate articles eg by Mörttinen, L., Pekkarinen, J., Suvanto, A. and Vartiainen, J. The articles have been published in the Finnish Economic Journal 3/2008.

The Bank of Finland's published forecasts explain in detail why assessments of economic developments have changed between forecast rounds. A forecast is a most probable set of outcomes for economic developments, but since changes in the global environment in particular are rapidly transmitted to a small open economy such as Finland, it is important in the context of a published forecast to assess and predict alternative factors that could affect the economy. The Bank of Finland publishes risk assessments of the key uncertainties relating to its forecasts. The alternative calculations in turn diversify the baseline scenario by presenting alternative projections that deviate from the forecasted path.

Key words: forecasts, errors, business cycles

Articles and boxes from previous publications

Articles

Finland's economic outlook 2011–2013. Bank of Finland Bulletin 1/2011.

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