Evaluation of the Riksbank's forecasts

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Foreword

The Riksbank is an authority under the Riksdag, the Swedish Parliament, with responsibility for monetary policy in Sweden. Monetary policy is decided by the Executive Board of the Riksbank. Monetary policy affects the economy and inflation with a time lag. Forecasts of economic developments in general, and of inflation in particular, are therefore an important part of the Riksbank's decision-making material.

This study evaluates the Riksbank's forecasts for a number of central economic variables. The Riksbank's accuracy is also compared with the forecasting precision of other forecasters. The study is a complement to the report *Account of Monetary Policy, 2019*. The forecast evaluation focuses on forecasts for the period 2010–2019, with a special analysis of the forecasts for 2019. The report has been produced by the Monetary Policy Department. Most of the work on this study has been performed by Yildiz Akkaya, Jesper Johansson, Mårten Löf, Ard Den Reijer and Hjalmar Skog.

Jesper Hansson
Head of the Monetary Policy Department

Summary

As it takes time for monetary policy to affect the real economy and inflation, it needs to be forward-looking and based on forecasts. The forecasts thereby become an important part in the decision-making process and should therefore also be evaluated systematically. Although the accuracy of the forecasts can vary from year to year, due to events that can (sometimes) be unpredictable, a systematic evaluation can nevertheless help to gradually improve it.

This study analyses and evaluates the Riksbank's forecasts for a number of central economic variables for the period 2010 to 2019.

Growth and inflation unexpectedly low in 2019

The report opens with a description of how economic development in 2019 compared to the forecasts, where the development of inflation is analysed in more detail.

GDP growth and inflation abroad, above all in the euro area, were lower than expected in relation to forecasts from both the Riksbank and other forecasters made in 2018 and 2019. At the same time, unemployment in Sweden was higher than expected and, just as abroad, growth and inflation became lower than expected. The rate of wage increases also became unexpectedly low, which may have contributed to the unexpectedly low inflation. At the same time, however, the Swedish krona became unexpectedly weak, which should have had the opposite effect. Adjusted for energy prices, inflation increased between 2018 and 2019. However, the analysis shows that it still became unusually low in 2018 and 2019, considering the development of resource utilisation, unit labour costs and the exchange rate in recent years.

According to a model analysis, the most important explanation for inflation having become unexpectedly low is that domestic and global demand has become unexpectedly low. At the same time, the unexpectedly weak krona has, to a certain extent, counteracted this and contributed to higher inflation. The weaker than expected krona is mainly explained in a model by unexpectedly low domestic demand and unexpectedly high risk premiums.

The Riksbank's forecasts better than or in line with the average, except for the repo rate

In the second section of the report, we compare the Riksbank's forecasts with forecasts made by other forecasters. First, the forecasts made by the Riksbank and other analysts for the years 2010 to 2019 are analysed. Then, the forecasts made in 2018 and 2019 for economic developments in 2019 are studied specifically.

Over the period 2010–2019, the Riksbank had the highest accuracy in forecasts for GDP growth and unemployment. The accuracy of the Riksbank's forecasts for CPIF inflation was in line with the average, while the forecasts for the repo rate were the least accurate. In the forecasts made in 2018 and 2019, the Riksbank, like others, overestimated GDP growth, inflation and the repo rate, and underestimated unemployment. Compared with others, the Riksbank made more accurate forecasts for last year's unemployment and less accurate forecasts for inflation and the repo rate. However, the difference between different forecasters is generally small.

1. Economic developments in 2019 in comparison to the forecasts

In this section, we compare outcomes for economic development in 2019 with the forecasts published by the Riksbank in its monetary policy reports from February 2017 to December 2019 inclusive. The focus is on those variables usually used to explain the development of inflation.

Inflation lower than 2 per cent in 2019

CPIF inflation amounted, on average, to 1.7 per cent in 2019. Measured in terms of the CPIF excluding energy, the rate of inflation averaged 1.6 per cent. Measures of core inflation, which exclude or reduce the significance of sharply varying prices, also indicate that inflation, on average, was slightly lower than 2 per cent in 2019.

0 shows the average rate of price increase for various components in the CPIF in 2018 and 2019 in relation to the average over the period 2000 to 2018. In 2019, the rate of increase in both the CPIF and the CPIF excluding energy was higher than the average rate of increase. The rate of price increases in all components except the capital stock was higher in 2019 than the historically average rate of increase. The downturn in CPIF inflation from 2018 to 2019 can primarily be explained by energy prices not increasing as rapidly in 2019 as in 2018. When adjusted for energy prices, CPIF inflation was higher in 2019 than in 2018.

Table 1. Sub-groups in the CPIF

Weight and average annual rate of increase in per cent

	Weight 2019	2000–2018	2018	2019
Services	45.0	1.7	1.9	2.0
Goods excluding food	27.0	-0.5	-0.4	-0.1
Food	17.8	1.8	2.2	2.6
Capital stock index	3.3	6.2	7.1	5.8
CPIF excluding energy	93.0	1.3	1.4	1.6
Energy	7.0	2.4	10.5	3.2
CPIF	100.0	1.4	2.1	1.7

Note: Weight refers to the weighting figure in the CPI.

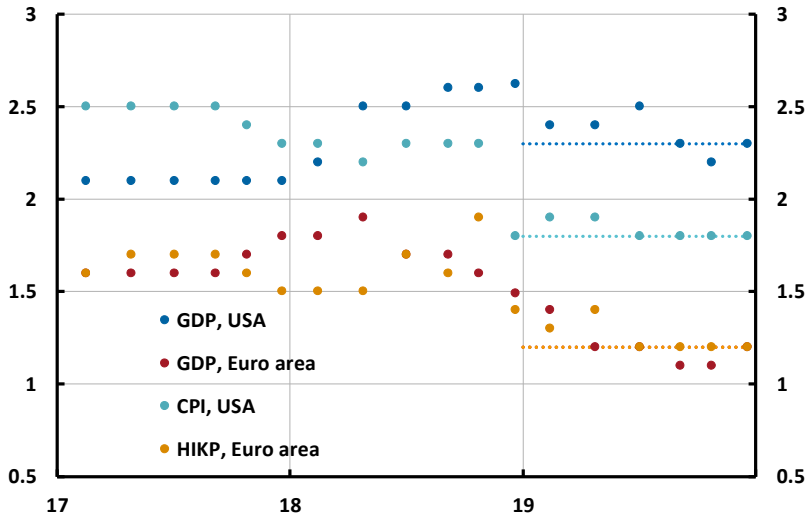
Sources: Statistics Sweden and the Riksbank

Growth and inflation abroad lower than forecast

The outcome for GDP growth in the United States was approximately in line with the forecasts the Riksbank has published over the last three years (see 0). GDP growth in the euro area and inflation in both the United States and the euro area were, however, surprisingly low. Other forecasters also overestimated growth and inflation abroad.

Figure 1. The Riksbank's forecasts for growth and inflation abroad (points) and outcomes (broken lines) for 2019

Annual percentage change



Note: The broken red line cannot be seen as outcome for HICP and GDP in the euro area coincide.

Sources: National sources and the Riksbank

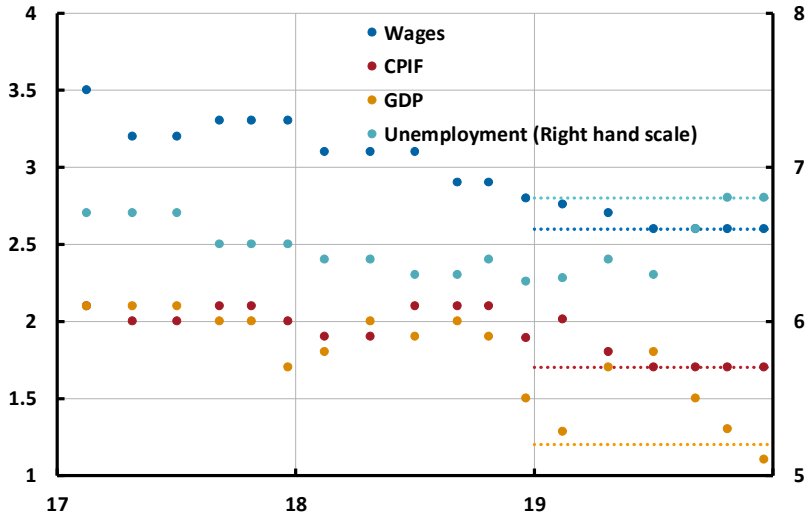
Unexpectedly low growth and inflation in Sweden

GDP growth in Sweden in 2019 was lower than in the forecasts the Riksbank has made over the last three years (see 0). During 2017 and 2018, GDP growth was expected to amount to about 2 per cent in 2019. In 2019, the forecasts were gradually revised down and, according to the latest statistics, GDP growth amounted to 1.2 per cent in 2019.

It is primarily gross fixed capital formation and household consumption that have been lower than expected (see 0). The development of the housing market in the autumn of 2017 caused housing investment to slow down. The fall in housing prices is an important reason for the lower housing investment in 2019 in relation to the forecasts made in 2017. In addition, industrial activity slowed down unexpectedly rapidly in 2019, which contributed to the business sector's other investments also increasing unexpectedly slowly. The development of the housing market probably also contributed to the slowdown of consumption. Exports increased somewhat faster than anticipated.

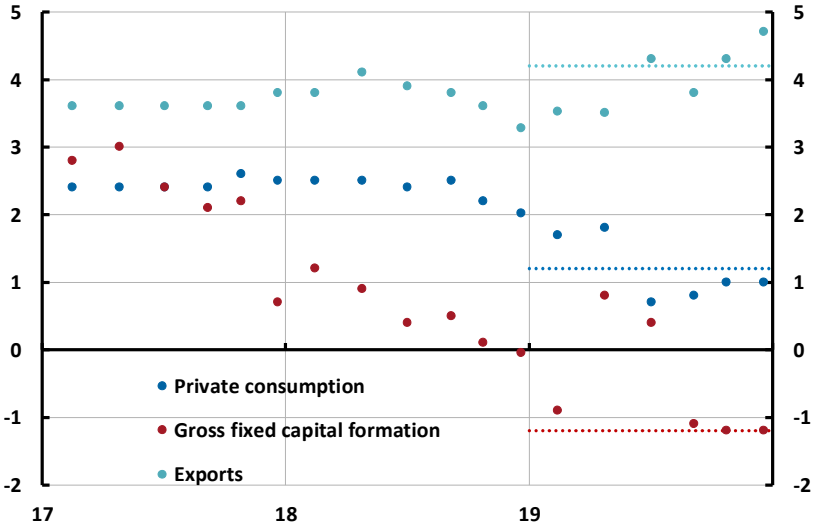
Figure 2. The Riksbank's forecasts for growth, unemployment, wages and CPIF inflation (points) and outcome (broken lines) for 2019

Annual percentage change



Sources: National Mediation Office, Statistics Sweden and the Riksbank

Figure 3. The Riksbank's forecasts for consumption, investment and exports (points) and outcomes (broken lines) for 2019
Annual percentage change



Sources: Statistics Sweden and the Riksbank

Unemployment has been higher than expected. However, it has been difficult to analyse development over the period in that statistics for the labour market have been significantly revised for the years 2018 and 2019 in relation to the statistics to which the Riksbank had access in the forecasts made up until the Monetary Policy Report of October 2019.[1] According to the new statistics, growth in employment had already started to tail off in 2018. Unemployment was revised upwards from July 2018 until June 2019 but was revised downwards for the months July to September 2019. The overall assessment of labour market statistics from various sources is that economic activity slowed down faster than expected in 2019.

Wages have increased more slowly than expected (see 0). Even though unemployment has risen and GDP growth has slowed down, resource utilisation is still deemed to have been unusually high. Compared with earlier periods with corresponding economic situations, wage increases have been unusually moderate. Unusually slow productivity growth is deemed to have contributed to this.[2]

At the same time as wages increased more slowly than expected, productivity has also increased unexpectedly slowly and this has led unit labour costs to increase slightly faster than expected. At the same time, the krona has also been weaker than expected (see 0). But despite the higher domestic cost pressures and weaker krona, inflation has been unexpectedly low (see 0 and 0).

[1] During the autumn, Statistics Sweden detected serious quality problems in the data collection for the Labour Force Surveys, which has meant that the statistics published have been incorrect. See, for example, the box on page 22 of the Monetary Policy Report, December 2019.
[2] See, for example, the report Wage Formation in Sweden 2018 from the National Institute of Economic Research and the article "Strong economic activity but subdued wage increases" in Monetary Policy Report, July 2017.

Figure 4. KIX, outcomes and forecasts

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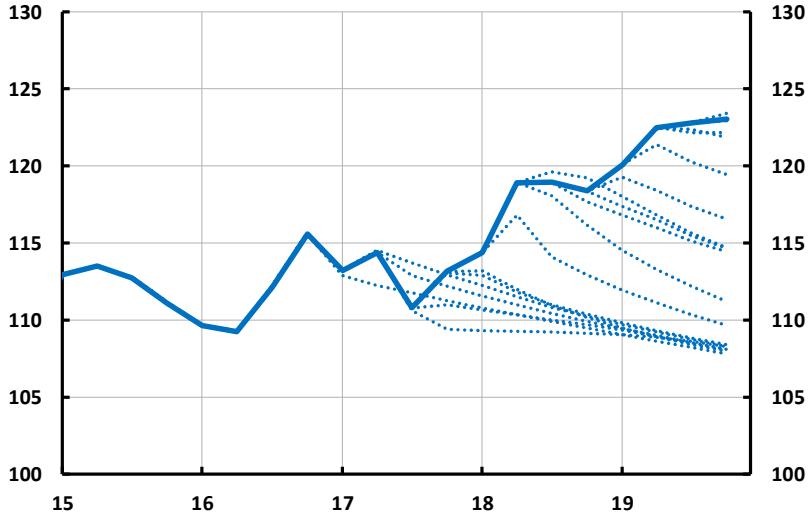
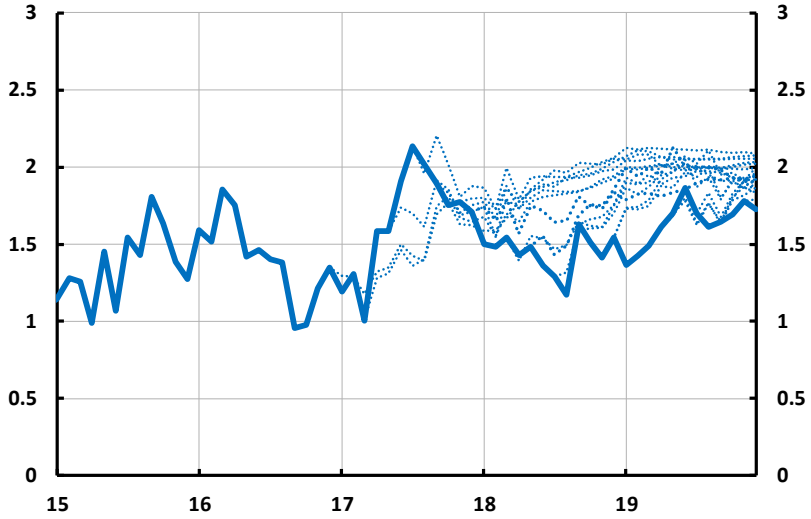


Note: The KIX (krona index) is a weighted average of the currencies in 32 countries that are important for Sweden's international trade. A higher value indicates a weaker exchange rate.

Source: The Riksbank

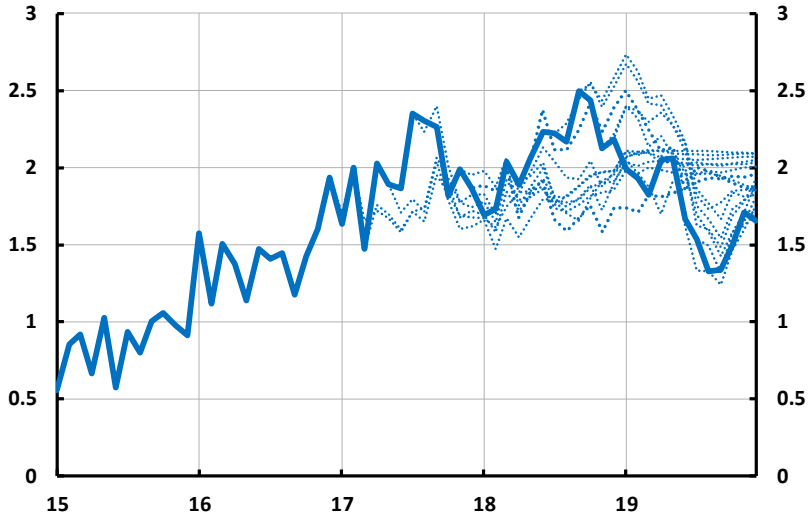
Figure 5. CPIF excluding energy, outcomes and forecasts

Annual percentage change



Sources: Statistics Sweden and the Riksbank

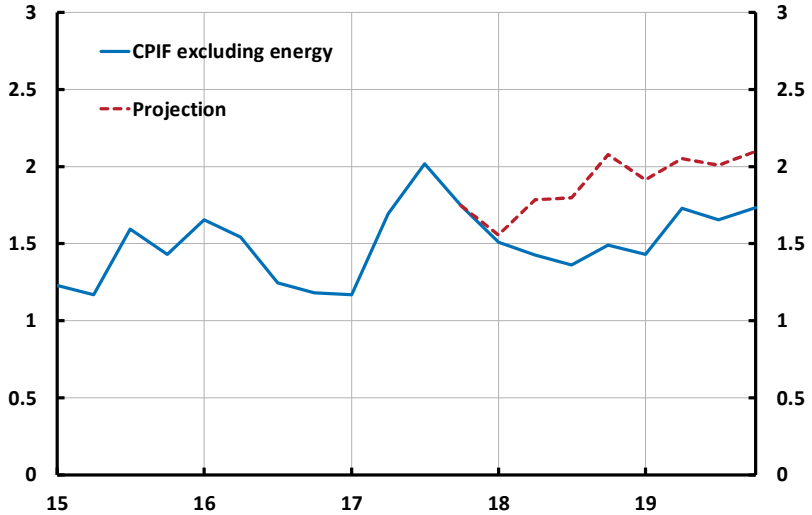
Figure 6. CPIF, outcomes and forecasts
Annual percentage change



Sources: Statistics Sweden and the Riksbank

0 shows that inflation in 2018 and 2019 were unusually low considering how resource utilisation, unit labour costs and the exchange rate have developed in recent years, that is the variables that usually explain the development of inflation.[3] If inflation had developed in line with historical correlations, the rate of increase in the CPIF excluding energy would have been 0.3-0.5 percentage points higher in 2018 and 2019.

Figure 7. Outcomes and projection for the CPIF excluding energy
Annual percentage change



Note: The projection is an average of forecasts made in 5 different variants of estimated equations in which the development of the CPIF excluding energy is explained by the development of the krona exchange rate (KIX), unit labour costs, global export prices and different measures of resource utilisation. The equations are calculated using data until the end of the fourth quarter of 2017, after which a forecast is made using the outcome of the explanatory variables until the end of the fourth quarter of 2019.

Sources: Statistics Sweden and the Riksbank

[3] This result has also been found in studies of the development of inflation in the euro area. See, for example, E. Bobeica et al., 2019, "The link between labour cost and price inflation in the euro area", ECB Working Paper Series No 2235 and Y. Abdih et al., 2018, "Understanding Euro Area Inflation Dynamics: Why So Low for So Long?", IMF Working Paper WP/18/188, 2018.

Unexpectedly low inflation explained by unexpectedly low demand in VAR model

0 and 0 show how a structural VAR model interprets the forecasting error 2019 for CPIF inflation and the exchange rate (KIX) in relation to the forecasts made in the Monetary Policy Report from July 2018.[4] According to the model, the most important explanation for inflation having been unexpectedly low is that domestic and global demand has been unexpectedly low. At the same time, the unexpectedly weak krona has contributed to higher inflation. The weaker than expected krona is mainly explained in the model by unexpectedly low domestic demand and unexpectedly high risk premiums.

Figure 8. CPIF inflation, breakdown of forecast errors
Percentage points

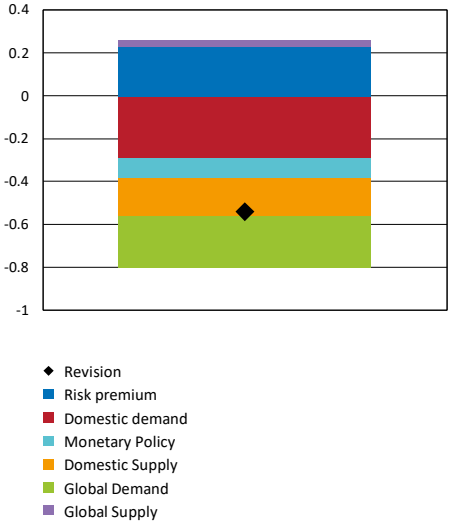
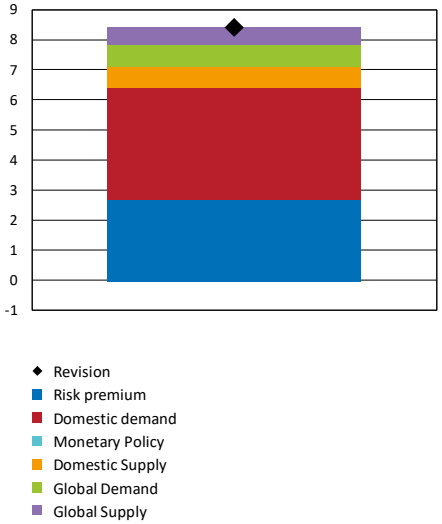


Figure 9. KIX, breakdown of forecast errors
Annual percentage change



Note: The Figure shows a breakdown of the forecast errors for average CPIF inflation and the average KIX index in the forecasts for 2019 made in the MPR, July 2018. The black rectangle shows the forecast error as percentage points and the bars show the contribution to the forecast error from various shocks.

Source: The Riksbank

2. Forecast evaluation

At the beginning of this section, we compare the Riksbank's forecasts with assessments performed by other forecasters for the period 2010–2019.[5] After this, we discuss the results for 2019 and also make a slightly more detailed analysis of the Riksbank's short-term inflation forecasts.

The forecasts compiled refer to forecasts of developments up to two years ahead. Forecasts for the whole of 2019 therefore refers to forecasts published in both 2018 and 2019.

Measures of forecasting precision

One of the most common evaluation measures when studying forecasts is average forecast error, or mean error. This shows whether there is any systematic over- or underestimation in the forecasts. In this report, forecast error is expressed as outcome minus forecast, with a positive mean error thus indicating that outcomes, on average, have been higher than the forecasts and a negative value pointing to outcomes being, on average, lower than the forecasts. Even if the mean error is close to zero, the forecasts do not need to have been accurate Major positive and negative forecasting errors can cancel each other out, giving a mean error that is close to zero, and giving the impression that accuracy has been

[4] See Corbo and Di Casola (2018)

[5] The results are less sensitive to random differences between different analysts when a slightly longer period is analysed but, at the same time, the results are affected by differences in forecasting accuracy from quite a long time ago. There are thus arguments for both a long and a relatively short evaluation period.

good despite it not having being so. We therefore also report the mean absolute error, that is the average of the absolute value of the forecast errors.[6]

As forecasts are made at different frequencies and on different occasions, forecasters do not have access to the same information at the time of forecasting. This makes it difficult to compare their accuracy. A forecaster who bases their analysis on more up-to-date statistics should have better accuracy. It is therefore important to consider differences in access to information when comparing accuracy. The analysis below presents an adjusted absolute average error that takes this into account.[7]

The Riksbank's forecasts better than or in line with the average, except for the repo rate

0 - 0 show average forecast error (mean error) and adjusted mean absolute error for GDP growth, unemployment, CPIF inflation and the repo rate. The forecasts have been performed by Swedish forecasters for the period 2010-2019.[8]

The red bars show the systematic errors or mean errors, where the forecast errors are consistently expressed as outcome minus forecast. The Figures show that the systematic errors for GDP are positive. This means that economic growth, on average, has been higher than expected in relation to all forecasters' forecasts. The negative bars in 0 show that unemployment, on average, has been lower than expected. Like other forecasters, the Riksbank has overestimated inflation and the level of the repo rate over this period.

The blue bars in 0 - 0 show the adjusted mean absolute errors, which equal zero on average. The measure is reported as a deviation from the mean value for all forecasters. A negative value can hence be interpreted as the accuracy of a certain forecaster being better than average. A positive value indicates the opposite. In the figures, forecasters are sorted according to the adjusted mean absolute error with the best accuracy furthest to the left. There are differences in accuracy among the various participants, but they are small. The difference between the best and worst forecaster, for example for CPIF inflation, is only 0.05 percentage points (see 0). Over the period, the Riksbank's forecasts have been most accurate for GDP growth and unemployment. The Riksbank's accuracy in the forecasts for CPIF inflation have been in line with the average, while the accuracy of the forecasts for the repo rate have been worst.

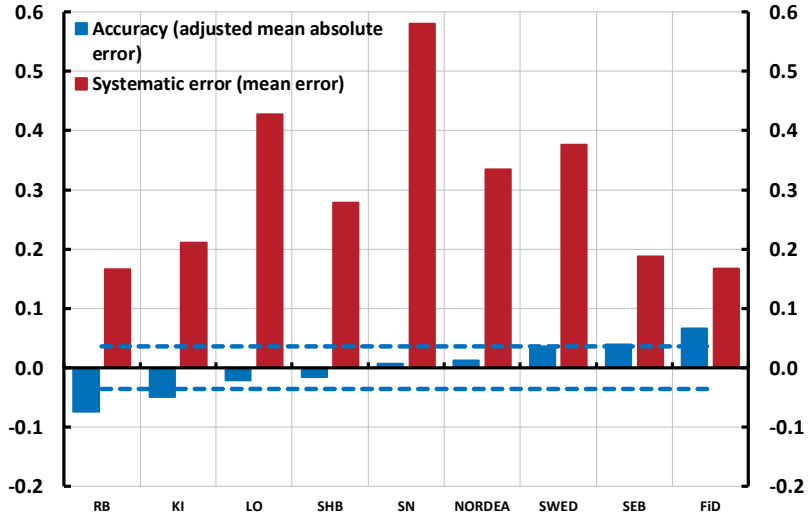
If the observed forecast errors for the period 2020 to 2019 are considered as a sample of a greater population of forecast errors, it is possible to calculate, using the standard deviations in the forecast errors, a 95-per cent confidence interval to discern whether there are significant, non-random differences in the accuracy of the different forecasters. Such an interval shows that the Riksbank's accuracy has been significantly better than average for GDP growth and unemployment and significantly worse for the repo rate. Accuracy for CPIF inflation has been in parity with the average (see 0 - 0).

[6] The absolute value refers to a number's distance to zero. Both 1 and –1 therefore have the absolute amount of 1.

[7] The method has been developed at the Riksbank, see Andersson and Aranki (2009) and Andersson, Aranki and Reslow (2016). A brief description of the method is given in the Appendix.

[8] For GDP growth, unemployment and inflation, the evaluation is based on forecasts from nine forecasters: The Riksbank (RB), the Ministry of Finance (MoF), the National Institute of Economic Research (NIER), the Swedish Trade Union Confederation (STUC), Nordea, Skandinaviska Enskilda Banken (SEB), Svenska Handelsbanken (SHB), the Confederation of Swedish Enterprise (CSE) and Swedbank (SWED). For the repo-rate forecasts, CSE is not included in the comparisons; instead forecasts are included based on market expectations (Market), according to market pricing of forward rates, calculated from derivative contracts (RIBA and FRA).

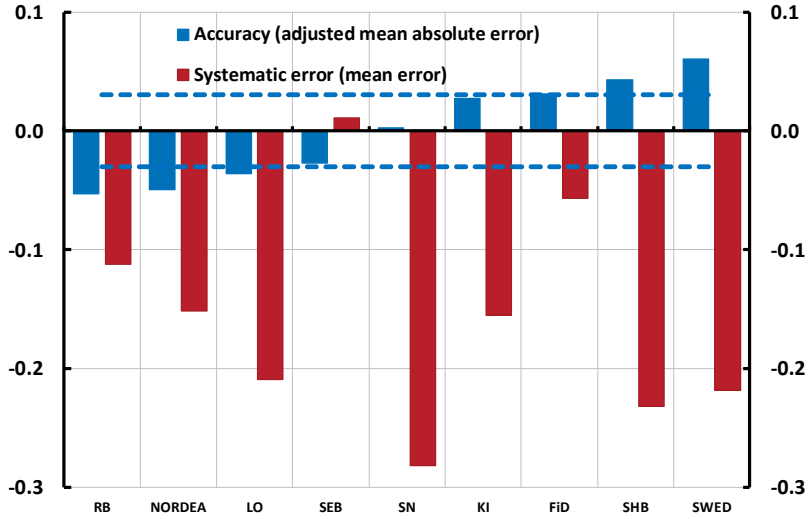
Figure 10. GDP growth, accuracy and systematic error in forecasts from various analysts for 2010-2019
Percentage points



Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

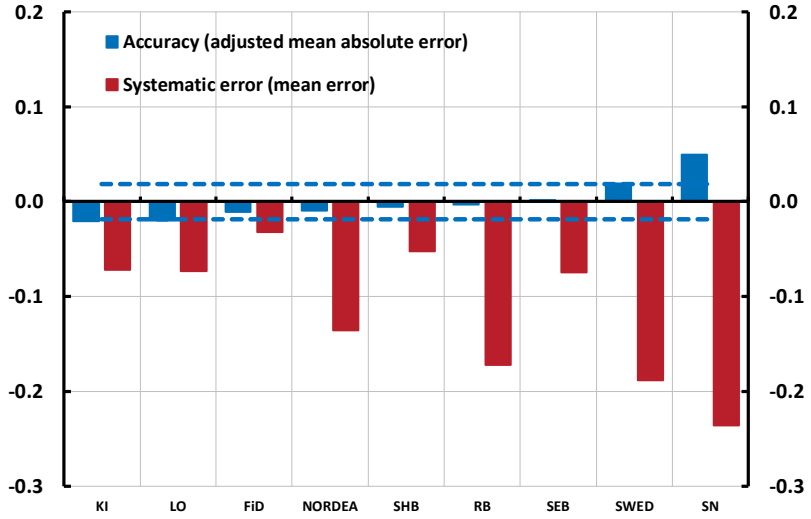
Figure 11. Unemployment, accuracy and systematic error in forecasts from various analysts for 2010-2019
Percentage points



Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

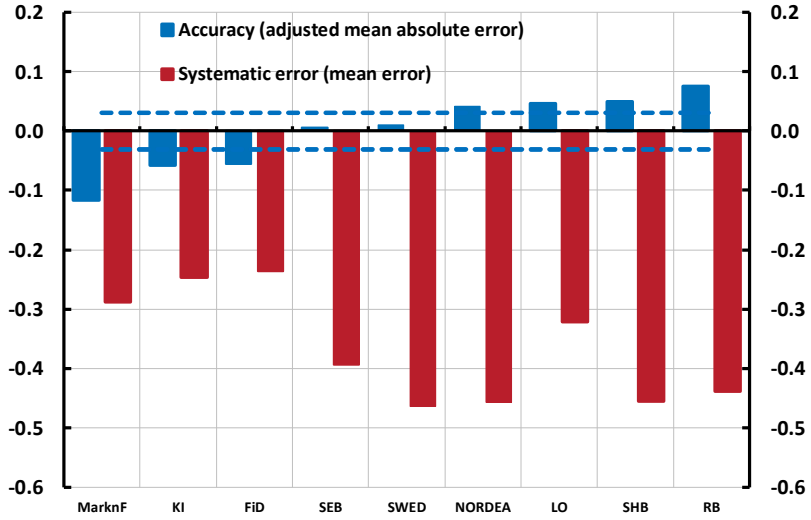
Figure 12. CPIF inflation, accuracy and systematic error in forecasts from various analysts for 2010-2019
Percentage points



Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Figure 13. Repo rate, accuracy and systematic error in forecasts from various analysts, 2010-2019
Percentage points

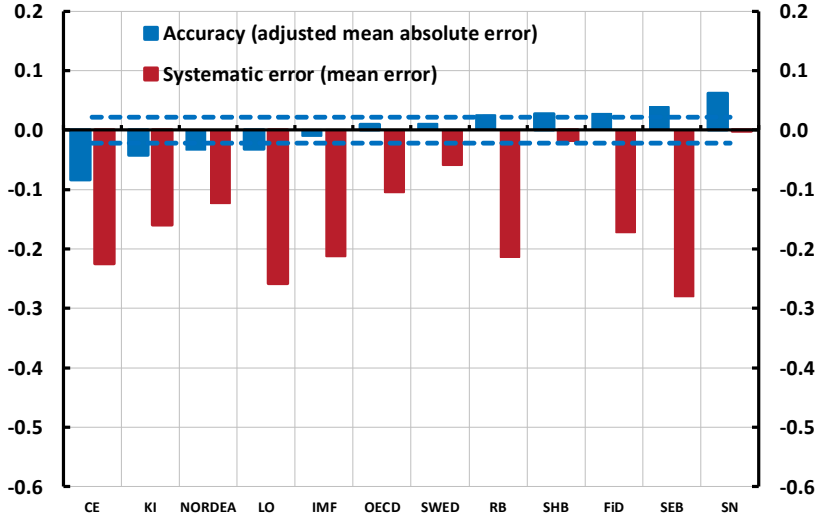


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

0-0 show the corresponding result for GDP growth and inflation in the United States and euro area. On average, the forecasts for GDP growth in both the US and the euro area have been too high during the period 2010-2019 (see the red bars). As regards inflation in the United States and euro area, there is no clear method. The blue bars in 0 to 0 show that the Riksbank's accuracy in international forecasts has been close to average.

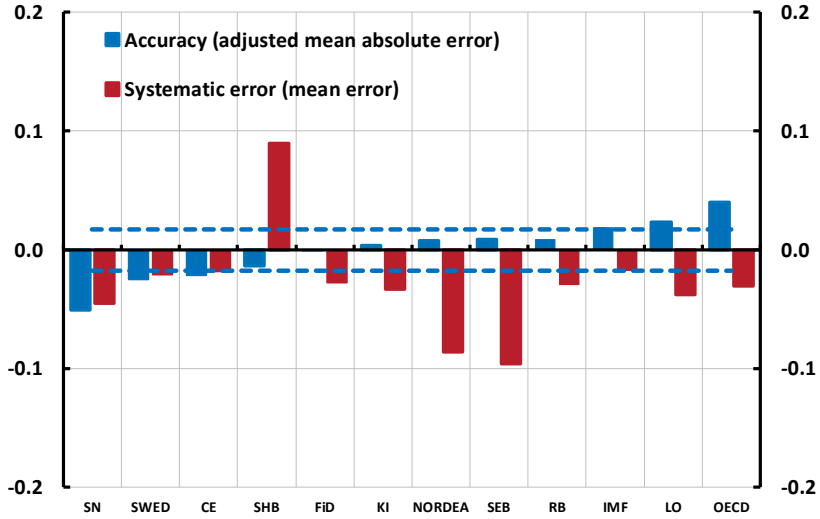
Figure 14. GDP growth in the United States, accuracy and systematic error in forecasts from various analysts, 2010-2019[9]
Percentage points



Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Figure 15. GDP growth in the euro area, accuracy and systematic errors in forecasts from various analysts, 2010-2019
Percentage points

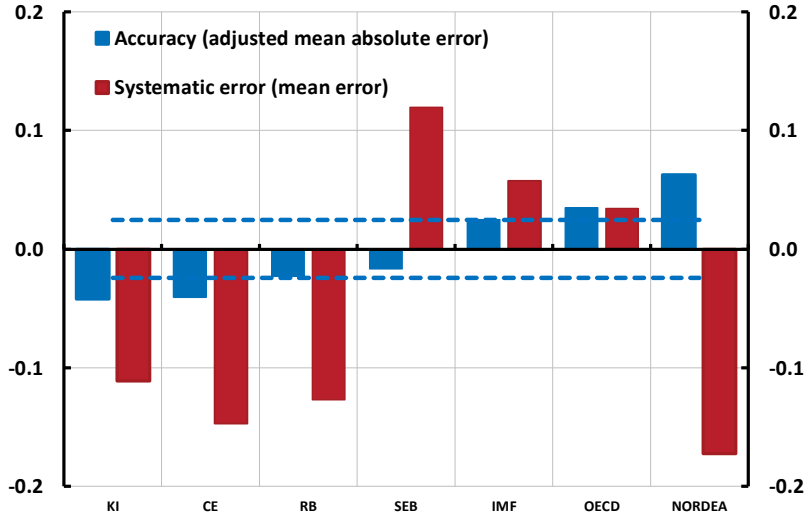


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

[9] CE refers to the forecasts reported by Consensus Economics every month.

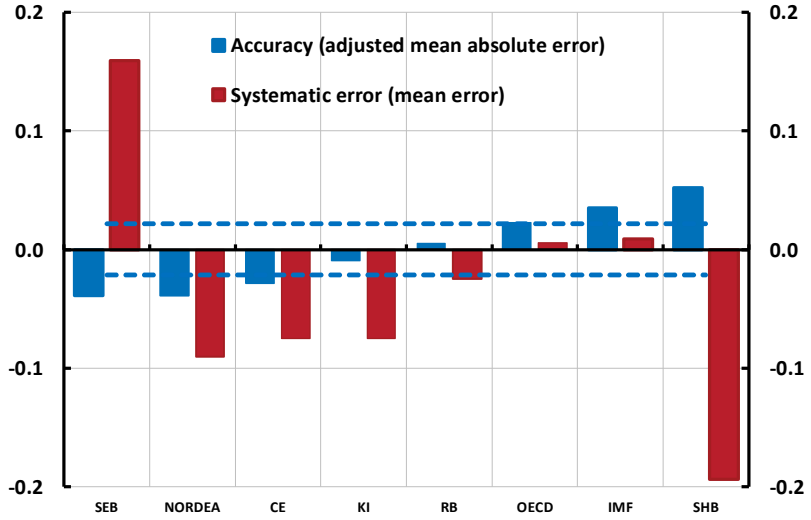
Figure 16. CPI inflation in the US, accuracy and systematic errors in forecasts from various analysts, 2010–2019
Percentage points



Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Figure 17. HICP inflation in the euro area, accuracy and systematic errors in forecasts from various analysts, 2010–2019
Percentage points



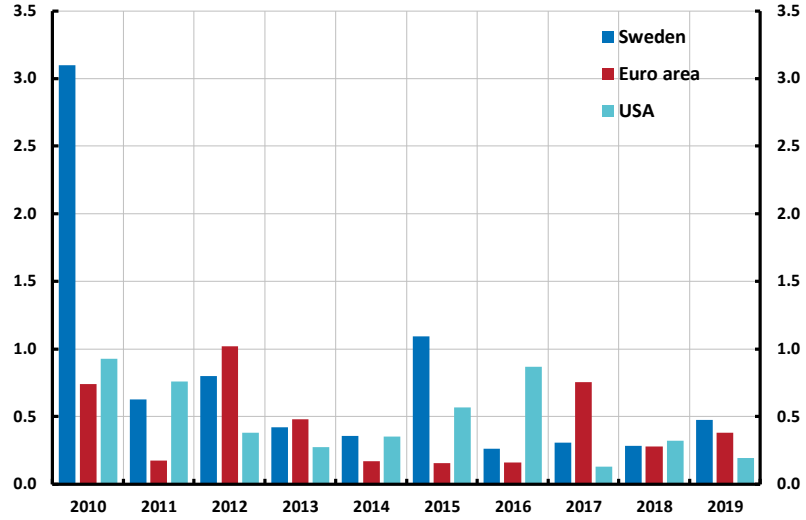
Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Varying levels of difficulty in making forecasts in different years

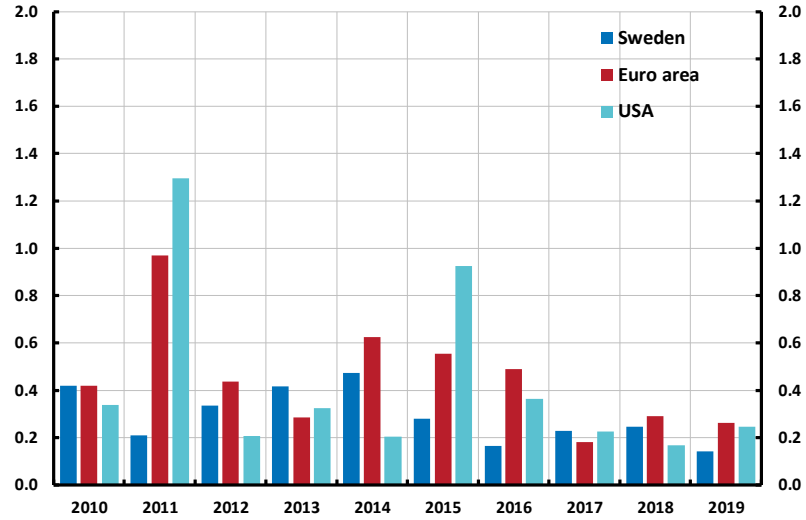
To gain a measure of how difficult it has been for forecasters to predict various variables over time, we calculate here an average of the different forecasters' mean absolute error year by year. Such average mean absolute errors are shown for GDP growth and inflation in Sweden, the United States and the euro area in 0 and 0 below. In 2019, the average mean absolute errors for GDP growth and inflation were relatively normal in all regions.

Figure 18. Average mean absolute errors for GDP growth 2010-2019



Sources: Respective analysts and the Riksbank

Figure 19. Average mean absolute errors for inflation 2010-2019



Sources: Respective analysts and the Riksbank

An evaluation of the Riksbank's forecasts for 2019

In this section, we investigate the forecasts for 2019 in the same way as for the period 2010-2019.[10] The results for the forecasts of Swedish variables are shown in 0 - 0 in appendix 1. All forecasters had expected higher GDP growth and lower unemployment in Sweden than turned out to be the case. The Riksbank's forecasts are among the more accurate for unemployment and among the less accurate for GDP growth, inflation and the repo rate, but the differences are small among analysts. All analysts had also expected inflation and the repo rate to be higher than they actually were.

The red bars in 0-0 show that GDP growth and inflation in general were unexpectedly low in the United States and euro area. The blue bars show that the Riksbank's accuracy for international variables has been close to average or better for the year 2019.

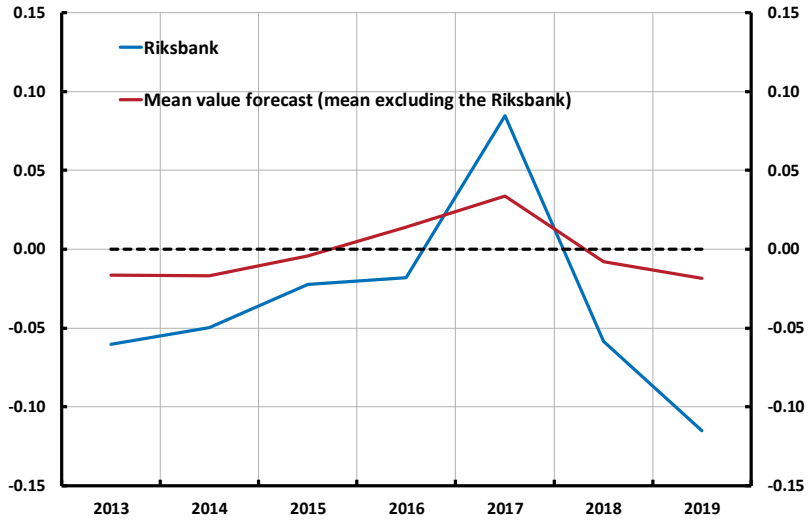
[10] The forecast comparison refers to forecasts for 2019 that were made over the period 2018 to 2019.

An evaluation of the Riksbank's inflation forecasts in the short term

In this section, we study how accurate inflation forecasts have been in the short term, i.e. three months ahead. Results are presented for a number of forecasters who normally report their monthly forecasts on a regular basis. These forecasts are compared with the Riksbank's published forecasts.[11]

As the Riksbank does not publish forecasts every month, two, or sometimes three, CPIF outcomes may often be published before a new forecast from the Riksbank is available. The analysis therefore includes forecasts one to three months ahead as far as the Riksbank is concerned. These forecasts, with varying forecast periods, are compared with assessments from other forecasters, who make new forecasts more often. In this analysis, the other forecasters thus have access to more or as much information as the Riksbank on forecast date.[12] The annual average of monthly forecast errors for CPIF inflation has been compiled in 0. The results show that the Riksbank has overestimated short-term inflation every year except 2017. The red line, labelled "Mean value forecast (mean excluding the Riksbank)", shows average forecast errors (outcome minus forecast) when a mean value of other analysts' forecasts has been calculated. Such a mean value forecast is normally the most reliable seen over longer periods.[13] The mean value forecast shows the same pattern as the Riksbank's forecasts, but the systematic forecast errors are fewer.

Figure 20. Annual average of monthly forecast errors for CPIF inflation, 2013–2019
Percentage points

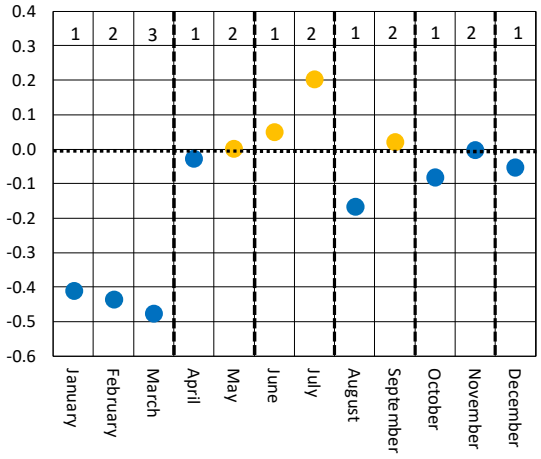


Sources: Bloomberg and the Riksbank

0 shows forecast errors for CPIF inflation for January to December 2019. The figures at the top of the figure show the information that was available to the Riksbank. A one means this is a one-step forecast.

[11] Bloomberg publishes one-step forecasts (forecasts one month ahead) every month from a number of forecasters. The number of forecasters, excluding the Riksbank, is eighteen during the studied period 2013–2018. They include the major Swedish banks and other private financial agents.
[12] Forecasts from other forecasters are mostly one-step forecasts and should therefore, in most cases, be more accurate than the Riksbank's most recently published forecast. Even in cases in which the Riksbank's forecast refers to inflation one month ahead, other forecasters have a certain advantage, as their forecasts are often made only a couple of days ahead of the CPIF outcome. The amount of information available on the development of factors such as fuel prices, electricity prices and exchange rates in recent days is often important.
[13] See, for instance, Stock and Watson (2004).

Figure 21. The Riksbank's forecast error for CPIF inflation in 2019
Percentage points



Source: The Riksbank

In January, the forecast error amounted to almost −0.4 percentage points. In the forecast, which was published in the Monetary Policy Report on 15 February, the Riksbank had access to CPIF information for December 2018, which means that it was a one-step forecast. The average overestimation of inflation by the Riksbank shown in 0 is thus largely due to inflation having been unexpectedly low in January, which then stayed in February and March as two- and three-step forecasts, respectively.

In 0, we compare different forecasters' accuracy over the short term. Here, both average forecast error (mean error) and mean absolute error (MAE) are presented for the period January 2013–December 2019. If forecasts had been made for all months of this period, there would be 84 of them in total. Eleven forecasters including the Riksbank are analysed here. The row marked "Mean value forecast" shows the result when an average of all forecasts (excluding those of the Riksbank) is evaluated. In this analysis, the mean value forecast takes second place in the ranking. Over the period, the most accurate analyst has a mean absolute error of 0.11. The Riksbank comes in ninth place with a mean absolute error of 0.15. Seven individual forecasters have thus on average made more accurate forecasts than the Riksbank during this period, but the differences are small.[14] It can also be noted that the Riksbank, on average, has forecast a slightly too high level of inflation in the short term.

Table 2. Evaluation of short-term forecasts for CPIF inflation on a 1–3 month horizon, 2013–2019

Ranking	Forecaster	Average error	MAE	Number of forecasts
1	Forecaster with lowest MAE	−0.02	0.11	81
2	Mean value forecast	0.00	0.12	84
9	**The Riksbank**	**−0.03**	**0.15**	**84**
12	Forecaster with highest MAE	−0.03	0.17	64

Note: Forecasts with a one- to three-month horizon for the Riksbank. The forecasting error is calculated as the outcome minus the forecast.
Sources: Bloomberg and the Riksbank

In 0, the Riksbank's two- and three-step forecasts have been excluded. The other analysts' forecasts for these months have also been excluded. It will now be easier to compare the results, but there will also be fewer forecasts and the results will be more uncertain. The mean value forecast is now the most accurate forecast. The Riksbank comes in seventh with a mean absolute error of 0.13. Five individual forecasters have, on average, made more accurate forecasters. It is also clearer here that the Riksbank, on average, has forecast slightly too high inflation one month ahead.

[14] The mean value forecast is not an individual forecaster.

Overall, this analysis shows that the Riksbank's accuracy in the very short term is close to the average for other forecasters, particularly if only one-step forecasts are included in the analysis.

Table 3. Evaluation of short-term forecasts for CPIF inflation on a 1-month horizon, 2013–2019

Ranking	Forecaster	Average error	MAE	Number of forecasts
2	Forecaster with lowest MAE	−0.04	0.12	41
1	Mean value forecast	−0,03	0.11	42
7	**The Riksbank**	**−0.06**	**0.13**	**42**
12	Forecaster with highest MAE	−0.02	0.16	36

Note: Forecasts with a one-month horizon for the Riksbank. The forecasting error is calculated as the outcome minus the forecast.

Sources: Bloomberg and the Riksbank

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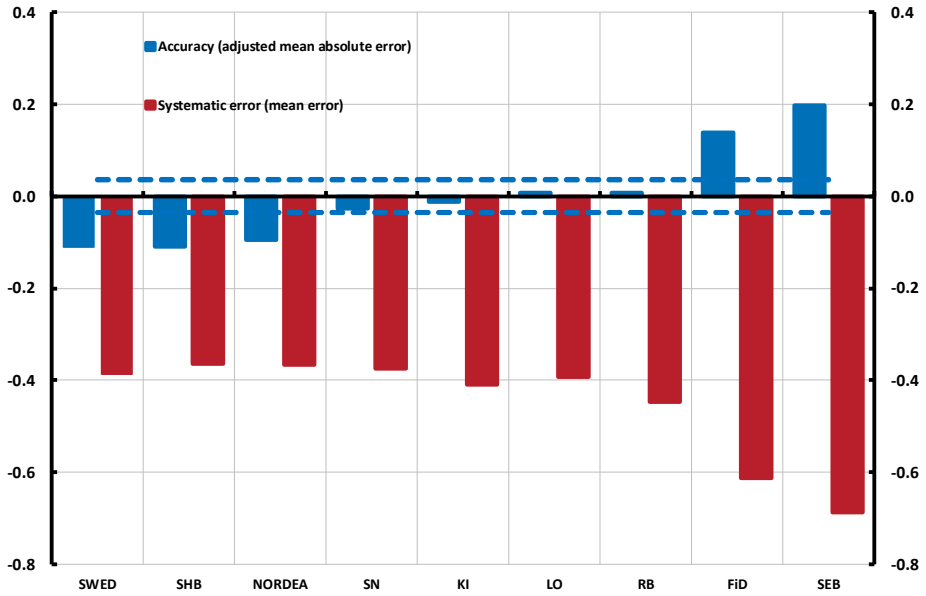
Appendix 1: Forecasts for 2019

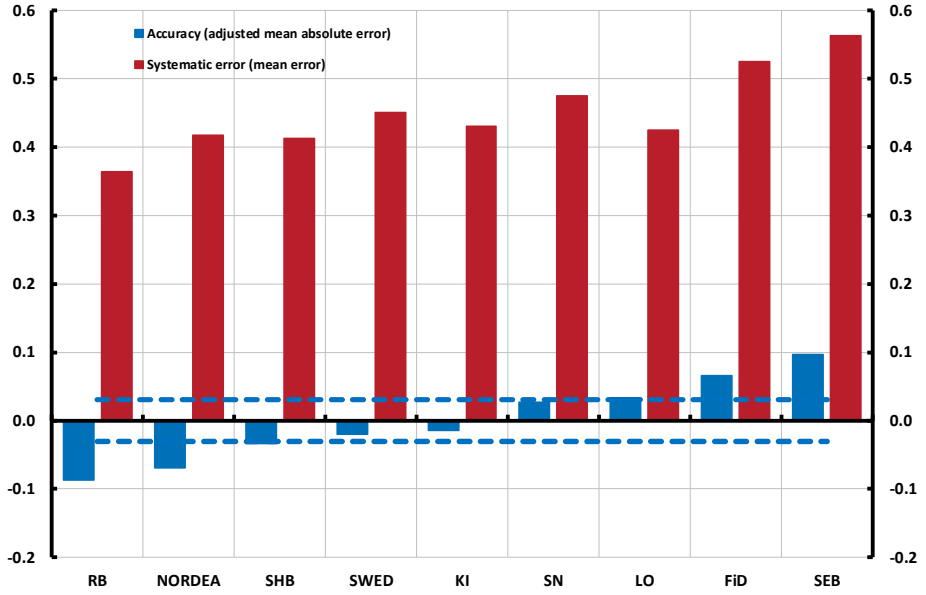
Figure 22. GDP growth, accuracy and systematic errors in forecasts for 2019 from various analysts, 2018–2019
Percentage points



Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

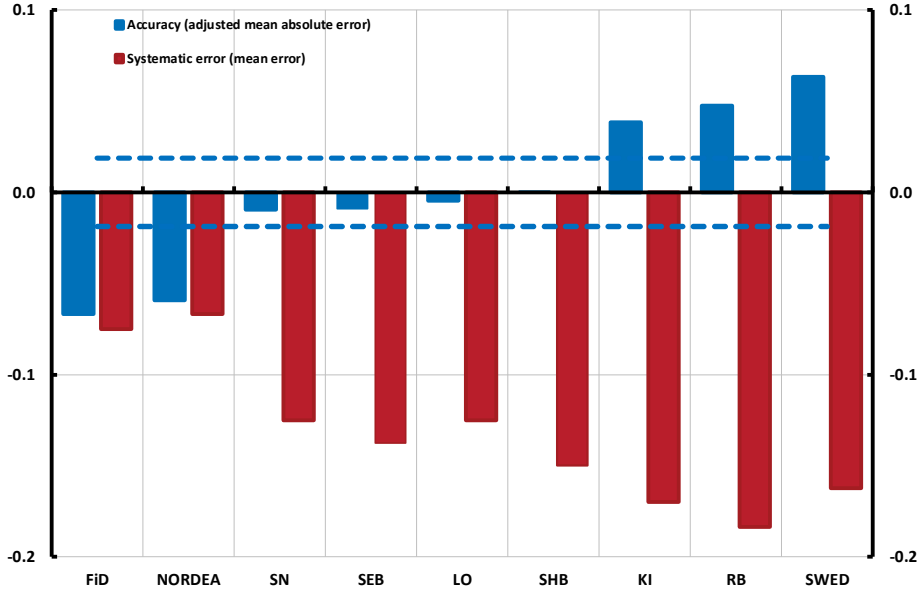
Figure 23. Unemployment, accuracy and systematic errors in forecasts for 2019 from various analysts, 2018-2019
Percentage points



Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

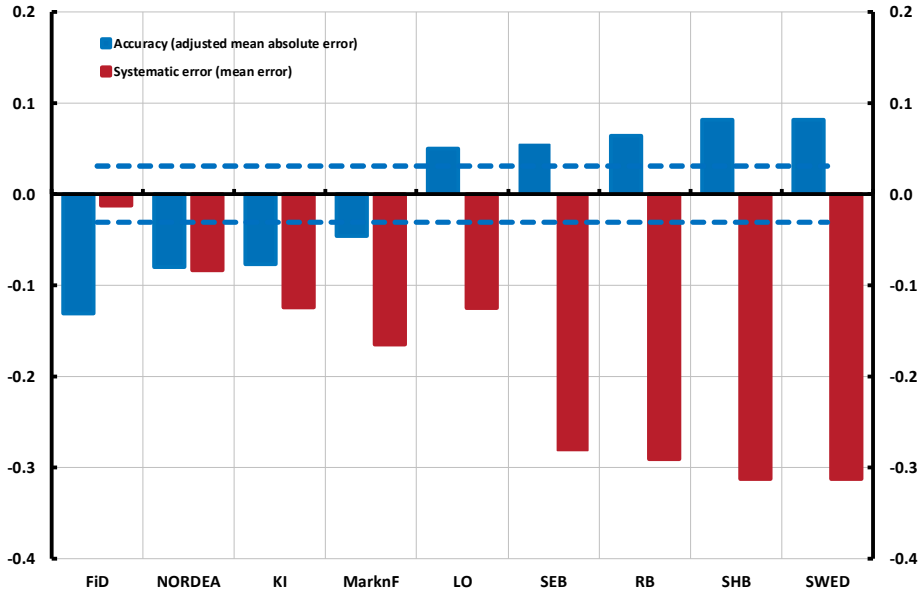
Figure 24. CPIF inflation, accuracy and systematic errors in forecasts for 2019 from various analysts, 2018-2019
Percentage points



Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Figure 25. Repo rate, accuracy and systematic errors in forecasts for 2019 from various analysts, 2018–2019
Percentage points

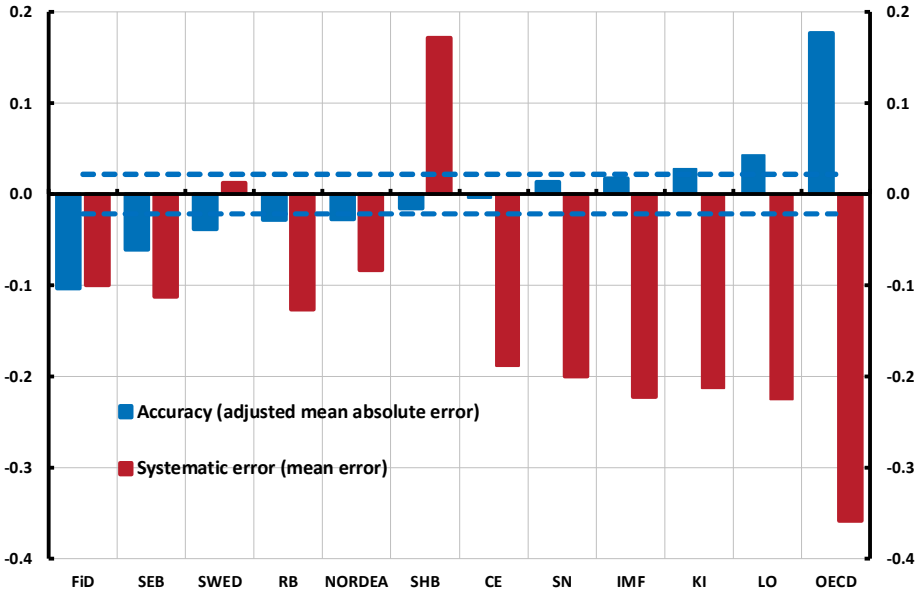


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Figure 26. GDP growth in the United States, accuracy and systematic errors in forecasts for 2019 from various analysts, 2018–2019

Percentage points

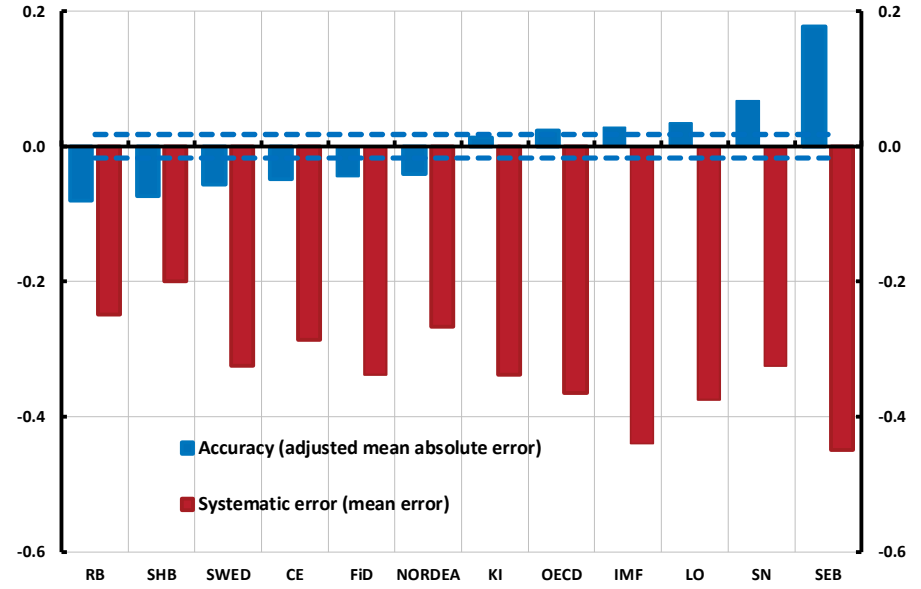


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Figure 27. GDP growth in the euro area, accuracy and systematic errors in forecasts for 2019 from various analysts, 2018-2019

Percentage points

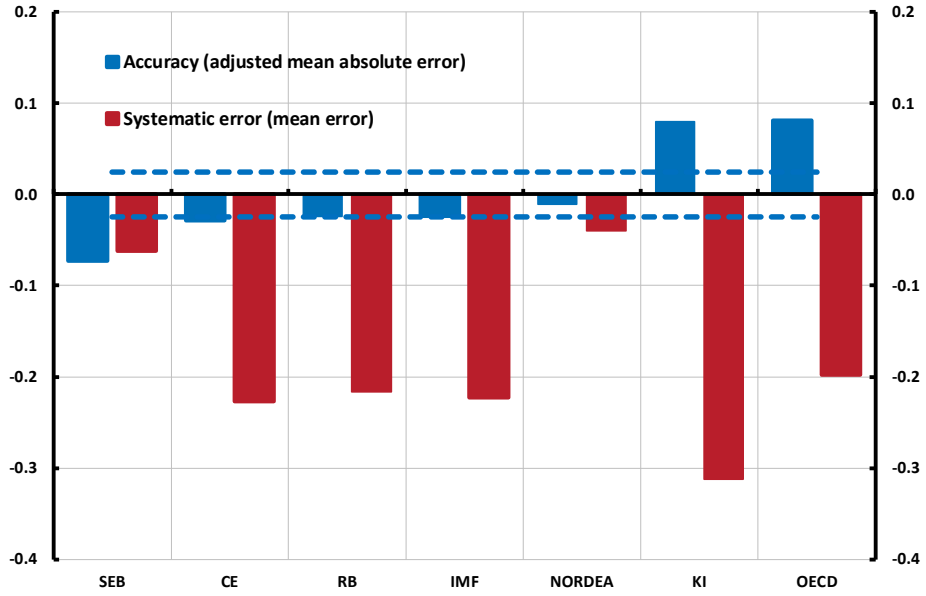


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Figure 28. CPI inflation in the United States, accuracy and systematic errors in forecasts for 2019 from various analysts, 2018-2019

Percentage points

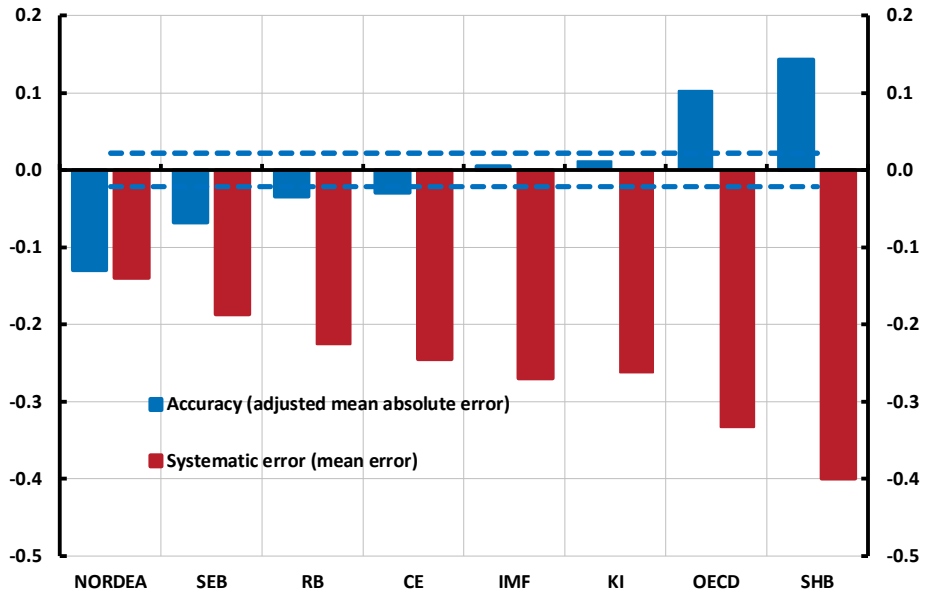


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Figure 29. HICP inflation in the euro area, accuracy and systematic errors in forecasts for 2019 from various analysts, 2018-2019

Percentage points



Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2010-2019. The interval is calculated as 2*standard deviation/square root of number of forecast errors.

Sources: Respective analysts and the Riksbank

Appendix 2: Measuring accuracy

Let x_t be an outcome for economic variable x,, for instance the rate of inflation or GDP growth for a certain period, t. Assume also that $x_{it,h}$ is a forecast for x_t,, made by forecaster *i* a certain number of months h before the outcome is published. The absolute forecasting error $\varepsilon_{it,h}$ is then given by

$$\varepsilon_{it,h} = \left|x_t - x_{it,h}\right|. \quad (1)$$

In this study, x_t refers to yearly averages, for example GDP growth in 2008, and the forecasts that are evaluated refer to the current or next year. This means therefore $h \leq 24$ months. In order to summarise the accuracy of forecaster *i*, its mean absolute error (MAE) can be calculated as

$$MAF_t = \frac{\sum \varepsilon_i}{n_i}, \quad (2)$$

Where n_i is the number of forecasts made by forecaster *i*. The measure shows how much the forecasts have deviated from the outcome on average and it can be used to compare forecasting precision, or how accurate various forecasters have been.

In practice, forecasters publish their forecasts at different points in time. If forecast horizon *h* differs among forecasters, it also means that the forecasters have access to different amounts of information when making their forecasts. This means it is not entirely fair to compare the mean absolute error among forecasters. Forecaster *i* that often publishes its forecasts late, has a low *h* on average, and should therefore, on average, have a better accuracy than other forecasters.

In order to correct the measure of accuracy because forecasters have access to different amounts of information when they make their forecasts, Andersson et al. (2016) propose dividing the absolute forecast error into different components. The results from this decomposition are then used to calculate accuracy or forecasting precision in a fairer way. The decomposition is done by estimating the equation

$$\varepsilon_{it,h} = \delta M_{it,h} + \mu_i + \mu_{i,t=c} + \lambda_t + e_{it,h}. \quad (3)$$

The first component in the equation, $M_{it,h}$, depends on the volume of information available at point in time *h*, when forecaster *i* publishes its forecast. The two components thereafter reflect the forecasters' general precision. The average accuracy of forecaster *i* is described by μ_i whereas the term $\mu_{i,t=c}$ captures the forecasting ability when evaluating individual years, *c*. The fourth term, λ_t,, takes into account the fact that some years are more difficult to forecast than others. Finally, the residual $e_{it,h}$ is the part of the forecasting error that the equation is not able to capture. It is assumed to be randomly allocated, with the mean value of zero and constant variance.

The annual growth rate for a specific year, *T*, is a function of all quarterly or monthly growth rates during years *T–1* and *T*. Andersson et al. (2016) show that the growth rates at the higher frequencies also have different weights in terms of annual growth.[15] This weighting scheme is used to construct $M_{it,h}$ in equation (3). The volume of information possessed by forecaster *i* in the publication month is here approximated by the accumulated weight up to a certain month, $W_{it,h}$. The weight increases, the closer one is in time to the definitive outcome. The time effect in equation (3) is defined as

$$M_{it,h} = 1 - W_{it,h}. \quad (4)$$

[15] See the discussion about Table 1 in Andersson et al. (2016), which describes the weighting scheme for quarterly data. This study uses monthly weights.

When $W_{it,h}$ increases, $M_{it,h}$ decreases and equation (4) can be seen as an approximation of the information that is missing when the forecast is published. The coefficient δ in equation (3) captures the marginal effect on the forecasting error of having access to less information, and the effect is allowed to vary over time.

Equation (3) is estimated over all n forecasters and horizons. Based on the estimates of μ_i and $\mu_{i,t=c}$, the adjusted mean absolute error is defined for a certain year as

$$\mu^*_{i,t=c} = \hat{\mu}_{i,t=c} + \hat{\mu}_i - \frac{1}{n}\sum_j\left(\hat{\mu}_{j,t=c} + \hat{\mu}_j\right). \quad (5)$$

The adjusted mean absolute error is therefore defined as the deviation from an average of all forecasters. A negative value means that forecaster *i* makes better forecasts than the average while a positive value means that the forecaster has made poorer forecasts than the average.

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