Riksbank study

Evaluation of the Riksbank's fore-casts

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SVERIGES RIKSBANK

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Riksbank studies

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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 background material for monetary policy decisions.

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 2021. This forecast evaluation focuses on forecasts for the period 2012–2021, with a special analysis of the forecasts for 2021.

The report has been produced by the Monetary Policy Department. Most of the work on study has been performed by Jesper Johansson, Gabriella Linderoth, Mårten Löf, Ard Den Reijer and Pär Stockhammar.

Jesper Hansson

Head of the Monetary Policy Department

Summary

This study analyses and evaluates the Riksbank's forecasts for a number of central macroeconomic variables for the period 2012 to 2021. The report opens with a description of how economic activity in 2021 compared to the forecasts. In the second part of the report, we compare the Riksbank's forecasts with those made by other forecasters.

The recovery following the economic crisis in connection with the pandemic was unexpectedly rapid, and GDP growth in Sweden was higher in 2021 than was expected in both the Riksbank's and other analysts' forecasts made in 2020 and 2021. Inflation was also higher than expected in 2021, mainly in the United States but also in Sweden and the euro area.

For the period 2012–2021, the Riksbank had on average a relatively high degree of accuracy in its forecasts for unemployment compared with the forecasts of others. The accuracy of the Riksbank's forecasts for GDP growth was in line with that of other forecasters, while the forecasts for CPIF inflation and the repo rate were less accurate than others. However, the difference in accuracy between different forecasters is generally small. In the forecasts for 2021 alone, the accuracy of the Riksbank's forecasts was in line with the other forecasters. This also applied to the Riksbank's inflation forecasts in the short term.

1 Economic developments in 2021 in comparison to forecasts

In this section, we compare outcomes for economic developments in 2021 with the forecasts published by the Riksbank and others in 2019, 2020 and 2021. The focus is on the variables normally used to explain the development of inflation.

The coronavirus crisis contributed to a low level of GDP growth and inflation, both in Sweden and abroad, in 2020. However, the economy recovered rapidly in Sweden, and in relation to the forecasts made in 2020, growth was unexpectedly high and unemployment was unexpectedly low in 2021. Inflation was higher than expected, especially at the end of the year as a result of a rapid increase in energy prices.

1.1 Rising inflation in Sweden 2021

During 2021, CPIF inflation averaged 2.4 per cent (see Table 1). This was significantly higher than the previous year and also high in relation to a historical average. Among the sub-groups in the CPIF, it was primarily energy prices that increased faster than usual. However, prices of services and goods also increased somewhat faster than normal. The rate of price increase for food was instead lower than its historical average.

Table 1. Sub-groups in the CPIF

Weight and average annual rate of increase in per cent

	Weight 2021	2000– 2019	2020	2021
Services	43.3	1.8	1.4	2.2
Goods excluding food	27.8	-0.4	0.1	0.2
Food	18.5	1.9	2.1	0.6
Capital stock index	3.4	5.3	5.6	5.9
CPIF excluding energy	**92.9**	**1.4**	**1.3**	**1.4**
Energy	7.1	3.9	-9.7	17.1
CPIF	**100.0**	**1.6**	**0.5**	**2.4**

Note. Weight refers to the weight in the CPIF.

Source: Statistics Sweden.

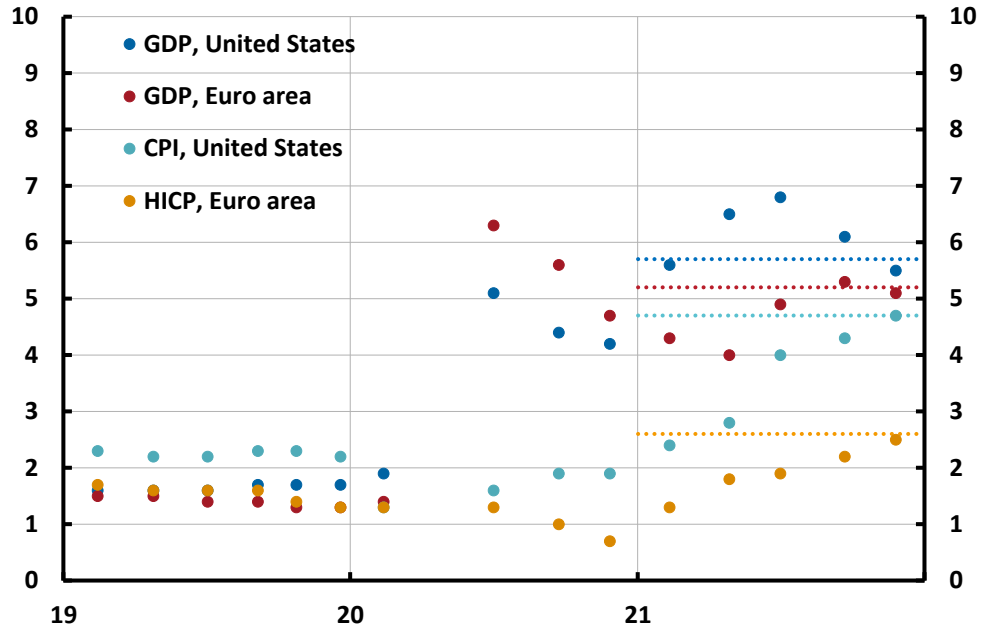
1.2 Unexpectedly high international inflation

International inflation was higher in 2021 than was expected in the Riksbank's forecasts, particularly in the United States but also in the euro area (see Figure 1). Rising energy prices contributed to this. But even adjusted for energy prices, inflation was higher than expected.

The recovery following the coronavirus crisis meant that growth in was also unexpectedly high in 2021, compared with the forecasts made in 2019. Compared to the forecasts made after the outbreak of the pandemic in 2020, growth in the United States was slightly higher than expected, but growth in the euro area was slightly lower than expected (see Figure 1).

Figure 1. International growth and inflation, the Riksbank's forecasts 2019–2021 (dots) and the outcome for 2021 (dashed lines)

Annual percentage change



Sources: National sources and the Riksbank.

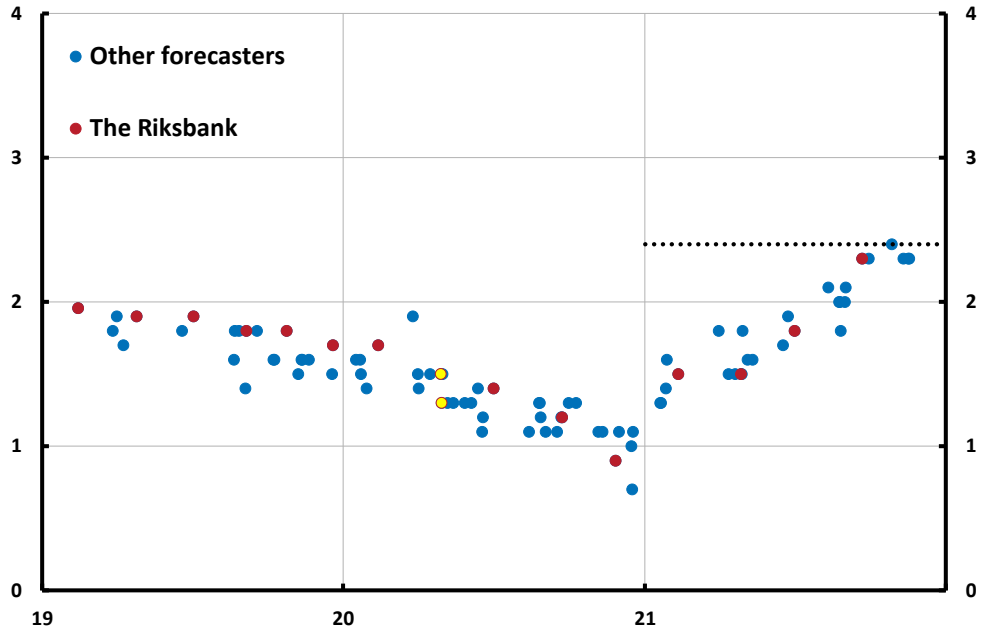
1.3 Unexpectedly high inflation in Sweden

As in the rest of the world, inflation in Sweden was unexpectedly high in relation to the forecasts by the Riksbank and other analysts (see Figures 2, 3 and 4). It was primarily energy prices, both electricity and fuel, that contributed to a rapid rise in inflation at the end of the year. The difference in the rate of increase between the CPIF and the CPIF excluding energy was as much as 2.4 percentage points in December 2021. This is the biggest difference in the period since the inflation target began to apply in the mid-1990s.

However, even adjusted for energy prices, inflation was somewhat higher than expected. This is due to the unexpectedly rapid recovery following the coronavirus crisis and the fact that demand therefore increased faster than supply. The rapid rise in demand meant, among other things, that prices of commodities, input goods and transport rose more than usual in 2021.

Figure 2. CPIF in Sweden, forecasts by the Riksbank and other analysts 2019–2021 (dots) and outcome for 2021 (dashed line)

Annual percentage change

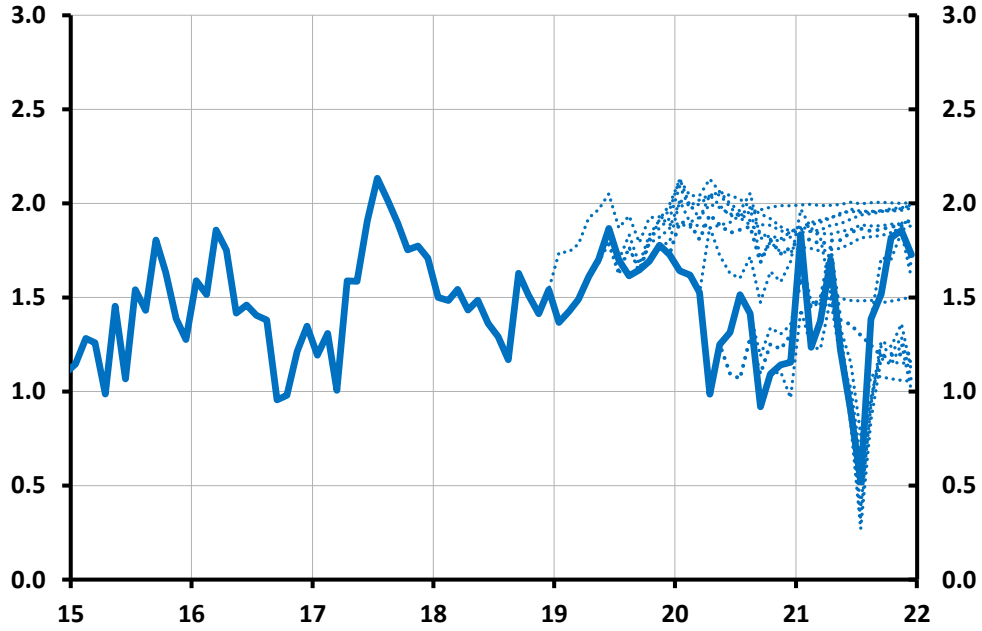


Note. No forecasts were published in the Monetary Policy Report in April 2020. Instead, two scenarios were presented for future developments for a small number of variables. These are depicted as yellow dots in the figure.

Sources: Statistics Sweden, the respective analysts and the Riksbank.

Figure 3. CPIF excluding energy, Riksbank's forecasts 2019–2021 (broken lines) and outcomes (solid lines)

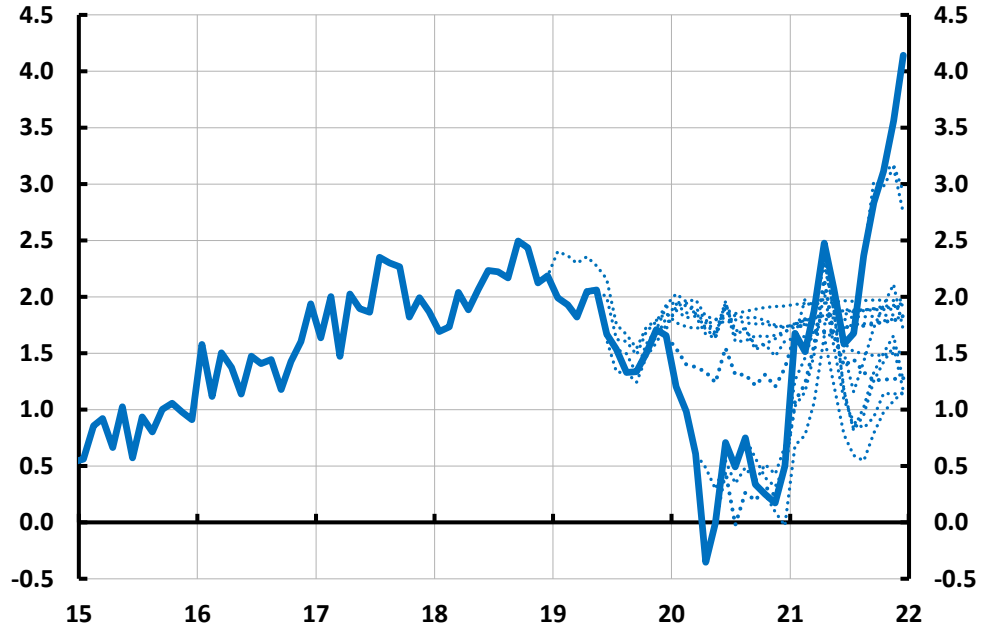
Annual percentage change



Sources: Statistics Sweden and the Riksbank.

Figure 4. CPIF, Riksbank's forecasts 2019–2021 (broken lines) and outcomes (solid lines)

Annual percentage change



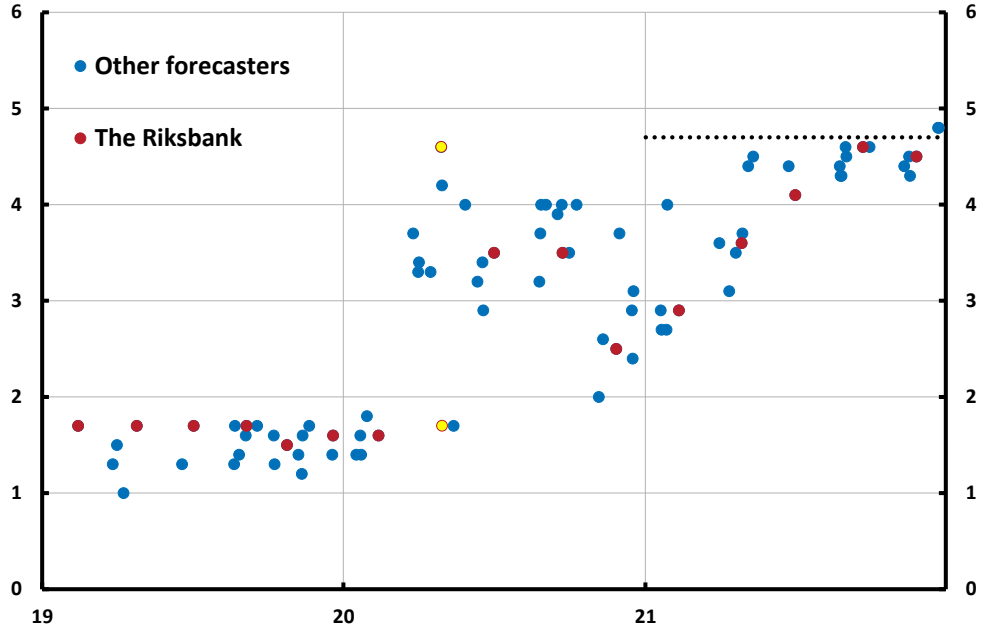
Sources: Statistics Sweden and the Riksbank.

The recovery of the Swedish economy following the coronavirus crisis was faster than any forecaster expected. GDP growth in Sweden was considerably higher in 2021 than in the forecasts made by the Riksbank and other forecasters prior to the pandemic, but also significantly higher than in the forecasts made in 2020 and the first half of 2021 (see Figure 5).

Among the components of GDP, it was mainly exports and investments that showed a surprisingly strong development. Both housing investments and other investments grew faster than expected. The fact that housing investments increased faster than expected in 2021 was mainly due to the surprisingly large number of rental properties being built. However, also more tenant-owner apartments and single-family dwellings were built than expected. The low interest rates have probably increased interest in investing in rental properties. The construction of tenant-owned flats and single-family dwellings has probably also benefited from the rapidly rising demand for housing during the pandemic, which also contributed to rising housing prices.

Figure 5. GDP in Sweden, forecasts by the Riksbank and other analysts 2019–2021 (dots) and outcome for 2021 (broken line)

Annual percentage change



Note. No forecasts were published in the Monetary Policy Report in April 2020. Instead, two scenarios were presented for future developments of a small number of variables. These are depicted as yellow dots in the figure.

Sources: Statistics Sweden, the respective analysts and the Riksbank.

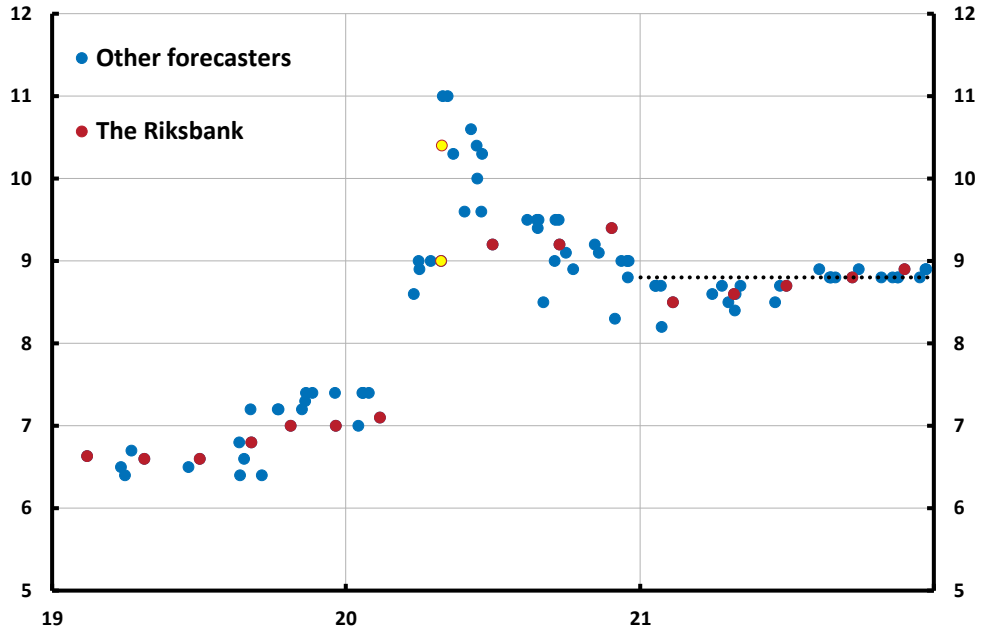
Unemployment was unexpectedly high in 2021, compared to the forecasts made in 2019 (see Figure 6).[1] The unexpectedly rapid recovery in GDP during the year meant

[1] The forecasts published before the Monetary Policy Report in December 2019 were partly based on incorrect statistics. The labour market statistics based on the Labour Force Surveys were substantially revised for the years 2018 and 2019, after serious quality flaws were detected in the data collection. Unemployment was revised upwards from July 2018 until June 2019, but was revised downwards for the months July to September 2019.

that the forecasts made in 2020, at the start of the pandemic, were too pessimistic. Unemployment was therefore lower in 2021 than in the forecasts made in 2020. However, both the outcome and the forecasts for unemployment in 2021 have been affected by a change in statistics in the Labour force Survey (LFS), which has led to several changes, including a higher level of unemployment in the statistics.[2] Without this change in the statistics, unemployment would have been lower and forecasting errors would have been greater.

Figure 6. Unemployment in Sweden, forecasts by the Riksbank and others 2019–2021 (dots) and outcome for 2021 (broken line)

Percentage of labour force aged 15–74



Note. No forecasts were published in the Monetary Policy Report in April 2020. Instead, two scenarios were presented for future developments of a small number of variables. These are depicted as yellow dots in the figure.

Sources: Statistics Sweden, the respective analysts and the Riksbank.

1.4 A model interpretation of unexpectedly high inflation

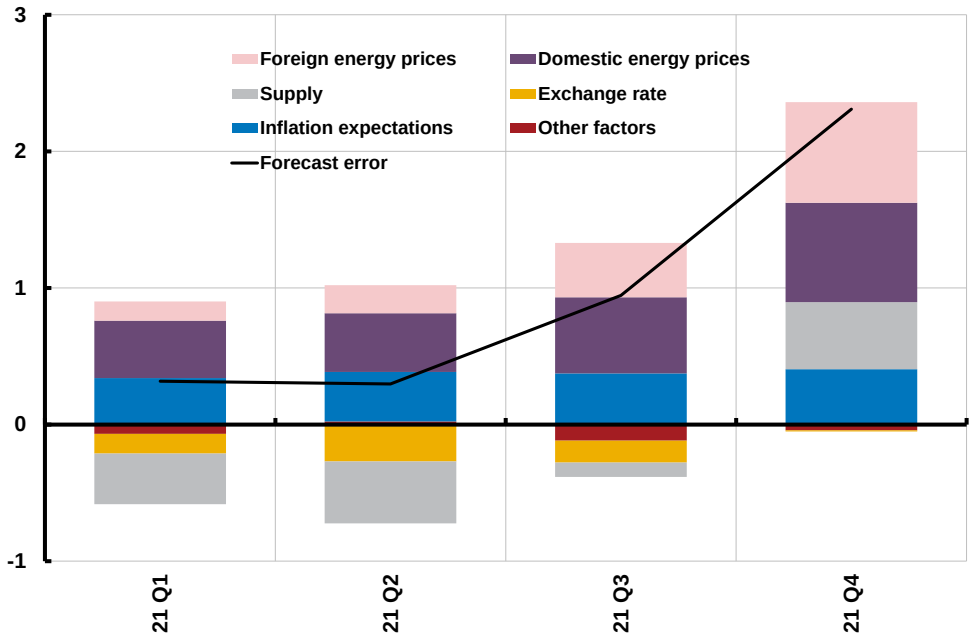
Figure 7 shows how the Riksbank's general equilibrium model, MAJA, interprets the forecasting error for inflation. The forecasting error from the forecast published by the Riksbank in July 2020 has been analysed in the model. The forecast from July was accurate until the second quarter of 2021. After that, the Riksbank was surprised by higher energy prices in Sweden and abroad (pink and purple columns). The rising inflation expectations in 2021 also contribute to the underestimation of CPIF inflation according to the model (blue columns). During the first to third quarters, the underestimation was held back to some extent by the surprisingly strong exchange rate, but this effect slowed down in the fourth quarter (yellow columns). Stronger productivity

[2] In recent data, the LFS has revised unemployment up prior to 2021 by an average of around 0.2 percentage points.

growth, and thus higher supply than expected, contributed negatively to the forecasting error for CPIF inflation in the first part of 2021 (grey columns). However, during the last quarter supply instead made a positive contribution.

Figure 7. Model interpretation of the forecasting errors from forecasts in the Monetary Policy Report, July 2020

Percentage points



Note. A solid line shows the forecasting error for CPIF inflation, defined as the outcome minus the forecast made in the Riksbank's Monetary Policy Report, July 2020. Positive forecasting error means underestimating the CPIF outcome and vice versa. This forecasting error has then been divided into six different categories using the Riksbank's general equilibrium model, MAJA, see Corbo and Strid (2020).

Source: The Riksbank.

2 Forecast evaluation

The beginning of this forecast evaluation discusses different measures of forecasting precision. We then compare the Riksbank's forecasts with forecasts made by other analysts for the period 2012–2021. The results just for 2021 are then discussed and we also analyse the Riksbank's inflation forecasts in the short term in more detail. The forecasts evaluated are those made in the same year and the year before. Forecasts for the whole of 2021 therefore refer to forecasts published in 2020 and 2021.

For the period 2012–2021, the Riksbank had a relatively high degree of accuracy in its forecasts for unemployment in relation to the forecasts of others. The accuracy of the forecasts for GDP growth was in line with that of other forecasters, while the forecasts for CPIF inflation and the repo rate were less accurate. However, the difference in accuracy between different forecasters is generally small. In the forecasts for 2021 alone, the accuracy of the Riksbank's forecasts was in line with the other forecasters. The accuracy of the Riksbank's inflation forecasts in the short term was also in line with that of others.

2.1 Measures of forecasting precision

One of the most common evaluation measures when studying forecasts is average forecasting error, or mean error. This shows whether there is any systematic over- or underestimation in the forecasts. In this report, the forecasting error is expressed as outcome minus forecast. A positive mean error thus indicates that outcomes, on average, have been higher than the forecasts, while a negative value implies the opposite. Even if the mean error is close to zero, this does not necessarily mean that the forecasts have been accurate. Major positive and negative forecasting errors can cancel each other out, giving a mean error that is close to zero, which gives the impression that accuracy has been good despite it not having being so. We therefore also report the mean absolute error, i.e. the average of the absolute value for the forecasting errors.[3] The average mean absolute errors in the forecasts for 2012– 2021 and for 2021 alone are shown in Table 2.

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

Table 2. Average absolute errors in forecasts for 2012-2021 and for 2021 made in the same year and the year before

Percentage points

	2012– 2021			2021		
	GDP	Unem-ployment	CPIF	GDP	Unem-ployment	CPIF
FiD	0.91	0.38	0.39	1.12	0.47	0.88
NIER	0.78	0.35	0.34	0.81	0.45	0.76
STUC	0.84	0.35	0.36	1.33	0.46	0.98
NORDEA	0.79	0.34	0.41	0.95	0.72	0.94
RB	0.78	0.28	0.40	1.24	0.42	0.78
SEB	0.90	0.44	0.38	1.09	0.68	0.86
SHB	0.91	0.41	0.39	1.15	0.41	0.84
CSE	0.75	0.33	0.41	1.24	0.54	0.30
SWED	0.93	0.40	0.46	1.68	0.51	0.81
Mean	**0.84**	**0.36**	**0.39**	**1.18**	**0.52**	**0.79**

Note. Abbreviations as follows: FiD=Ministry of Finance, KI=National Institute of Economic Research, LO=Swedish Confederation of Trade Unions, RB=Sveriges Riksbank, SHB=Svenska Handelsbanken, SN=Confederation of Swedish Enterprise and SWED=Swedbank.

Sources: Respective analyst and the Riksbank.

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 whose analysis is based on more up-to-date statistics should be more accurate. It is therefore important to consider differences in access to information when comparing accuracy. This is why an adjusted mean absolute error that tries to take this into account is presented in the analysis.[4] In practice, this is done by adjusting the forecasting error of a forecaster for how an average forecaster's forecasting error has decreased historically when the forecast has, for example, been made two months later and thus data for two additional months has been available.

2.2 Assessment of forecasts for 2012–2021

Figures 8–11 show average forecasting error (mean error) and adjusted mean absolute error for GDP growth, unemployment, CPIF inflation and the repo rate. The forecasts have been made by Swedish forecasters for the period 2012–2021.[5] By evaluating forecasts for a period longer than a single year, it is possible to more accurately estimate systematic differences in the accuracy of the different forecasters.

[4] 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 Appendix 2.

[5] See note on Table 2 for an explanation of abbreviations in the figures.

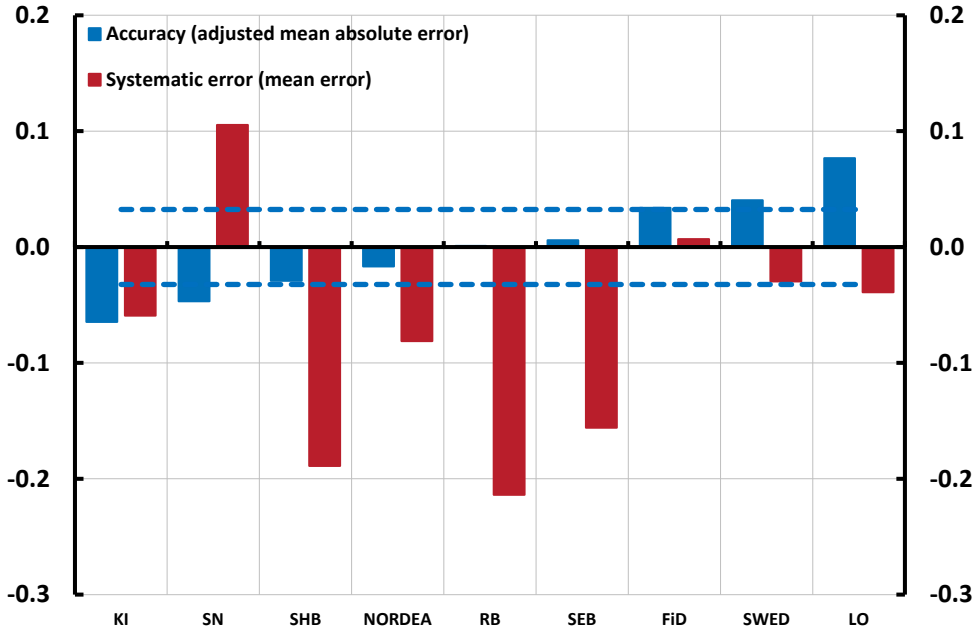
The red columns show the systematic errors or mean errors, where the forecasting errors are consistently expressed as outcome minus forecast. The figures show that the systematic error with regard to, for instance, the Riksbank's GDP forecasts, is negative. This means that growth has on average been lower than expected over the past ten years. The columns with negative values in Figure 10 show that inflation on average has been lower than expected in relation to the forecasts of almost all forecasters.

The blue columns in these figures show the adjusted mean absolute error. The measure is reported as a deviation from the mean value for all forecasters, which means that they are equal to zero on average. A negative value shall 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 so that the most accurate ones are furthest to the left. There are differences in accuracy among them, but these are small. The difference between the best and worst forecaster, as regards CPIF inflation, for example, is only 0.1 percentage points (see Figure 10). During the period shown in the figures, the Riksbank's forecasts have been relatively accurate with regard to unemployment. The accuracy of the forecasts for GDP growth was in line with the forecasts of other analysts, while the forecasts for CPIF inflation and the repo rate were less accurate than those of others.

The observed forecasting errors for the period 2012 to 2021 can be considered as a sample from a larger population of forecasting errors. This makes it possible to use the standard deviation of these forecasting errors to calculate a 95% confidence interval, to illustrate whether there are significant, non-random, differences between the accuracy of the different forecasters. Such an interval shows that the Riksbank’s accuracy has been significantly better than the average for unemployment and significantly worse for CPIF inflation and the repo rate. The accuracy for GDP growth is not significantly different from that of the average (see Figures 8–11).

Figure 8. GDP growth, accuracy and systematic error in forecasts from various analysts, 2012–2021

Percentage points

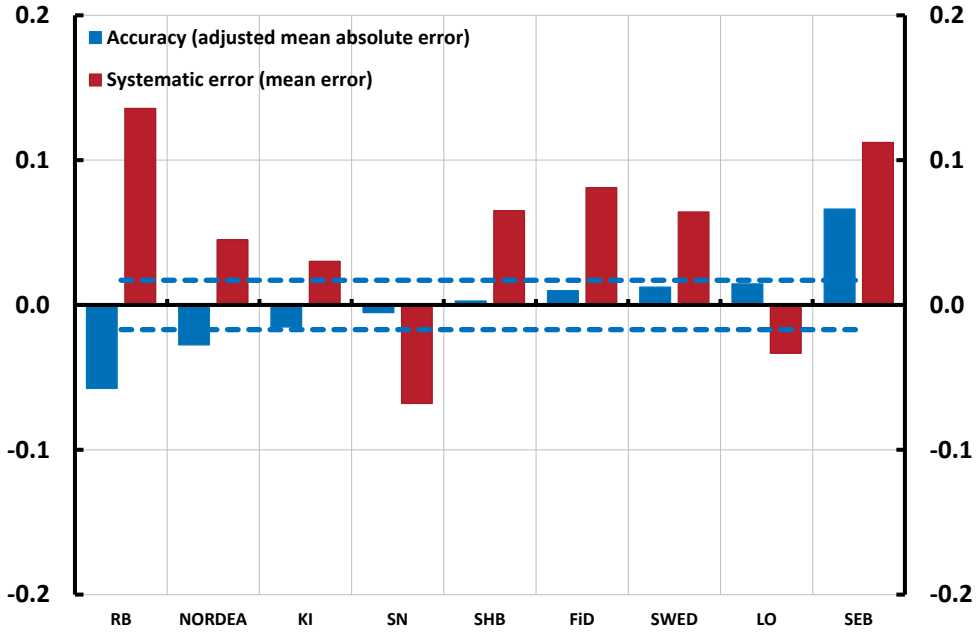


Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 9. Unemployment, accuracy and systematic errors in forecasts made by various analysts for 2012-2021

Percentage points

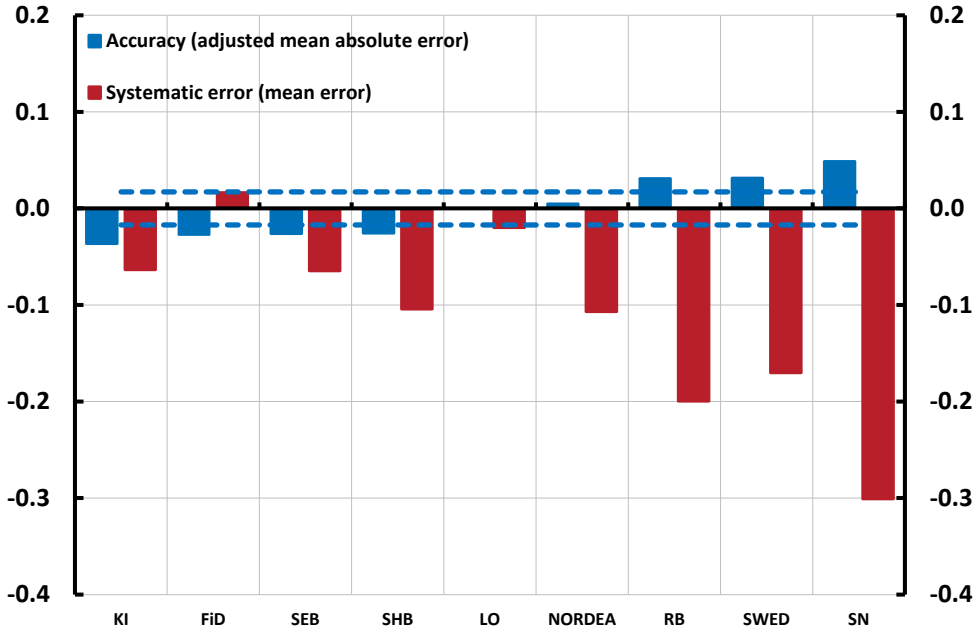


Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 10. CPIF inflation, accuracy and systematic error in forecasts made by various analysts for 2012-2021

Percentage points

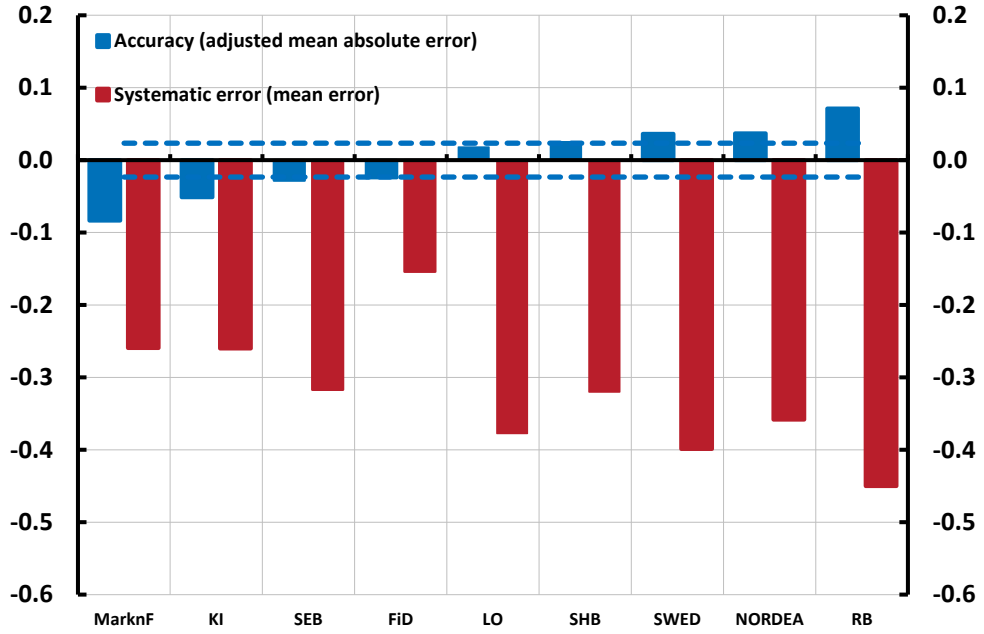


Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 11. Repo rate, accuracy and systematic errors in forecasts made by various analysts, 2012–2021

Percentage points



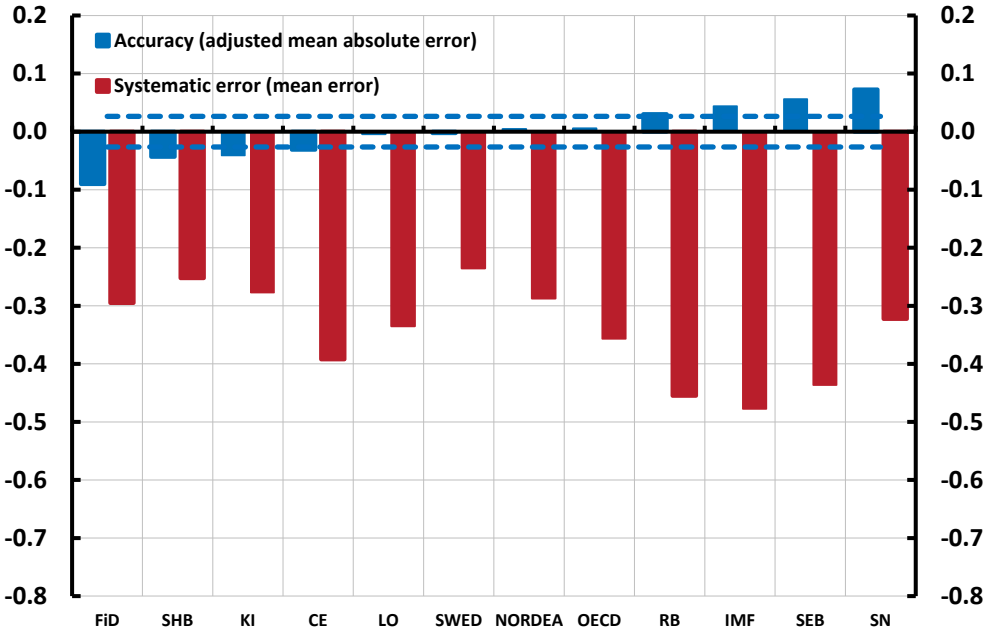
Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figures 12–15 show the results for GDP growth and inflation in the USA and the euro area. On average, the forecasts for GDP growth in both the United States and the euro area have been too high for the period 2012–2021 (negative red columns). Inflation does not have the same systematic errors. The blue columns in Figures 12–15 show that the Riksbank's accuracy in the forecasts for inflation abroad has been close to the average, while the forecasts for growth have been slightly worse than those of other forecasters.

Figure 12. GDP growth in the United States, accuracy and systematic errors in forecasts made by various analysts, 2012–2021[6]

Percentage points



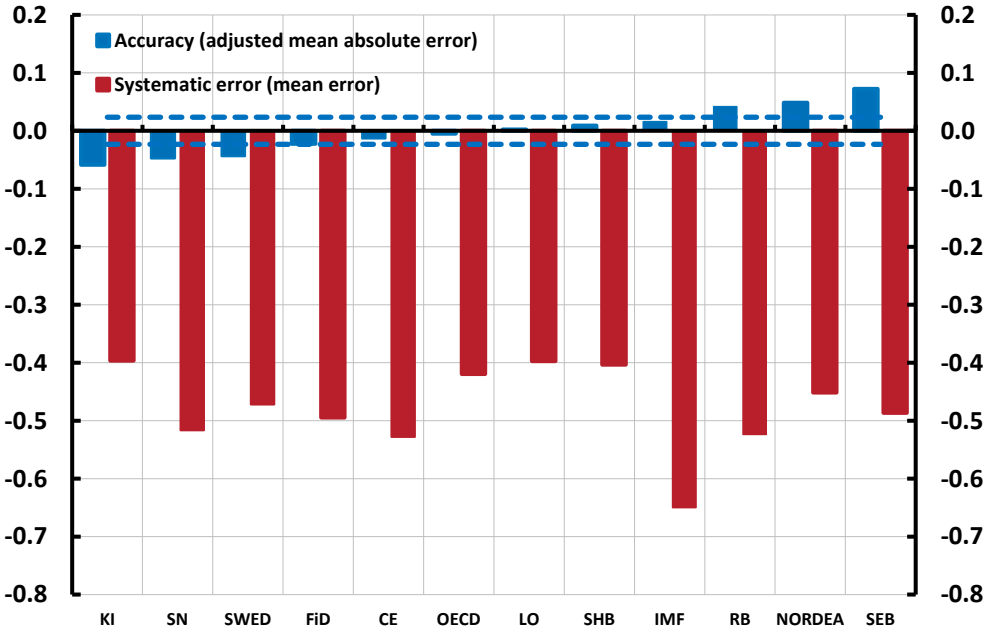
Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

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

Figure 13. GDP growth in the euro area, accuracy and systematic errors in forecasts made by various analysts, 2012–2021

Percentage points

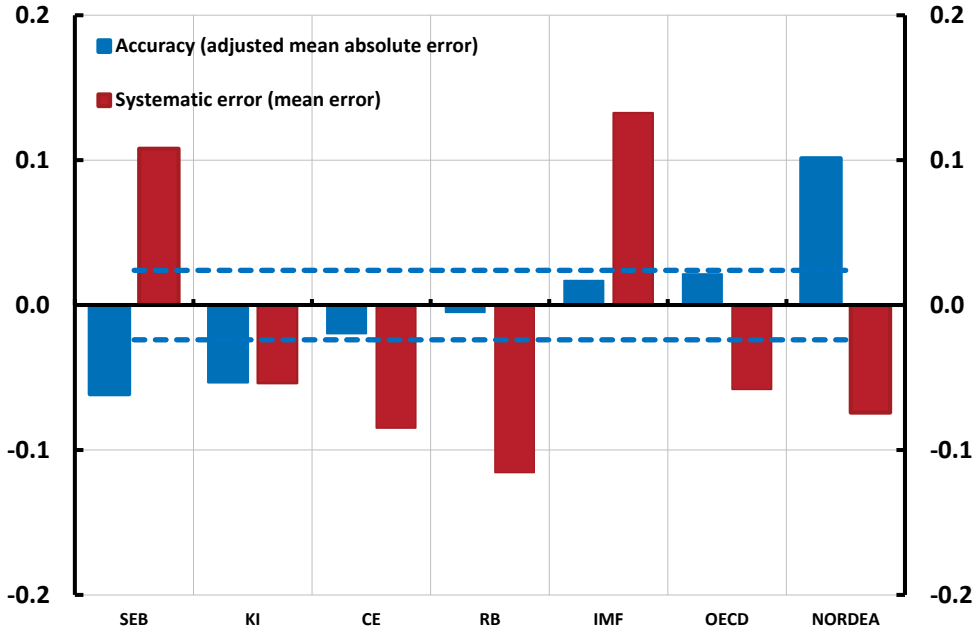


Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 14. CPI inflation in the United States, accuracy and systematic errors in forecasts made by various analysts, 2012–2021

Percentage points

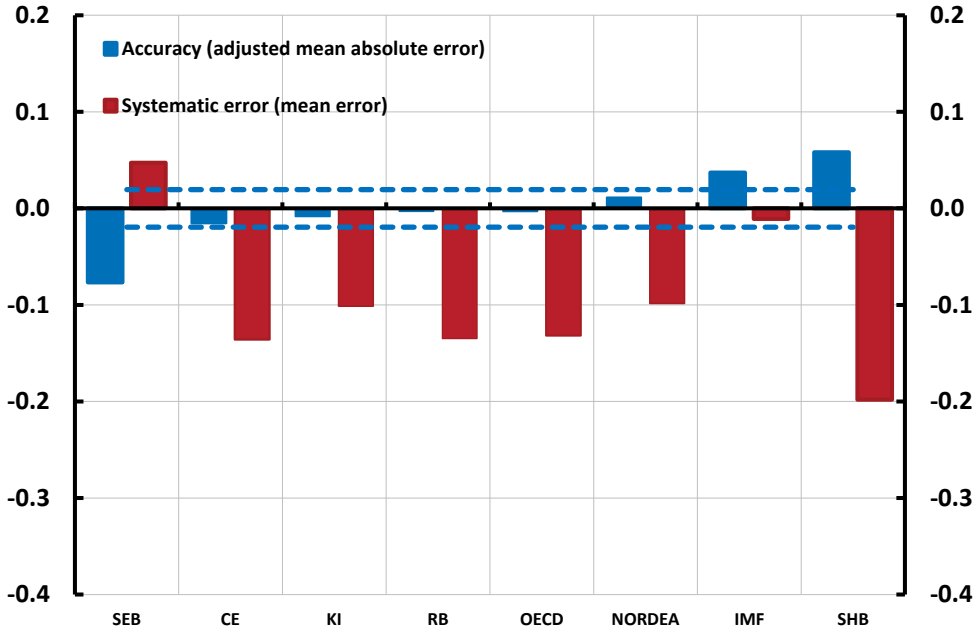


Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 15. HICP inflation in the euro area, accuracy and systematic errors in forecasts made by various analysts, 2012–2021

Percentage points



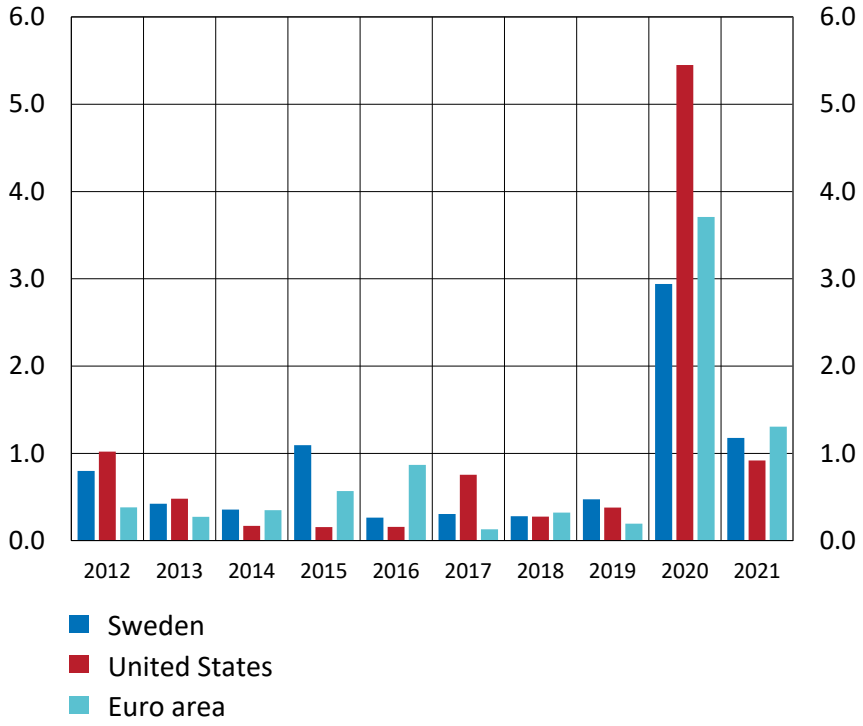
Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

2.3 Varying levels of difficulty in making forecasts in different years

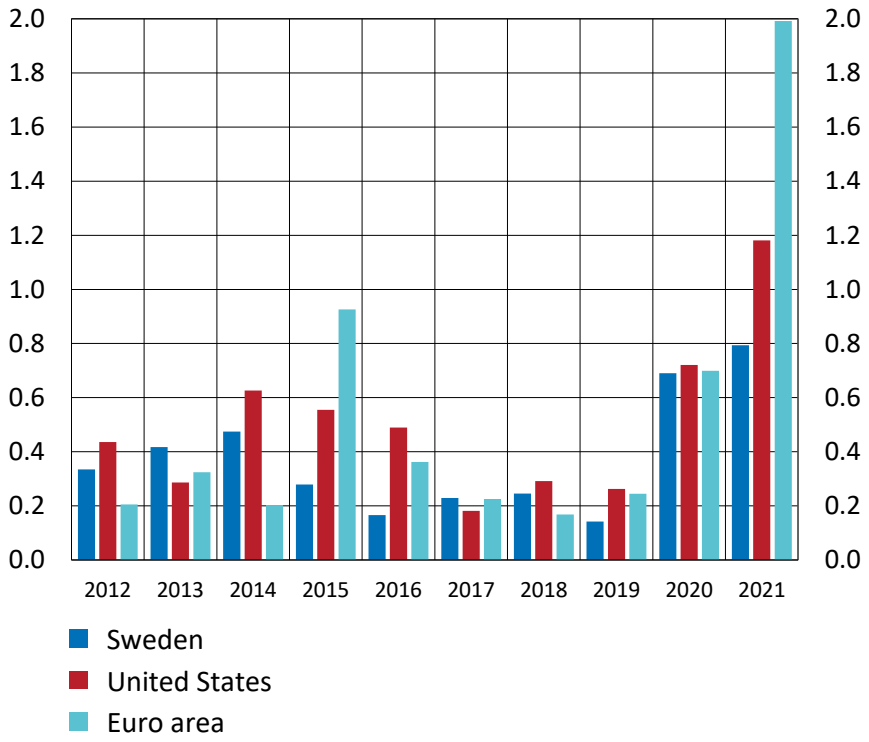
To gain a measure of how difficult it has been to forecast different variables over time, an average of the mean absolute error of different forecasters year by year can be calculated. Such average mean absolute errors are shown for GDP growth and inflation in Sweden, the United States and the euro area in Figure 16 and Figure 17. In 2021, the average mean absolute errors were unusually large in all of these regions, particularly for inflation.

Figure 16. Average mean absolute errors for GDP growth 2012–2021



Sources: Respective analyst and the Riksbank.

Figure 17. Average mean absolute errors for inflation 2012–2021



Sources: Respective analyst and the Riksbank.

2.4 Assessment of forecasts for 2021

The forecasts for 2021 have been evaluated in the same way as the forecasts for 2012-2021, as set out in Section 2.2. The results are shown in Figures 19–26 in Appendix 1.

The clearest result is that all forecasters had expected lower inflation both in Sweden and abroad. At the same time, the vast majority of forecasters had expected lower GDP growth both in Sweden and abroad in 2021 than was the case. The accuracy of the Riksbank's forecasts was roughly in line with other forecasters.

2.5 Evaluation of the Riksbank’s inflation forecasts in the short term

We have also studied the accuracy of inflation forecasts in the shorter run, that is, one to three months ahead. The analysis in section 2.2, which was based on forecasts up to two years ahead, showed that all forecasters underestimated inflation in 2021. A similar pattern emerges when only short-term forecasts are analysed. The results are

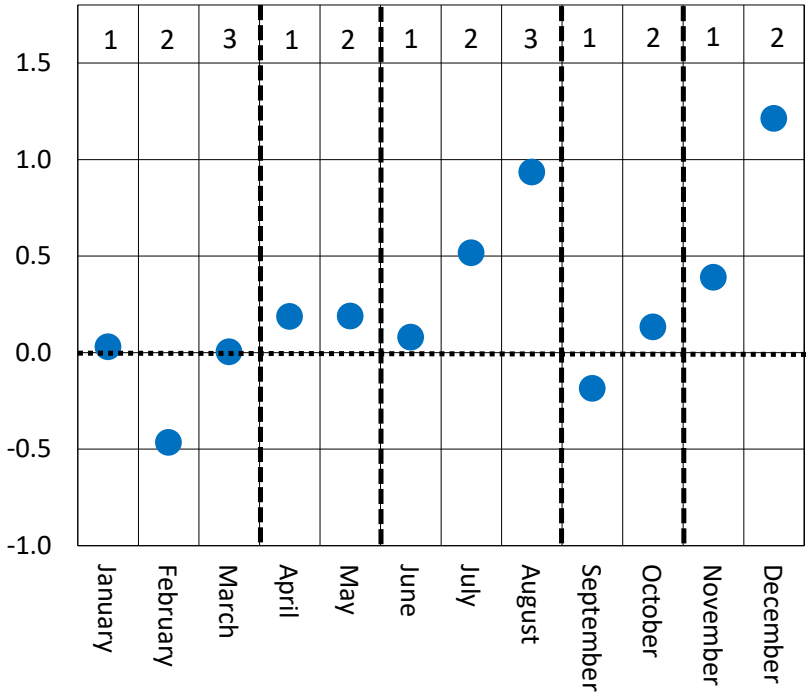
reported in this section for both the Riksbank, and a number of other forecasters who usually report their monthly forecasts on a regular basis.[7]

The Riksbank presents new forecasts five times a year – in February, April, July, September and November. It is therefore possible for two, or sometimes three, CPI outcomes to be published before a new forecast from the Riksbank is available. In some parts of the analysis in this section we therefore include one-step, two-step and three-step forecasts from the Riksbank.

Figure 18 shows the Riksbank's forecasting errors for CPIF inflation for January to December 2021. The figures at the top of the figure show the information that was available to the Riksbank. A one means that this is a one-step forecast, and so on. Inflation outcomes were higher than expected eight out of twelve months. Forecasting errors were often relatively small, but larger in February, July and November and very large in August and December.

Figure 18. The Riksbank's forecasting errors for CPIF inflation, 2021

Percentage points



Note. In the upper row, (1) refers to a one-step forecast, (2) to a two-step forecast, and (3) to a three-step forecast.

Source: The Riksbank.

In February, the forecasting error amounted to almost –0.5 percentage points. In the forecast which was presented in the Monetary Policy Report on 10 February 2021, the

[7] Bloomberg publishes one-step forecasts (forecasts one month ahead) every month from a number of forecasters. The number of forecasters excluding the Riksbank varies slightly from year to year, but amounts to just over ten on average during the period studied 2013–2021. They include the major Swedish banks and other private financial agents.

Riksbank had access to CPIF information for December 2020, which means that it was a two-step forecast. Among the price groups, the development of prices for food, other goods and energy was weaker than expected. For food, it was the weakest month of February throughout the whole 2000s. The fall in prices could not be explained by large declines in a few products, but was relatively broad. Among other products, the development in prices of pharmaceuticals, household textiles and personal hygiene products was unusually weak. The deviation in energy prices can be fully explained by significantly lower electricity prices than expected in the second half of February.

In July and August, CPIF inflation was 0.5 and 0.9 percentage points respectively higher than the forecast in the Monetary Policy Report published on 1 July. The main reason why the CPIF was higher than in the assessment was that electricity prices increased faster than expected, although prices of goods and services also increased slightly faster than forecast.

In November, the rate of increase in the CPIF was 0.4 percentage points higher than expected. Fuel prices had developed roughly in line with the assessment in the September Monetary Policy Report, but electricity prices had again been higher than expected. In December, the rate of increase in the CPIF was as much as 1.2 percentage points higher than expected when electricity prices had risen even more. The contribution of energy prices to the CPIF was 2.5 percentage points in December, where the contribution from electricity was 1.9 percentage points.

In Table 3, we compare different forecasters' accuracy over the short term. Here, both average forecasting error (mean error) and mean absolute error (MAE) are presented for the period January 2013–December 2021. The row marked "Mean value forecast" shows the result when an average of all forecasts (excluding those of the Riksbank) is evaluated. According to the academic literature, such a mean value forecast is considered very reliable and, over longer periods, it is usually very difficult to make better forecasts.[8] In the analysis below, the Riksbank's two-step and three-step forecasts have been removed. The forecasts of the other analysts for those months have also been excluded. This facilitates a comparison, since the forecasts of the Riksbank and other observers are based on approximately the same amount of information.[9]

In this analysis, the mean value forecast takes third place in the ranking. The Riksbank comes in sixth place with a mean absolute error of 0.14. Thus, four individual forecasters have, on average, made more accurate forecasts than the Riksbank.[10] Table 3 also shows that the Riksbank, on average, has forecast a slightly too high inflation one month ahead (negative mean error). Overall, this analysis shows that the Riksbank's accuracy in the very short term is close to the average for other forecasters.

[8] See, for instance, Stock and Watson (2004).

[9] Even in cases in which the Riksbank's forecast refers to inflation one month ahead, other forecasters should have a certain advantage, as their forecasts are often made only a couple of days ahead of the CPIF outcome. It is often important how updated the information that is available to the forecaster is with regard to the development of, for example, fuel prices, electricity prices and exchange rates.

[10] The mean value forecast is not counted as an individual forecaster in this case.

Table 3. Evaluation of short-term forecasts for CPIF inflation on a one-month horizon, 2013-2021.

Ranking	Forecaster	Average error	MAE	# Forecasts
1	Forecaster with lowest MAE	−0.01	0.13	48
3	Mean value forecast	−0.02	0.14	30
6	**The Riksbank**	**−0.05**	**0.14**	**51**
12	Forecaster with highest MAE	−0.06	0.18	35

Note. MAE stands for mean absolute error. The forecasting error is calculated as outcome minus forecast.

Sources: Bloomberg and the Riksbank.

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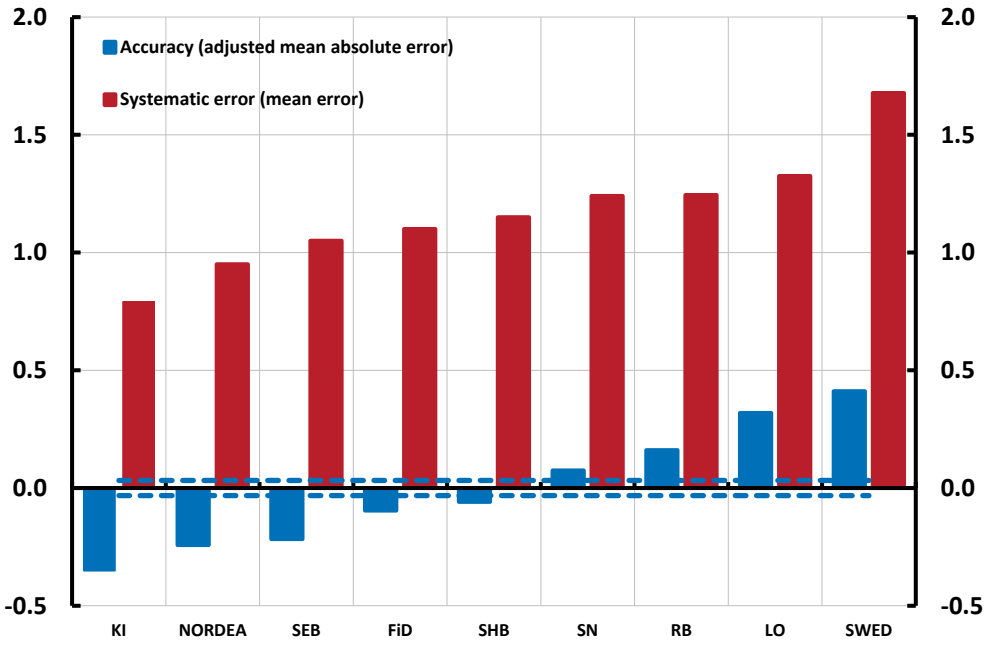
APPENDIX 1: Forecasts for 2021

Figure 19. GDP growth, accuracy and systematic errors in forecasts for 2021 made by various analysts, 2020–2021

Percentage points

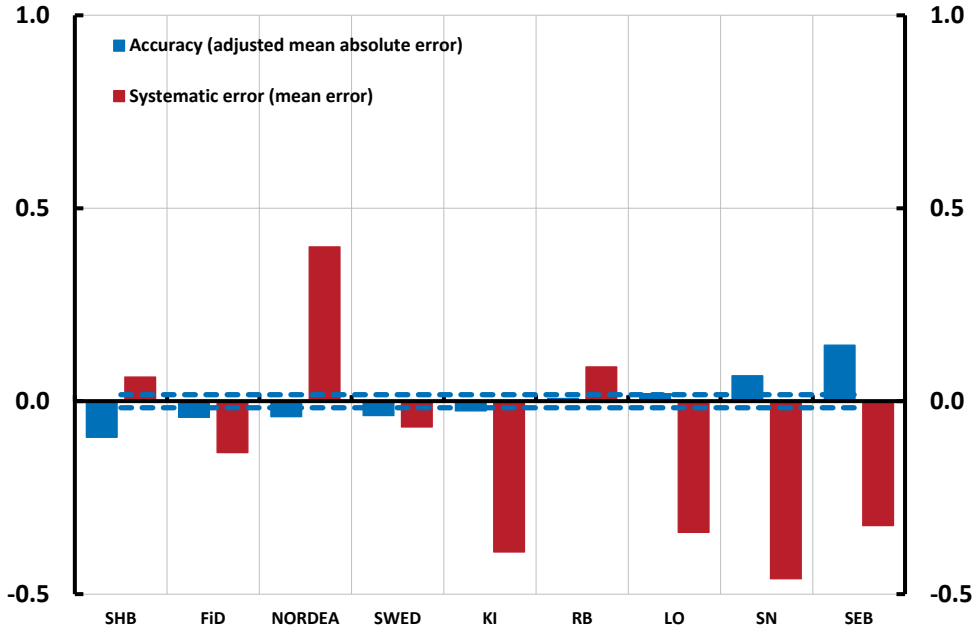


Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 20. Unemployment, accuracy and systematic errors in forecasts for 2021 made by various analysts, 2020–2021

Percentage points

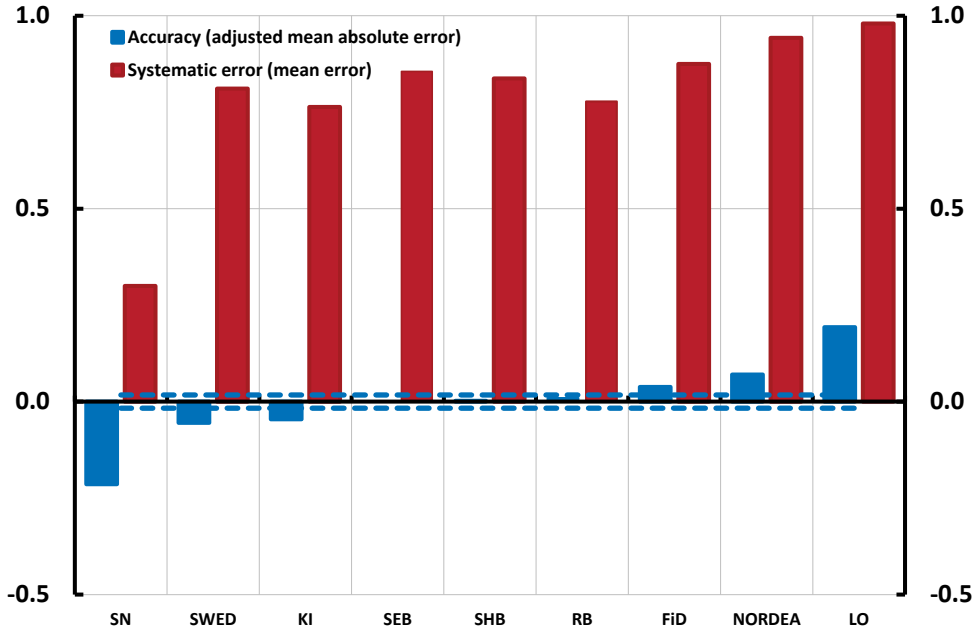


Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 21. CPIF inflation, accuracy and systematic errors in forecasts for 2021 made by various analysts, 2020–2021

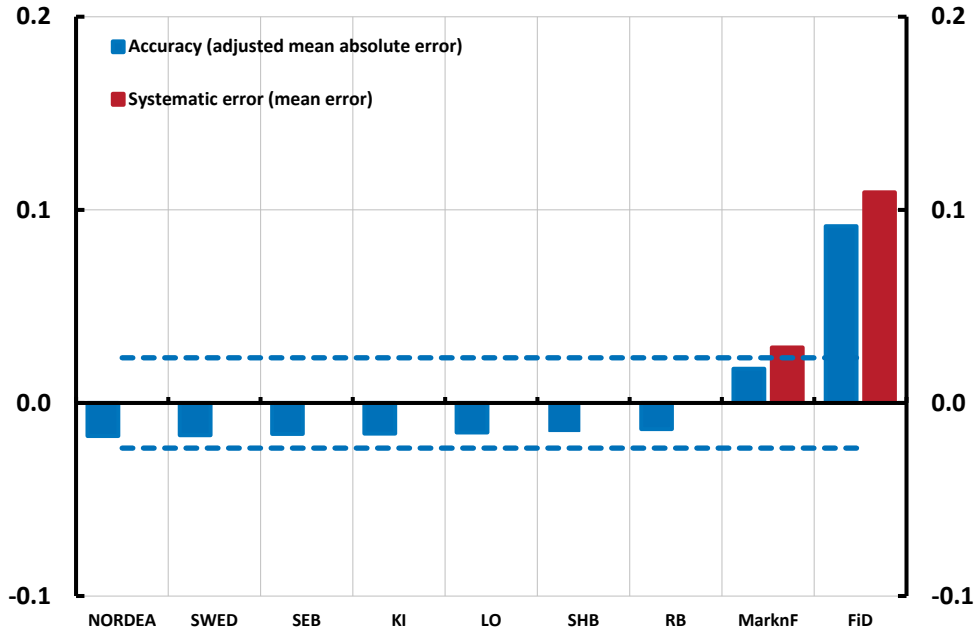
Percentage points



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 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.
Sources: Respective analyst and the Riksbank.

Figure 22. Repo rate, accuracy and systematic errors in forecasts for 2021 made by various analysts, 2020–2021

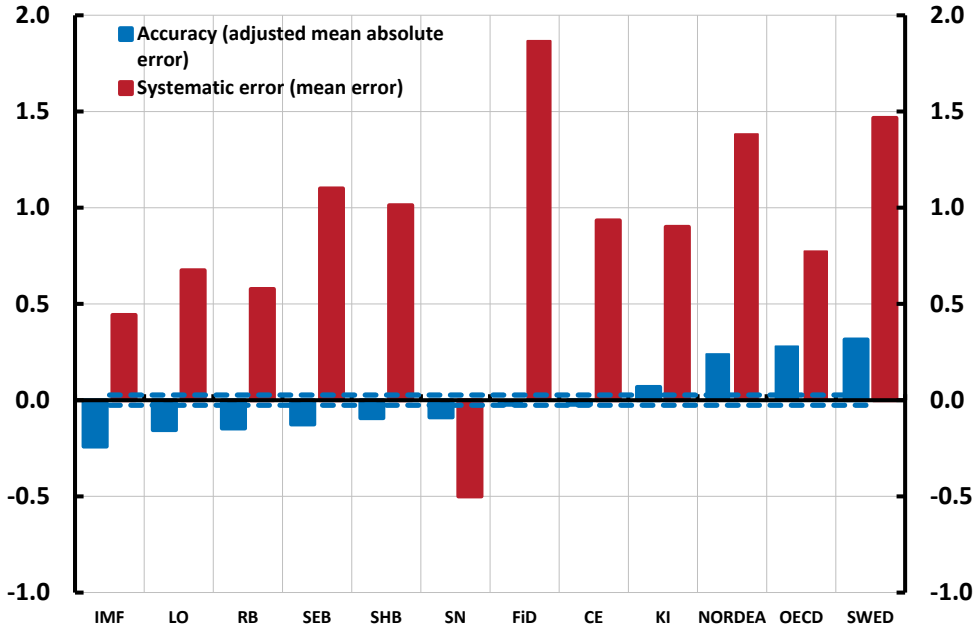
Percentage points



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 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.
Sources: Respective analyst and the Riksbank.

Figure 23. GDP growth in the United States, accuracy and systematic errors in forecasts for 2021 made by various analysts, 2020–2021

Percentage points

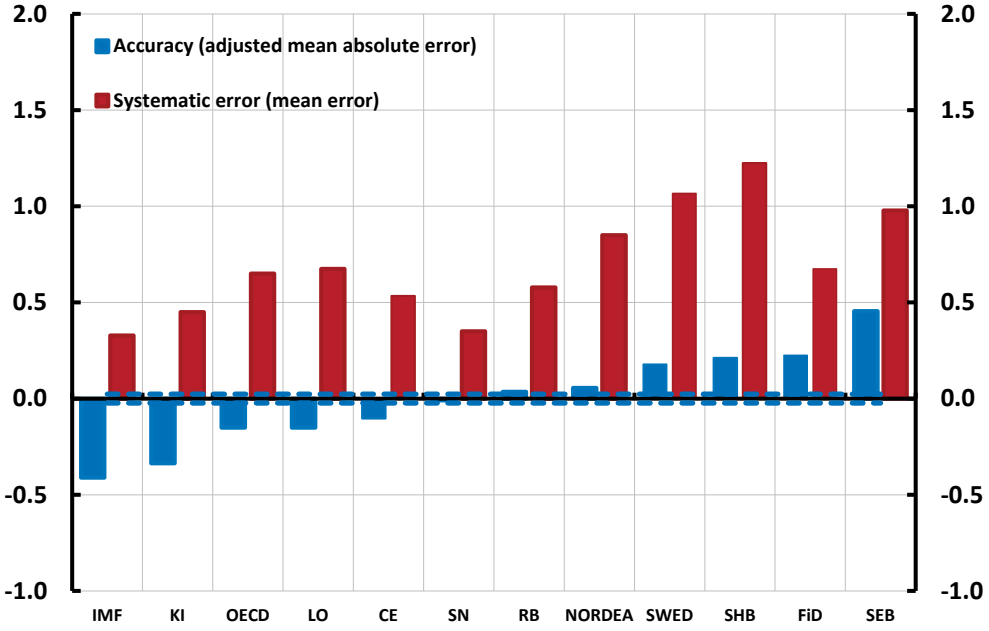


Note. The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 24. GDP growth in the euro area, accuracy and systematic errors in forecasts for 2021 made by various analysts, 2020–2021

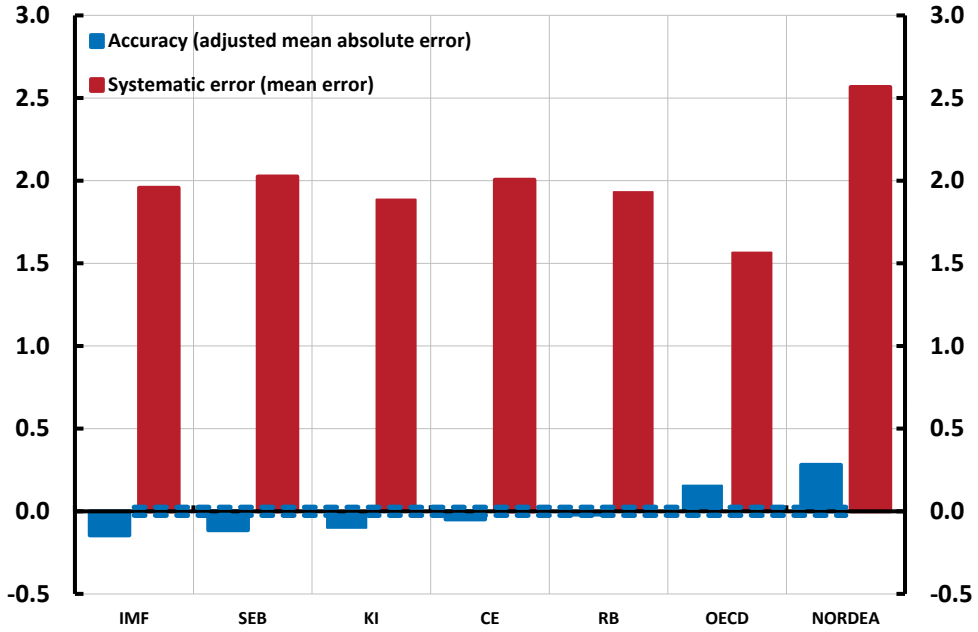
Percentage points



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 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.
Sources: Respective analyst and the Riksbank.

Figure 25. CPI inflation in the United States, accuracy and systematic errors in forecasts for 2021 made by various analysts, 2020–2021

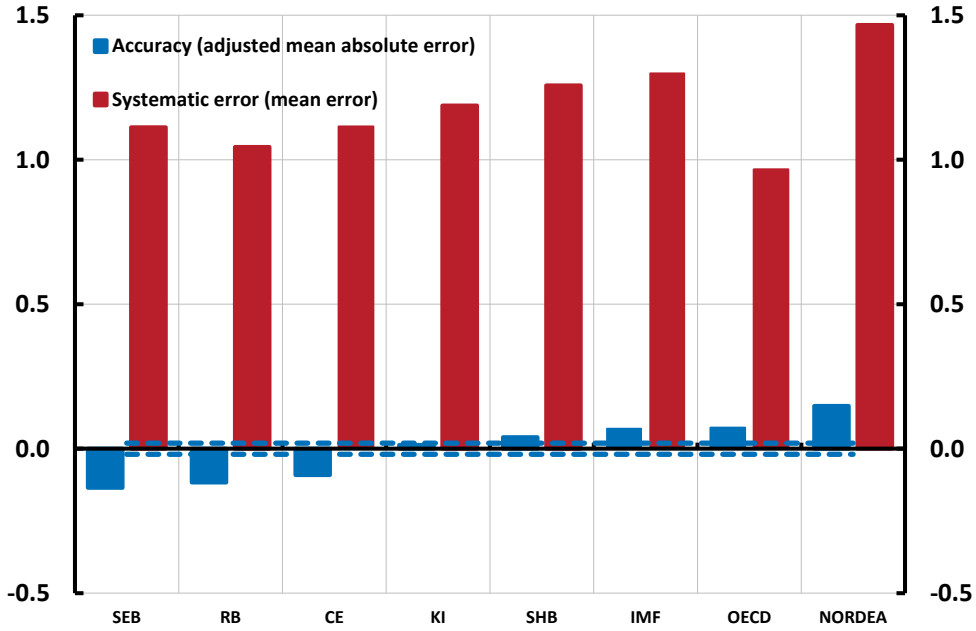
Percentage points



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 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.
Sources: Respective analyst and the Riksbank.

Figure 26. HICP inflation in the euro area, accuracy and systematic errors in forecasts for 2021 made by various analysts, 2020–2021

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 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

APPENDIX 2: Measuring accuracy

Let x_t be an outcome for an economic variable x, for example the inflation rate or GDP growth for a specific period, t. Assume also that $x_{it,h}$ is a forecast for x_t, made by a 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 evaluated refer to the current or next year. This means therefore that $h \leq$ 24 months. If one wants to summarise the accuracy of a forecaster, one can calculate its mean absolute error (MAE) 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, that is, 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. It is therefore not entirely fair to directly compare the mean absolute error between them. A forecaster that often publishes its forecasts late, has a low *h* on average, and should therefore on average have a better accuracy than others.

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 forecasting error into different components. The results from this decomposition can then be 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 have different weights in the annual growth.[11] This weighting scheme is used to construct $M_{it,h}$ in equation (3). The volume of information that forecaster *i* has in the publication month is here approximated by the accumulated weight up to a certain month, $W_{it,h}$. So the weight increases the closer one is in time to the definitive outcome. The time effect in equation (3) is defined as

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

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 estimates 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.

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

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