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. It is the Executive Board of the Riksbank that decides how monetary policy is to be conducted. But monetary policy affects the economy and inflation with a time lag. Forecasts of economic developments in general, and of inflation in particular, are an important part of the Riksbank's decision guidance.

This Study evaluates the Riksbank's forecasts for a number of central economic variables. The evaluation involves comparing the Riksbank's forecasts with forecasts by other analysts. This forecast evaluation focuses on forecasts for the period 2013–2022, with a special analysis of the forecasts for 2022.

The study is a complement to the report Account of Monetary Policy 2022. The report has been produced by the Monetary Policy Department. The main work on the study was carried out by Jesper Johansson, Mårten Löf, Ard Den Reijer, Pär Stockhammar and Anna Österberg.

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Summary

This study analyses and evaluates the forecasts the Riksbank has published for a number of central economic variables for the period 2013 to 2022. The report opens with a description of how economic developments in 2022 compared to the forecasts. In the second part of the report, we compare the Riksbank's forecasts with those made by other forecasters.

During the pandemic, inflation rose more than expected, both in Sweden and abroad. The main reasons for this are considered to be unexpectedly large effects of the imbalances between supply and demand that arose after the pandemic and rising energy and food prices following Russia's invasion of Ukraine. At the same time, however, demand in Sweden has been good, which has enabled companies to raise their prices.

For the period 2013–2022, 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 forecasts for GDP growth was in line with the accuracy of other forecasters, while the forecasts for CPIF inflation were slightly poorer than those of others. The forecasts for the policy rate were less accurate than those of other forecasters. However, the difference in accuracy between different forecasters is generally small. In the forecasts for 2022 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 2022 in comparison to forecasts

In this section, we compare outcomes for economic developments in 2022 with the forecasts published by the Riksbank and others in 2020, 2021 and 2022. The focus is on the variables normally used to explain the development of inflation.

During 2022, inflation rose more than expected, both in Sweden and abroad. The main reasons for this are considered to be unexpectedly large effects of the imbalances between supply and demand that arose after the pandemic and rising energy and food prices following Russia's invasion of Ukraine. At the same time, demand in Sweden has been good, which has enabled companies to raise their prices.

1.1 Rapidly rising inflation in Sweden 2022

After several years when inflation has been slightly below 2 per cent, it began to rise in 2021 and accelerated in 2022. This meant that it reached the highest level since the inflation target was introduced in Sweden. There are several reasons why inflation rose. Following the pandemic, rapidly rising global demand combined with production disruptions contributed to rising prices for commodities, other inputs and freight. The war in Ukraine then meant that prices were further pushed with regard to food and energy, among other things. At the same time, demand was good until the end of 2022, which enabled companies to pass on their cost increases and raise their prices.[1]

During 2022, CPIF inflation averaged 7.7 per cent (see Table 1). This was significantly higher than the previous year and also high in relation to a historical average. Prices in all subgroups increased faster than normal, which indicates that the upturn in inflation is broad. According to the companies responding to the Riksbank's Business Surveys, companies have adjusted prices both more often and in larger steps than usual.[2]

[1] According to a study by the National Institute of Economic Research (NIER), companies increased their prices in line with how their costs changed between the second quarter of 2021 and the second quarter of 2022 (see NIER (2022)).

[2] See Sveriges Riksbank (2022b).

Table 1. Sub-groups in the CPIF
Weight and average annual rate of increase in per cent

	Weight 2022	2000–2020	2021	2022
Services	43.7	1.8	2.2	4.4
Goods excluding food	28.9	-0.4	0.2	6.0
Food	18.2	1.9	0.6	9.3
Capital stock index	3.4	5.3	5.9	6.9
CPIF excluding energy	**94.1**	**1.4**	**1.4**	**5.9**
Energy	5.9	3.2	17.1	32.9
CPIF	**100.0**	**1.5**	**2.4**	**7.7**

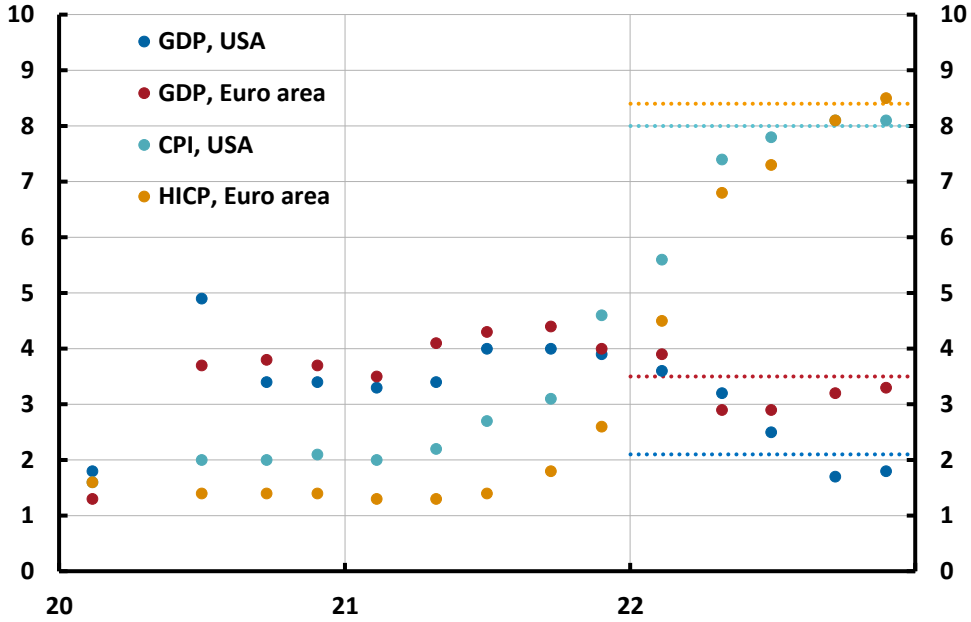
Note: Weight refers to the weighting coefficient in the CPIF.

Source: Statistics Sweden.

1.2 Unexpectedly high international inflation

International inflation has also risen and in 2022 it was higher than expected in the Riksbank's forecasts (see Figure 1). However, growth abroad was lower in relation to the forecasts made in 2020 and 2021, particularly in the United States (see Figure 1).[3]

Figure 1. International growth and inflation, the Riksbank's forecasts for 2022 made 2020–2022 (dots) and the outcome for 2022 (broken lines)
Annual percentage change



Sources: National sources and the Riksbank.

[3] The level of international GDP was nevertheless roughly in line with expectations. The lower-than-expected GDP growth in 2022 is partly due to an unexpectedly rapid increase in GDP in 2021, which meant that the growth rate for 2022 was lower in the forecasts made in 2020 and 2021.

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 Figure 2, Figure 3 and Figure 4).[4]

The unexpectedly large imbalances between supply and demand after the pandemic and the war in Ukraine explain why developments in 2022 deviated so much from the Riksbank's forecasts. But even after these factors were included in the forecasts, inflation rose unexpectedly quickly and continued to be underestimated in the forecasts made in 2022. The Riksbank thus underestimated the magnitude of the effects of the earlier supply shocks on inflation.[5]

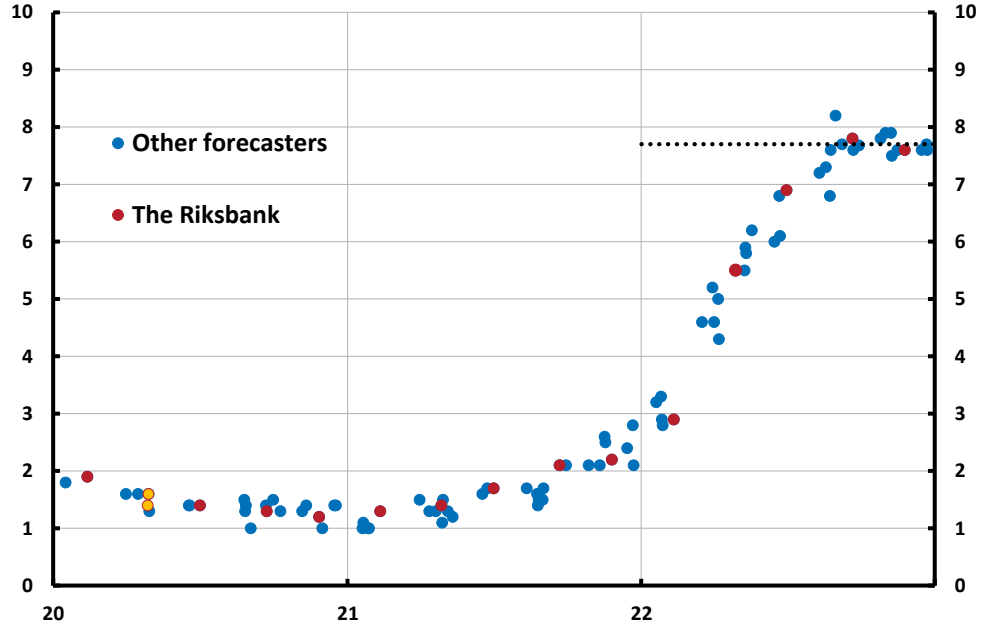
In the short term, the inflation forecast is often partly made "bottom-up", i.e. forecasts are made for sub-groups in the CPIF that are then totalled. In Figure 5 we show how much the forecast error for the subgroups has contributed to the total forecast error for CPIF inflation, calculated for the forecast published in the Monetary Policy Report in February 2021. At that time, the Riksbank had access to outcomes up to December 2020 and the first forecast month is January 2021. The figure shows that the forecast error in 2021 is mainly explained by higher energy prices than expected. In 2022, the forecast error is more widely distributed among the subgroups. It was mainly higher than expected prices for goods that contributed to the forecast error in January and February. However, this was offset by lower energy prices in the same period. Since then, the contribution of goods and food prices to the forecast error has risen gradually. The contribution from services prices has also increased, at least until the end of summer last year. The contribution from energy prices has been more volatile since spring 2022.

[4] The other forecasters included in the comparison are the Ministry of Finance, the National Institute of Economic Research, Nordea, SEB, the Swedish Trade Union Confederation, Handelsbanken, the Confederation of Swedish Enterprise and Swedbank.

[5] See Sveriges Riksbank (2022a) for a discussion of why inflation was unexpectedly high in 2022.

Figure 2. CPIF in Sweden, the Riksbank's and other analysts' forecasts for 2022 made in 2020-2022 (dots) and outcome for 2022 (broken line)

Annual percentage change

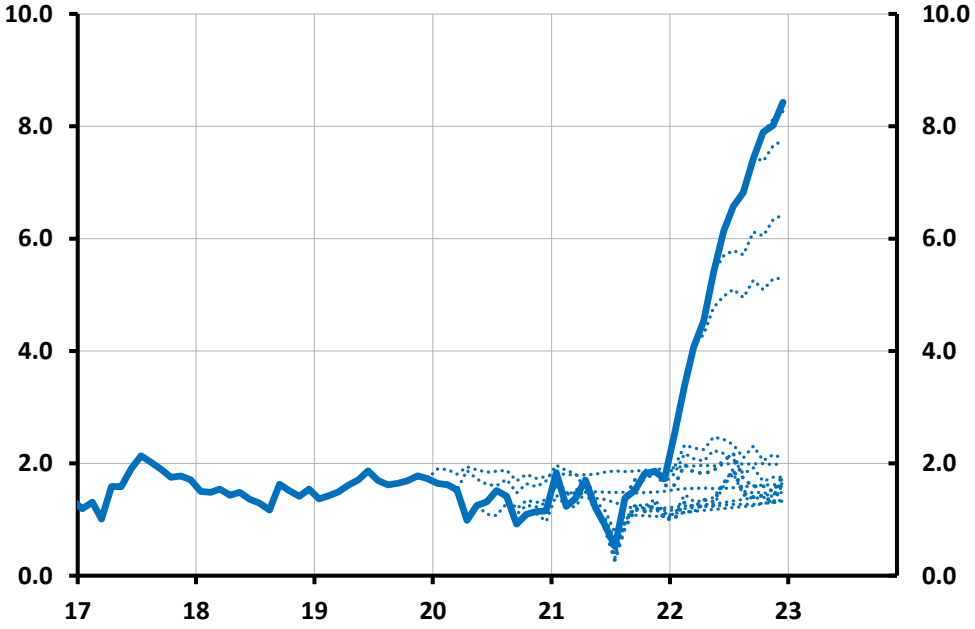


Note. No forecasts were published in the Monetary Policy Report in April 2020. Instead, two scenarios were presented for future developments for a small number of variables. These are depicted as yellow dots in the figure.

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

Figure 3. CPIF excluding energy, Riksbank's forecasts 2020–2022 (broken lines) and outcomes (solid line)

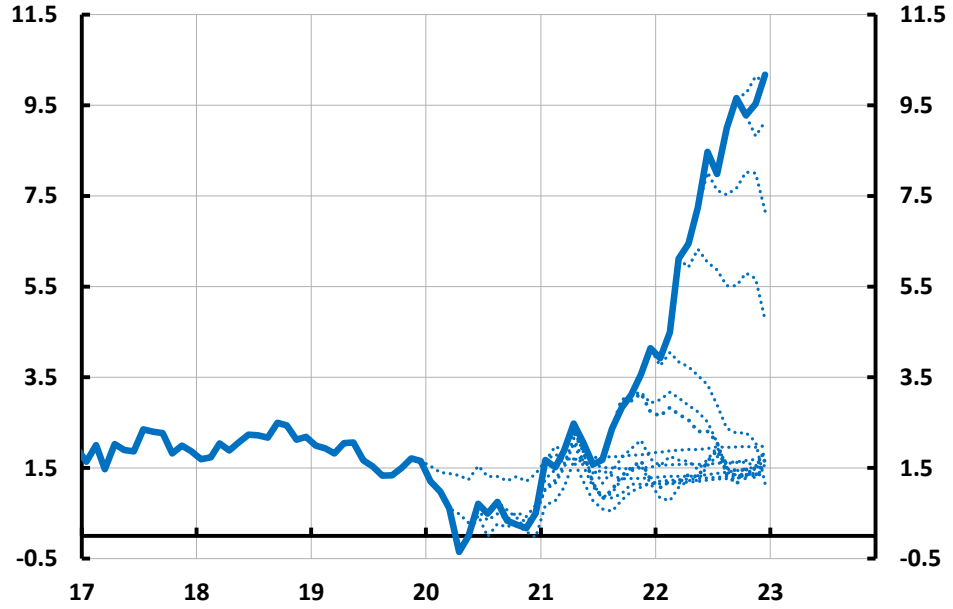
Annual percentage change



Sources: Statistics Sweden and the Riksbank.

Figure 4. CPIF, Riksbank's forecasts 2020–2022 (broken lines) and outcomes (solid line)

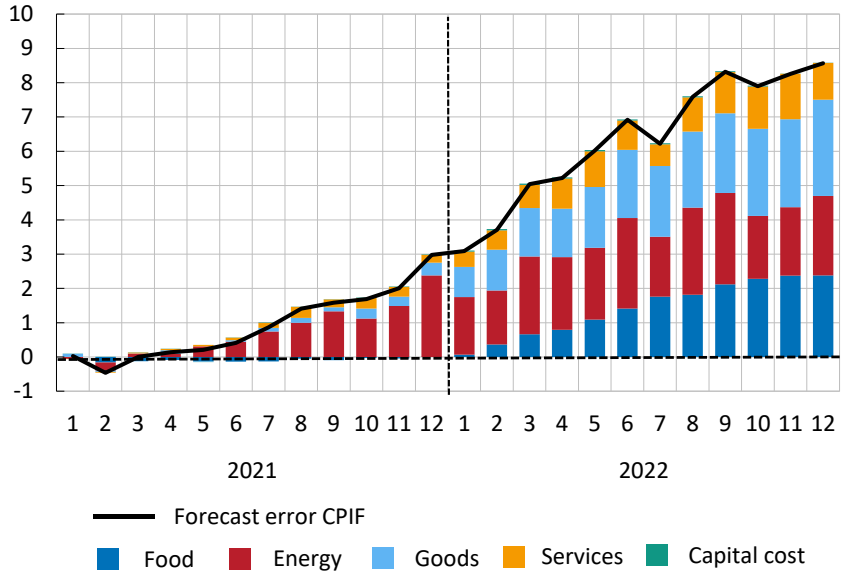
Annual percentage change



Sources: Statistics Sweden and the Riksbank.

Figure 5. Contribution of different components to the forecast error for the annual percentage change in the CPIF

Percentage points



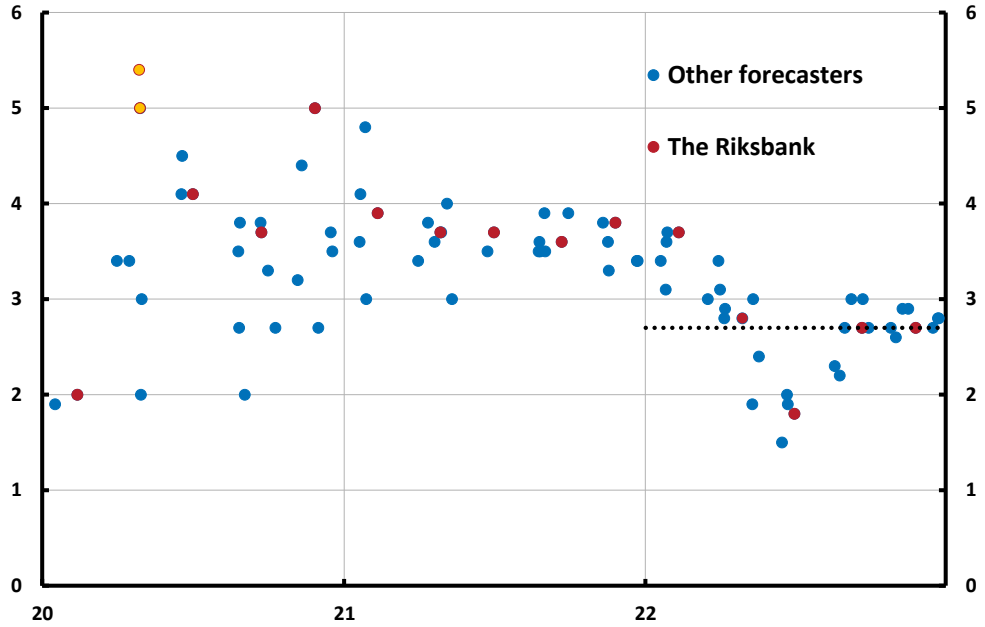
Note: The forecast error has been calculated for the forecast published by the Riksbank in the Monetary Policy Report in February 2021. In 2022, the weight for food was 18.2 per cent, energy 5.9 per cent, goods 28.9 per cent, services 43.7 per cent and cost of capital 3.4 per cent in the CPIF. The X axis shows the months in 2021 and 2022 while the Y axis shows the contribution to the forecast error.

Sources: Statistics Sweden and the Riksbank.

GDP growth was unexpectedly high in 2022, compared to the forecasts made in 2021 (see Figure 6). However, this is partly due to the fact that the level of GDP was unexpectedly high in 2021, which had a dampening effect on the growth rate in 2022. The recovery of the Swedish economy after the pandemic was faster than many forecasters expected and GDP growth in Sweden was therefore higher in 2021 than in the forecasts made by the Riksbank and other forecasters in 2020 and the first half of 2021, which contributed to the level of GDP in 2022 being higher. Demand in the economy is thus not judged to have become surprisingly weak, which is also reflected in the fact that unemployment has become roughly in line with expectations in the forecasts made in 2021 and 2022 (see Figure 7).

Figure 6. GDP in Sweden, the Riksbank's and other analysts' forecasts for 2022 made in 2020-2022 (dots) and outcome for 2022 (broken line)

Annual percentage change

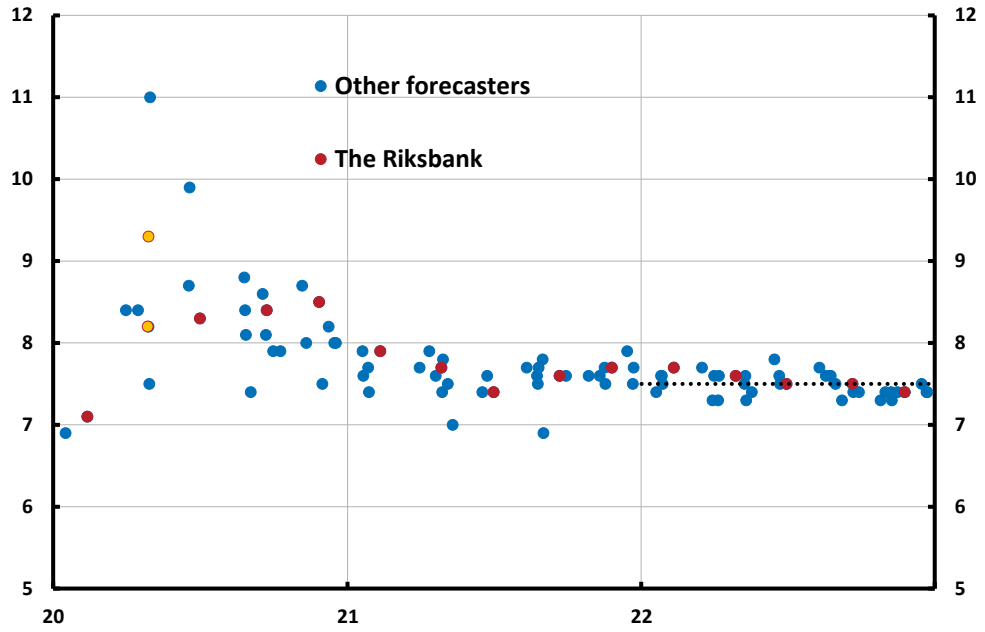


Note. Refers to calendar-adjusted GDP. No forecasts were published in the Monetary Policy Report in April 2020. Instead, two scenarios were presented for future developments of a small number of variables. These are depicted as yellow dots in the figure.

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

Figure 7. Unemployment in Sweden, the Riksbank's and other analysts' forecasts for 2022 made in 2020-2022 (dots) and outcome for 2022 (broken line)

Percentage of labour force aged 15–74 years



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 8 below shows how the Riksbank's general equilibrium model, MAJA, interprets the forecast error for CPIF inflation. We have selected the forecast error from the forecast published by the Riksbank in July 2021 in the model analysis.[6] According to MAJA, this forecast error is partly explained by the fact that the Riksbank had been surprised by higher energy prices.[7] The rising inflation expectations and the weaker-than-expected krona in 2022 also contribute to the Riksbank underestimating inflation (blue and yellow bars). However, the largest contribution to the forecast error comes from what is known in the figure as price mark-ups, which are characterised by everything in the model that pushes up inflation and at the same time has a negative effect on economic activity. Examples include supply problems, indirect effects of rising energy costs or higher margins. Other forecasters have also been surprised by

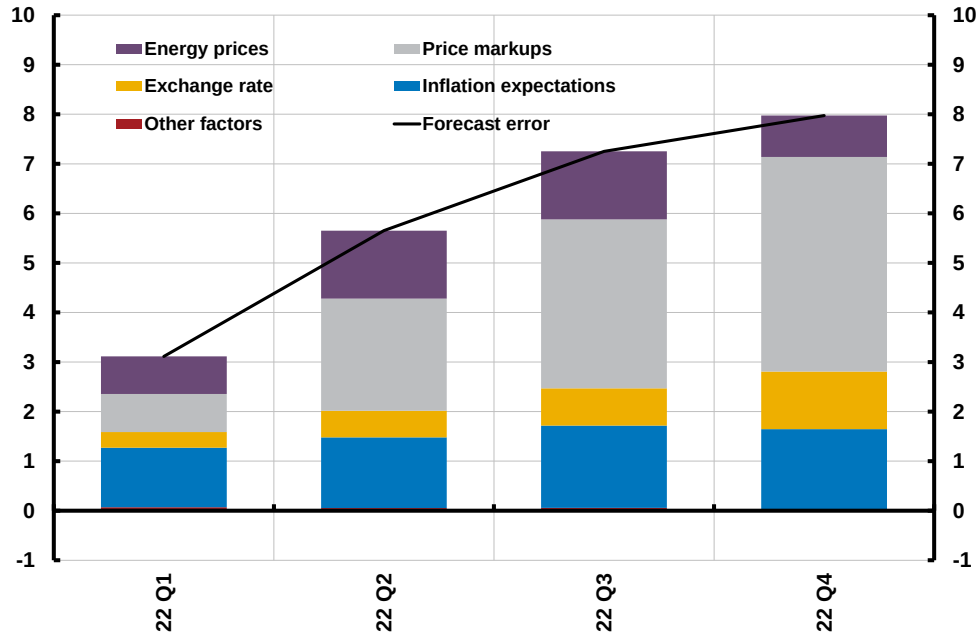
[6] At the time of this forecast, the last available outcome was May 2021 and inflation had not yet started to rise.

[7] The figure shows only the direct effects of energy price increases on CPIF inflation. However, when energy prices rise, inflation is also affected via indirect channels, for example by rising fuel prices affecting bus companies' costs and, in the next step, their ticket prices, or by higher costs for operating and heating properties resulting in higher rents. These indirect effects are attributed in the model to the so-called price mark-ups, see more below. When energy prices rise, this can also affect inflation expectations and thus inflation via higher wage demands, for example. This type of delayed effect is usually called a secondary effect and is mainly reflected in the category "Inflation expectations" in Figure 8.

higher inflation without GDP and unemployment surprising in a stronger direction (see Section 2.4).

Figure 8. Model interpretation of the forecast errors from forecasts in the Monetary Policy Report, July 2021

Percentage points



Note: The 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 2021. A positive forecast error means underestimating the CPIF outcome and vice versa. This forecast error has then been divided into five different categories using the Riksbank's general equilibrium model, MAJA, see Corbo and Strid (2020).

Source: The Riksbank.

2 Forecast evaluation

Monetary policy affects the economy and inflation with a time lag. Forecasts of economic developments are therefore an important part of the Riksbank's decision-making process. The beginning of this forecast evaluation discusses different measures of forecasting precision. Then we compare the Riksbank's forecasts with forecasts made by other analysts for the period 2013-2022. The results for 2022 alone 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 2022 therefore refer to forecasts published in 2021 and 2022.

For the period 2013-2022, the Riksbank was relatively accurate in its forecasts for unemployment compared with other analysts. The accuracy of the Riksbank's forecasts for GDP growth was in line with the accuracy of other forecasters, while the forecasts for CPIF inflation were slightly poorer than those by others. However, the difference in accuracy between different forecasters is generally small. In the forecast evaluation for 2022 alone, the accuracy of the Riksbank's forecasts for GDP and unemployment was in line with other forecasters, but it was slightly better for CPIF inflation. The accuracy of the Riksbank's short-term inflation forecasts was relatively good in relation to those of other analysts.

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, we express the forecasting error 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.[8] The average mean absolute errors in the forecasts for 2013– 2022 and for 2022 alone are shown in Table 2.

[8] 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 2013-2022 and for 2022 made in the same year and the year before

Percentage points

	2013–2022			2022		
	GDP	Unem-ployment	CPIF	GDP	Unem-ployment	CPIF
FiD	0.87	0.36	0.87	0.64	0.25	3.86
NIER	0.75	0.33	0.65	0.65	0.17	3.26
STUC	0.82	0.35	0.70	0.64	0.24	3.32
NORDEA	0.76	0.35	0.73	0.56	0.19	3.74
RB	0.78	0.26	0.70	0.78	0.20	3.78
SEB	0.91	0.41	0.72	0.93	0.20	3.90
SHB	0.90	0.39	0.89	0.89	0.14	4.30
CSE	0.72	0.33	0.70	0.64	0.18	3.02
SWED	0.89	0.39	0.79	0.64	0.16	4.00
Mean	**0.82**	**0.35**	**0.75**	**0.71**	**0.19**	**3.69**

Note: Abbreviations as follows: FiD=Ministry of Finance, NIER=National Institute of Economic Research, STUC=Swedish Trade Union Confederation, RB=Sveriges Riksbank, SEB=Skandinaviska Enskilda Banken, SHB=Svenska Handelsbanken, CSE=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.[9] In practice, this is done by adjusting a forecaster's forecast error for how the 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 2013–2022

Figure 9 - Figure 12 show average forecast error (mean error) and adjusted mean absolute error for GDP growth, unemployment, CPIF inflation and the policy rate. The forecasts have been made by Swedish forecasters for the period 2013–2022.[10] By evaluating forecasts for a period longer than a single year it is possible to estimate

[9] The method has been developed at the Riksbank, see Andersson and Aranki (2009) and Andersson, Aranki and Reslow (2017). A brief description of the method is given in Appendix 2.

[10] See note to Table 2 for an explanation of abbreviations in the figures.

systematic differences in the accuracy of the different forecasters in a more reliable way.

The red columns in the figure show the systematic errors or mean errors, where the forecast errors are consistently expressed as outcome minus forecast. We can then see 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 11 show that inflation on average has been higher than expected in the forecasts of all forecasters.[11]

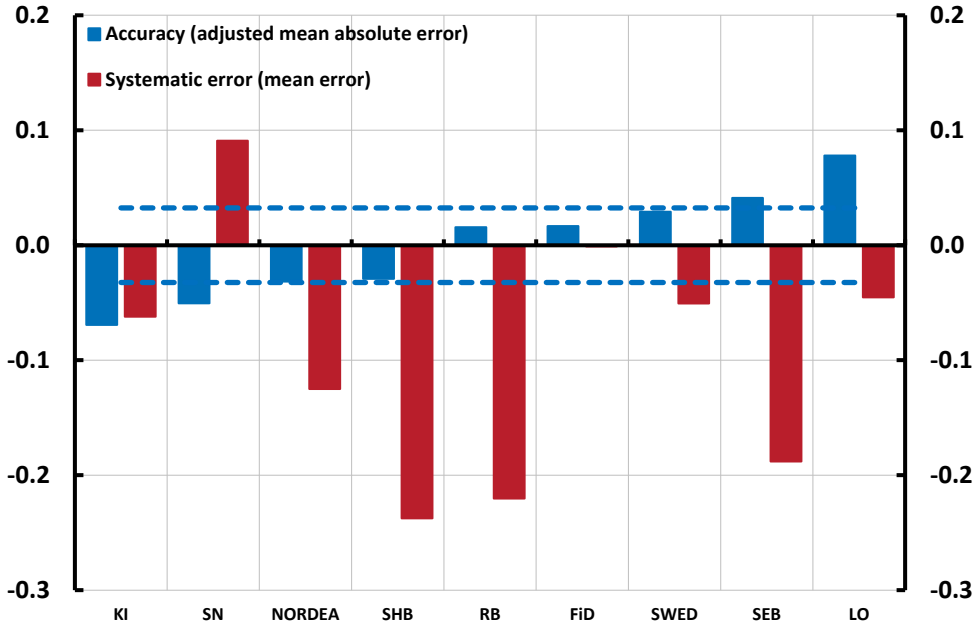
The blue bars show the adjusted mean absolute error. We report this measure as a deviation from the mean value for all forecasters, which means that they are equal to zero on average. A negative value shall be interpreted as the accuracy of a certain forecaster being better than average. A positive value indicates that it is worse. In the figures, forecasters are sorted according to the adjusted mean absolute error so that the most accurate ones are furthest to the left. We can see that 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 11). 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 accuracy of other forecasters, while the forecasts for CPIF inflation were slightly poorer than those of others.

One can regard the observed forecast errors for 2013 to 2022 as a sample from a larger population of forecast errors. This makes it possible to use the standard deviation of these forecasting errors to calculate a 95% confidence interval, to see whether there are significant, non-random, differences between the accuracy of the different forecasters. Such an interval shows, for instance, that the Riksbank’s accuracy has been significantly better than the average for unemployment, but significantly worse for the policy rate (see Figure 9 - Figure 12).

[11] However, this result is entirely due to higher-than-expected inflation in 2022, while in the ten-year period up to 2021 inflation was on average lower than expected.

Figure 9. GDP growth, accuracy and systematic error in forecasts from various analysts, 2013–2022

Percentage points

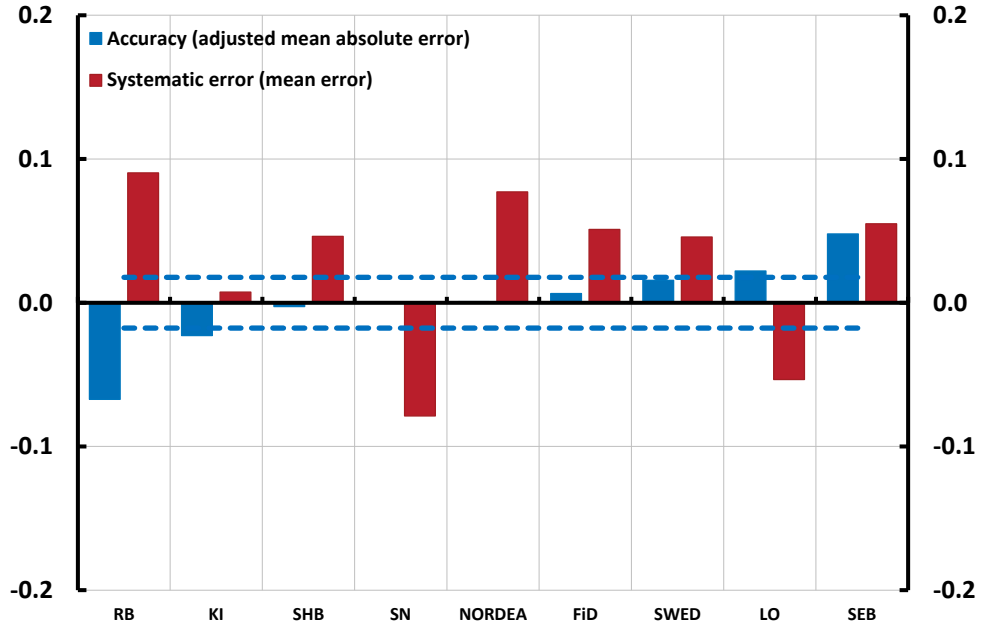


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2013–2022. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 10. Unemployment, accuracy and systematic errors in forecasts made by various analysts for 2013-2022

Percentage points

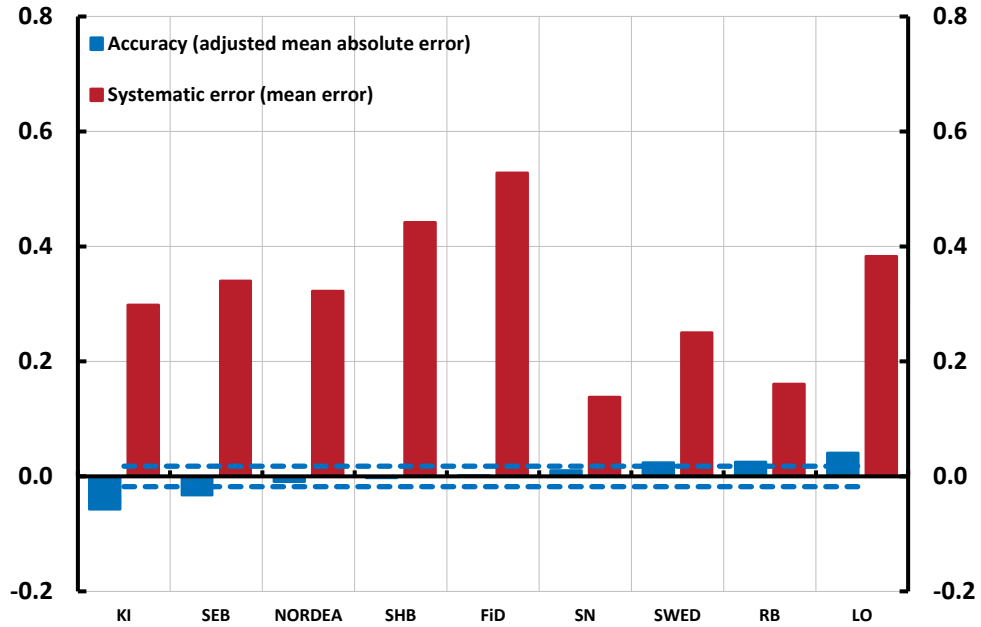


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2013–2022. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 11. CPIF inflation, accuracy and systematic error in forecasts made by various analysts for 2013-2022

Percentage points



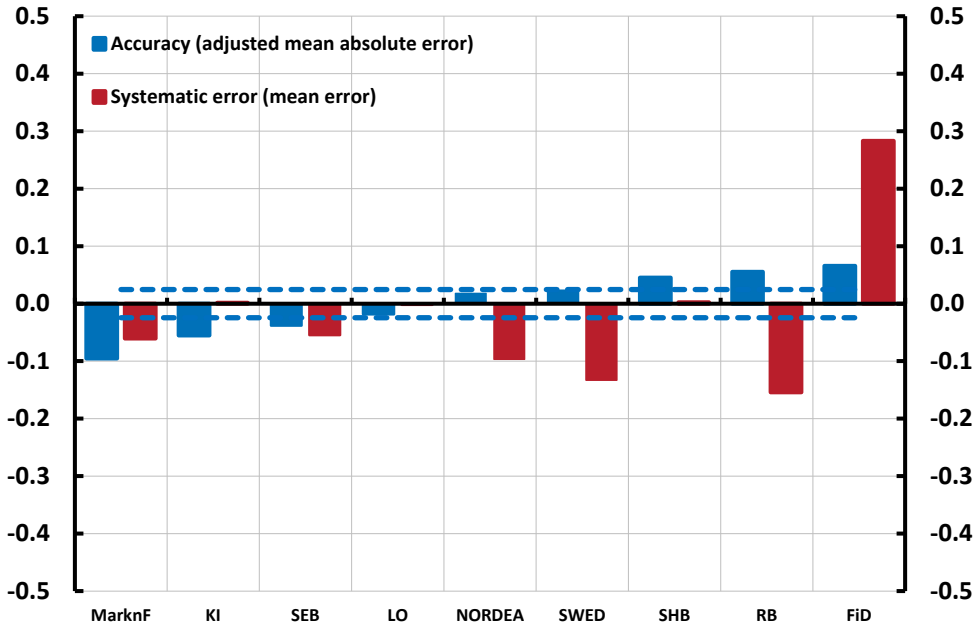
Note. The broken lines show a 95-per cent confidence interval calculated using the standard

deviation in all adjusted mean absolute errors for all forecasters over the period 2013–2022. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 12. Policy rate, accuracy and systematic errors in forecasts made by various analysts, 2013–2022

Percentage points



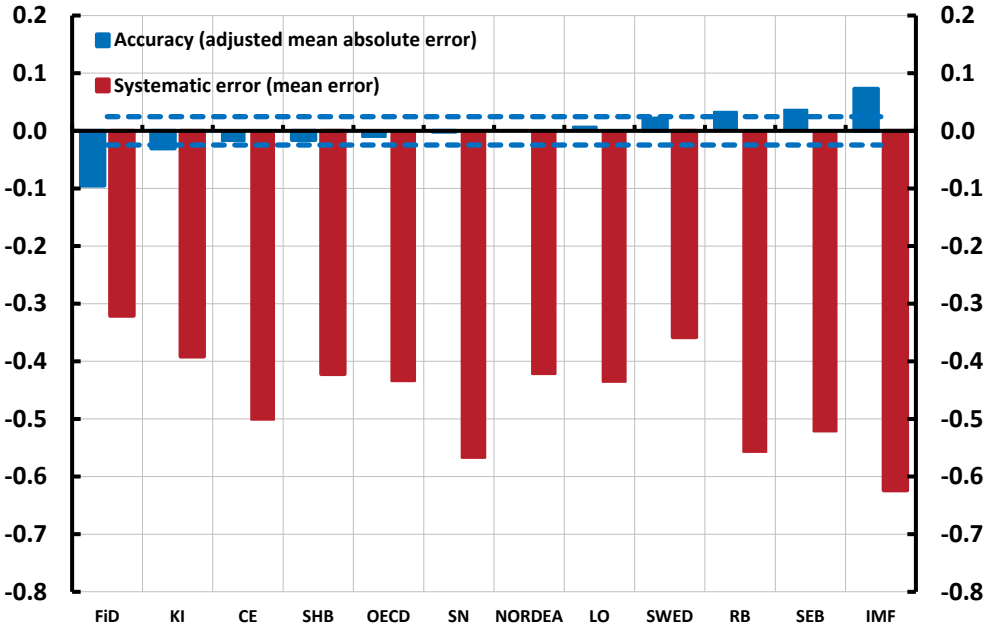
Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2013–2022. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 13 - Figure 16 show the results for GDP growth and inflation in the United States and the euro area. There we can see that the forecasts for GDP growth have on average been too high for the period 2013-2022 in both the United States and the euro area, as there are negative red bars. Inflation has become higher than expected. The blue bars in the figures show that the Riksbank's accuracy in its forecasts for inflation were close to that of the other forecasters, while the Riksbank's forecasts for GDP growth in the United States and the euro area have been slightly less accurate than the average.

Figure 13. GDP growth in the United States, accuracy and systematic errors in forecasts made by various analysts, 2013–2022[12]

Percentage points



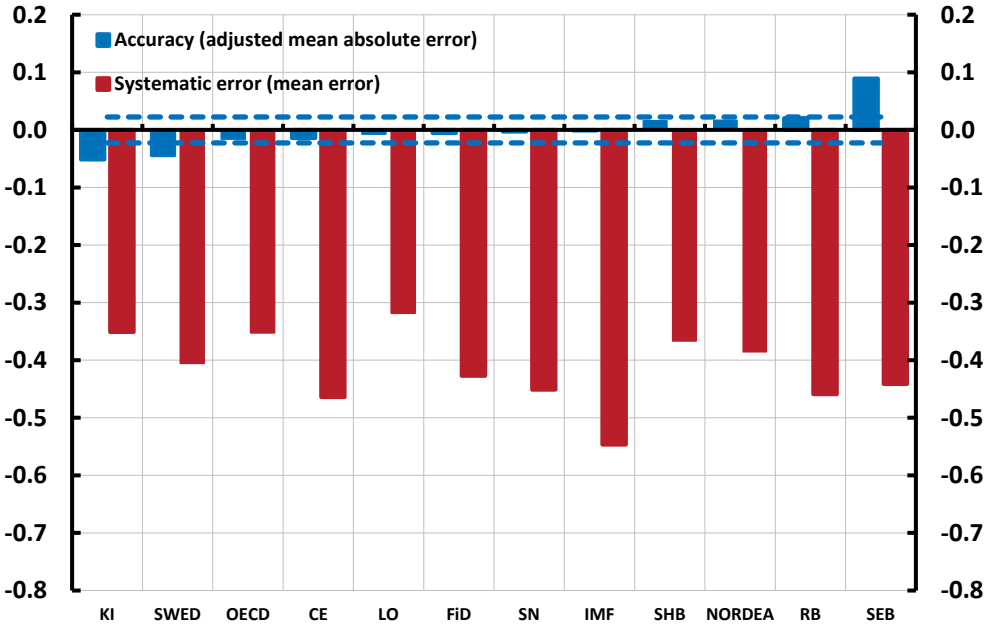
Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2013–2022. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

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

Figure 14. GDP growth in the euro area, accuracy and systematic errors in forecasts made by various analysts, 2013–2022

Percentage points

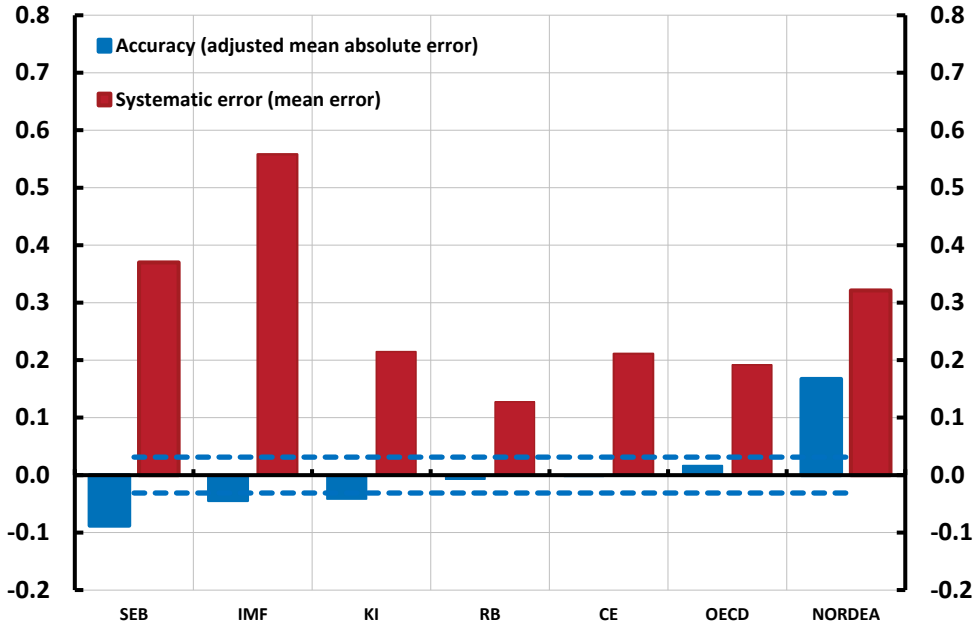


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2013–2022. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 15. CPI inflation in the United States, accuracy and systematic errors in forecasts made by various analysts, 2013–2022

Percentage points

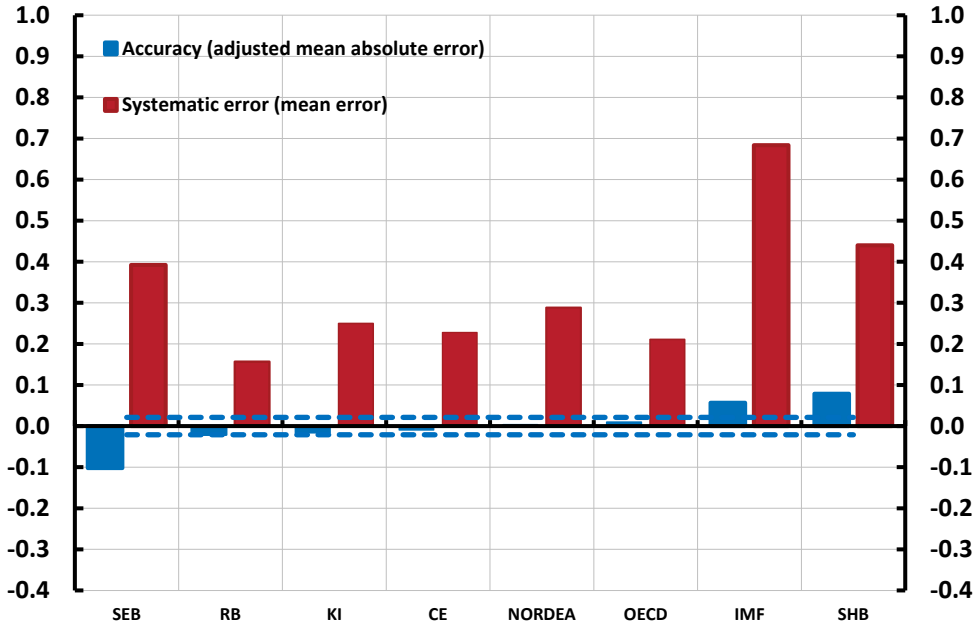


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2013–2022. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 16. HICP inflation in the euro area, accuracy and systematic errors in forecasts made by various analysts, 2013–2022

Percentage points



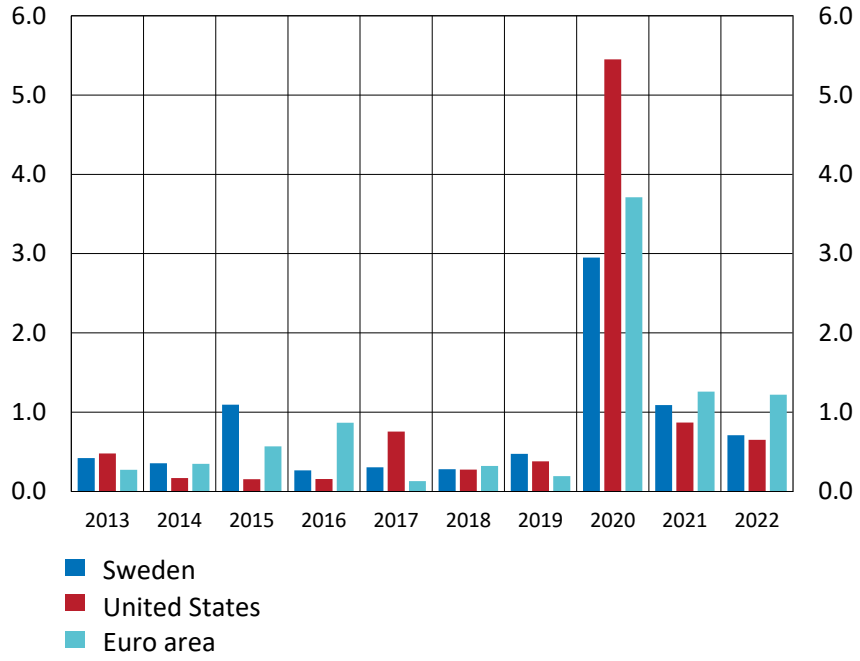
Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2013–2022. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

2.3 Varying levels of difficulty in making forecasts in different years

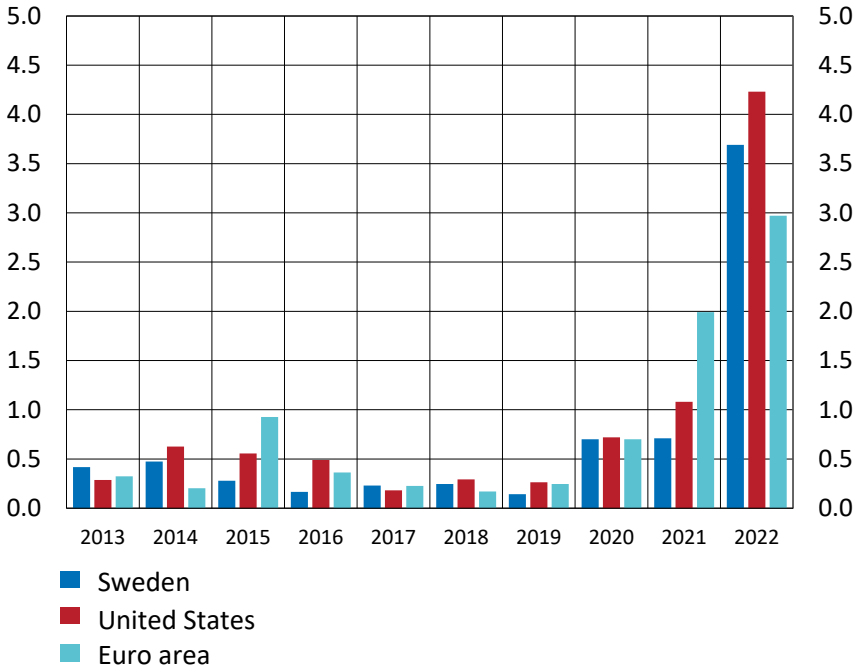
To gain a measure of how difficult it has been to forecast different variables over time, an average of the mean absolute error of different forecasters year by year can be calculated. Such average mean absolute errors are shown for GDP growth and inflation in Sweden, the United States and the euro area in Figure 17 and Figure 18. There we can see that the average mean absolute errors were unusually large for inflation in 2022.

Figure 17. Average mean absolute errors for GDP growth 2013–2022



Sources: Respective analyst and the Riksbank.

Figure 18. Average mean absolute errors for inflation 2013–2022



Sources: Respective analyst and the Riksbank.

2.4 Assessment of forecasts for 2022

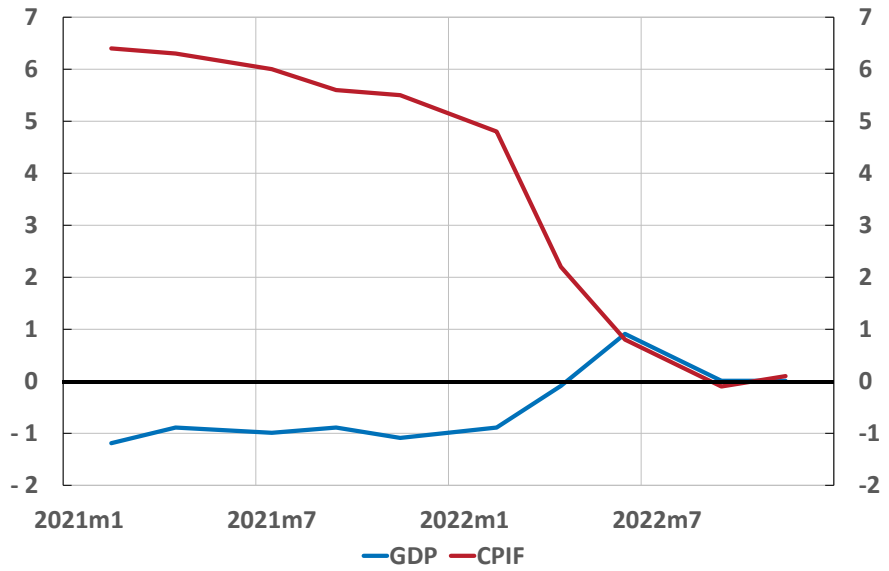
We have evaluated the 2022 forecasts in the same way as the 2013-2022 forecasts, which are presented in section 2.2. The results are shown in Figure 23 to Figure 30 in Appendix 1.

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 higher GDP growth both in Sweden and abroad during 2022 than was the case. Overall, the accuracy of the Riksbank's forecasts was roughly in line with the other forecasters.

Figure 19 below shows the Riksbank's forecast error for CPIF inflation and GDP growth in 2022 in forecasts published in 2021 and 2022.

Figure 19. The Riksbank's forecast errors for CPIF inflation and GDP growth

Outcome minus forecast, percentage points



Note: Refers to the forecasts for the 2022 annual average of inflation and growth in the Riksbank's published forecasts in 2021 and 2022. For example, the first value in each time series refers to the forecast error in the forecast from February 2021, when CPIF inflation in 2022 was underestimated by just over six percentage points while GDP growth was overestimated by just over one percentage point.

Source: Sveriges Riksbank.

The Riksbank has underestimated CPIF inflation and overestimated GDP growth for 2022 for most of 2021 and 2022.[13] The correlation between the Riksbank's forecast error for CPIF inflation and GDP growth is close to -0.9, which signals that it is not high demand that has driven up inflation. Other forecasters have also been surprised by rising inflation without higher GDP growth (see Table 3).

[13] The overestimation of GDP growth in 2022 is partly due to an overestimation of the level of GDP in 2021, see Section 1.2.

Table 3. Correlation between forecast errors

	GDP-CPIF	GDP-Unemployment	Interest rate-CPIF	GDP-GDP abroad	CPIF inflation abroad
RB	-0.89***	0.56*	0.97***	0.82***	0.98***
NIER	-0.84***	-0.10	0.91***	0.69**	0.96***
FiD	-0.78***	0.72**	0.94***		
SEB	-0.80***	0.44	0.95***	0.92***	0.99***
SHB	-0.80***	-0.19	0.87**	0.80**	
Nordea	-0.28	0.05	0.95***	0.53*	0.99***
SWED	-0.95***	0.39	0.96***	0.92***	

Note: Abbreviations as follows: RB=the Riksbank, NIER=National Institute of Economic Research, FiD=Ministry of Finance, SEB=Skandinaviska Enskilda Banken, SHB=Handelsbanken, SWED=Swedbank.

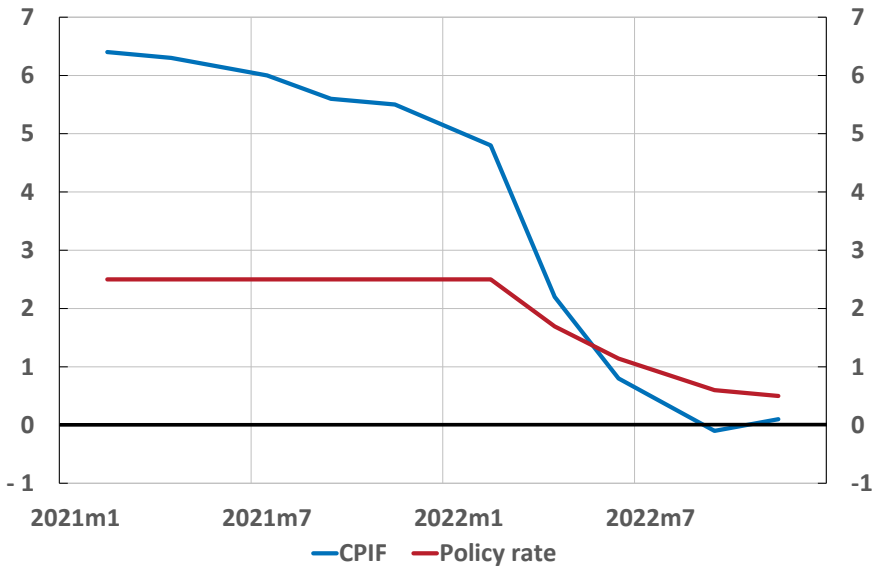
*,** and *** indicate significance at the 10, 5 and 1 per cent significance level, respectively.

Sources: Respective analyst and the Riksbank.

Figure 20 shows clearly that for most of 2021 and 2022 the Riksbank has underestimated how CPIF inflation and the policy rate would develop in 2022. It is not until the latter part of 2022 that the forecast errors approach zero. The correlation between the two forecast error series is close to one, as it is for all other forecasters. This can be explained by the fact that many recent shocks, such as high energy prices and supply problems, have pushed up inflation. And at the same time have led to increases in the policy rate to reduce the risk of inflation becoming entrenched.

Figure 20. The Riksbank's forecast errors for CPIF inflation and the policy rate

Outcome minus forecast, percentage points

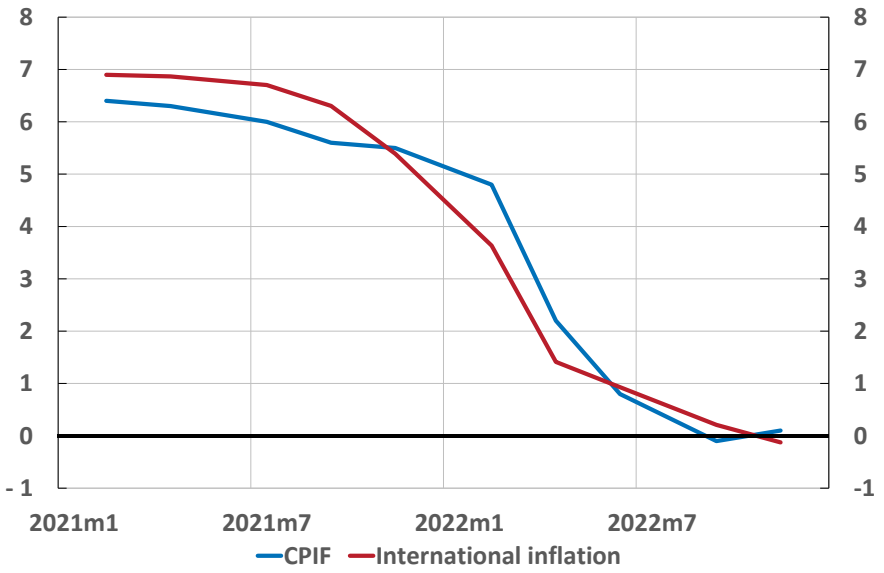


Source: Sveriges Riksbank.

The forecast errors for the Swedish variables are for all forecasters very similar to the forecast errors for the corresponding international variable (see Figure 21 for an example). This indicates that economic developments in 2022 were dominated by shocks of a more global nature.

Figure 21. The Riksbank's forecast errors for CPIF inflation and international inflation.

Outcome minus forecast, percentage points



Note: International inflation is trade-weighted inflation in the euro area and the United States.

Source: Sveriges Riksbank.

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

This section studies the accuracy of the Riksbank's inflation forecasts in the shorter term, i.e. forecasts 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 2022. We can draw the same conclusion if we only analyse short-term forecasts. Here we report the results for both the Riksbank, and a number of other forecasters who usually report their monthly forecasts on a regular basis.[14]

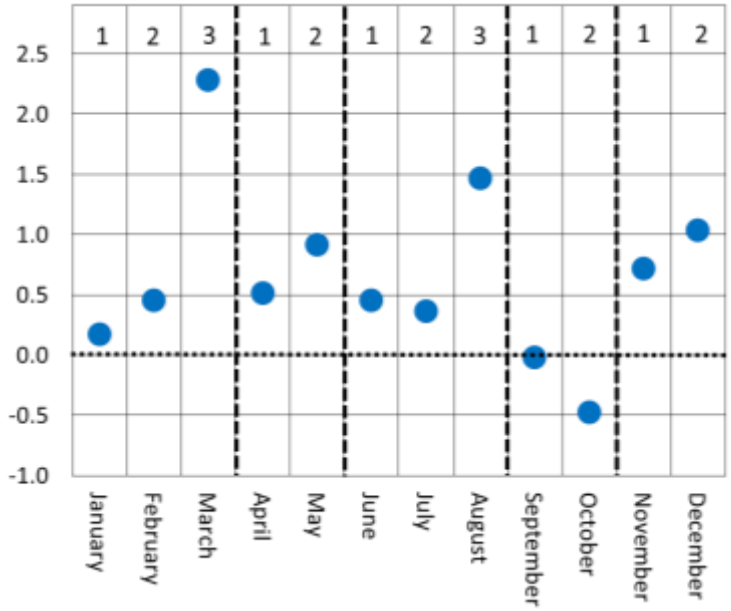
The Riksbank presents new forecasts five times a year – in February, April, June or July, September and November. Between them, Statistics Sweden often publishes two, and sometimes three, new CPI outcomes before the Riksbank publishes a new

[14] Bloomberg publishes one-step forecasts (forecasts one month ahead) every month from a number of forecasters. The number of forecasters, excluding the Riksbank, amounts to eight during the studied period 2013–2022. They include the major Swedish banks and other private financial agents.

inflation assessment. Therefore, in some parts of the analysis in this section, we show forecasts one-month, two-month and three-month ahead from the Riksbank.

Figure 22 shows the Riksbank's forecast error for CPIF inflation for the period January to December 2022. The numbers at the top of the figure show whether one, two or three monthly outcomes have been published since the Riksbank last published a forecast. A one means that this is a one-step ahead forecast, and so on. Inflation outcomes were higher than expected ten out of twelve months. The forecast errors were often relatively large, and very large in March, May, August and December.

Figure 22. The Riksbank's forecast error for CPIF inflation individual months 2022
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 January, the forecast error amounted to just under 0.2 percentage points, measured as outcome minus forecast. In the forecast presented in the Monetary Policy Report on 10 February 2022, the Riksbank had access to the CPIF for December 2021. Goods prices rose much faster than expected and the upturn was broad, with rapid price increases in sub-indices such as furniture, textiles and other furnishing products. Services prices also increased at a slightly higher rate than forecast, while food prices developed more in line with the forecast. At the same time, the contribution from electricity prices was significantly lower than expected, which mitigated the forecast error. The main reason why electricity prices made a negative contribution to the forecast error in January was that the new annual weight was lower than expected. In February, when a forecast two months ahead is evaluated for the Riksbank, CPIF inflation was 0.5 percentage points higher than the most recently published forecast. The trend of higher prices for goods and services continued, but now food prices also rose faster than expected. Once again, lower-than-expected electricity prices contributed

to dampening the forecast error. In March 2022, when the Riksbank's latest assessment was three months old, the forecast error reached a record high. Goods prices, which rose rapidly in both January and February, once again rose faster than expected in March. Services prices also rose faster than forecast, as did food prices. Higher-than-expected energy prices also added significantly to the forecast error.

In April, inflation was higher than expected again. In the forecast presented in the Monetary Policy Report on 28 April 2022, the Riksbank had access to the CPIF for March 2022. It was thus a one-step forecast that was evaluated. Goods prices, which had risen rapidly since January, continued to rise in April, but somewhat more slowly than expected. At the same time, food prices rose marginally faster than forecast, while services prices rose much faster than expected. Some service prices that increased particularly rapidly in April were banking services and restaurant prices for alcoholic beverages. Electricity prices were also higher than expected compared with the forecast in the April Monetary Policy Report. Part of the reason for this was that electricity prices rose sharply in the days prior to the publication of the report. In May, goods prices continued to rise, but the outcomes came in relatively well in line with the assessment. The deviation between outcome and forecast for service prices widened further in May. The same applied to food prices. Higher than expected fuel and electricity prices also contributed to a larger forecast error.

In June and July, CPIF inflation was 0.5 and 0.4 percentage points respectively higher than in the forecast in the Monetary Policy Report published by the Riksbank on 30 June. The upturn was broad in June and prices increased faster than expected for all major sub-aggregates except energy prices, which were in line with the forecast. In July, the gap between outcome and forecast widened further for prices of goods, food and services. At the same time, fuel prices came in much lower than forecast, which mitigated the forecast error for the CPIF. The trends continued in August, with slightly higher than expected prices for goods, services and food. However, compared with the assessment in the June MPR, electricity prices now rose much faster than expected, contributing to an increase in the forecast error to 1.5 percentage points.

In September, the forecast error was small, but food prices rose faster than the assessment in the September Monetary Policy Report. This time, it was mainly the prices of fruit and vegetables that were higher than expected, at the same time as Systembolaget (the Swedish Alcohol Retailing Monopoly) made a major price adjustment for many of its products. In October, the deviation between outcome and forecast widened further for food prices, as beer prices, for example, rose faster than they usually do in October. However, other commodity prices also rose faster than in the assessment. Lower electricity prices at the same time contributed to the forecast error being clearly negative in October.

In November, the rate of increase in the CPIF was 0.7 percentage points higher than expected. Electricity prices contributed to CPIF inflation being unexpectedly high. The forecasts for the November MPR were finalised in mid-November. During the second half of November, electricity prices rose sharply, which contributed to an unexpectedly rapid increase in CPIF electricity prices. With regard to other components, the

Riksbank's forecast errors were small. In December, electricity prices once again contributed to higher CPIF inflation. Higher energy prices than expected contributed a total of 0.9 percentage points to the total deviation between outcome and forecast in December. Goods prices, which in November developed in line with the most recently published forecast, also rose unexpectedly quickly in December.

In Table 4, we compare different forecasters' accuracy over the short term. Here we report both the average forecast error, which we call the Average error in the table, and the mean absolute error, which we call MAE, for the period January 2013 to December 2022. The row "Mean forecast" shows the result when we evaluate an average of all forecasts except the Riksbank's. According to research literature, such a mean value forecast is considered relatively accurate and, over longer periods, it is usually difficult to make better forecasts.[15] In the analysis below, we have sorted out the Riksbank's two and three-step forecasts. The forecasts of the other analysts for those months have also been excluded. This makes it easier to compare them, as the forecasts by the Riksbank and other analysts are then based on approximately the same amount of information.[16]

The Riksbank ranks fourth among the various forecasters, with a mean absolute error of 0.16. Thus, three individual forecasters out of a total of nine, have on average made more accurate forecasts than the Riksbank.[17] Table 4 also shows that the Riksbank, on average, has forecast a slightly too high inflation rate one month ahead, as the mean error is negative. Overall, this analysis shows that the Riksbank's accuracy in the very short term is fairly good in relation to other forecasters.

Table 4. Evaluation of short-term forecasts for CPIF inflation on a one-month horizon, 2013-2022.

Ranking	Forecaster	Average error	MAE	# Forecasts
	Mean value forecast	−0.03	0.15	56
1	Forecaster with lowest MAE	−0.04	0.15	55
4	**The Riksbank**	**−0.07**	**0.16**	**56**
9	Forecaster with highest MAE	−0.06	0.20	40

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

Sources: Bloomberg and the Riksbank.

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

[16] 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.

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

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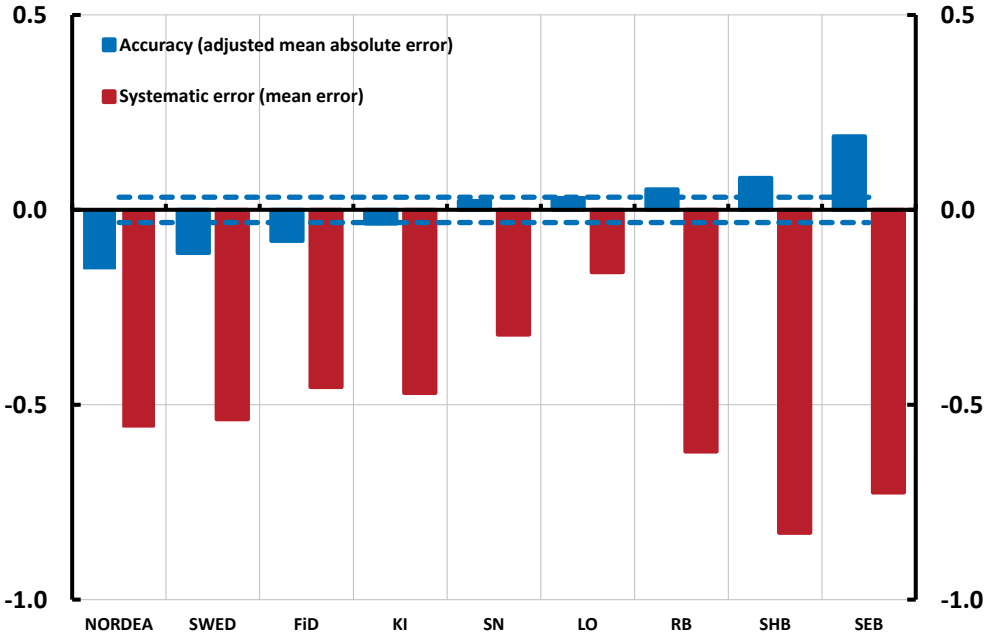
APPENDIX 1: Forecasts for 2022

Figure 23. GDP growth, accuracy and systematic errors in forecasts for 2022 made by various analysts, 2021–2022

Percentage points

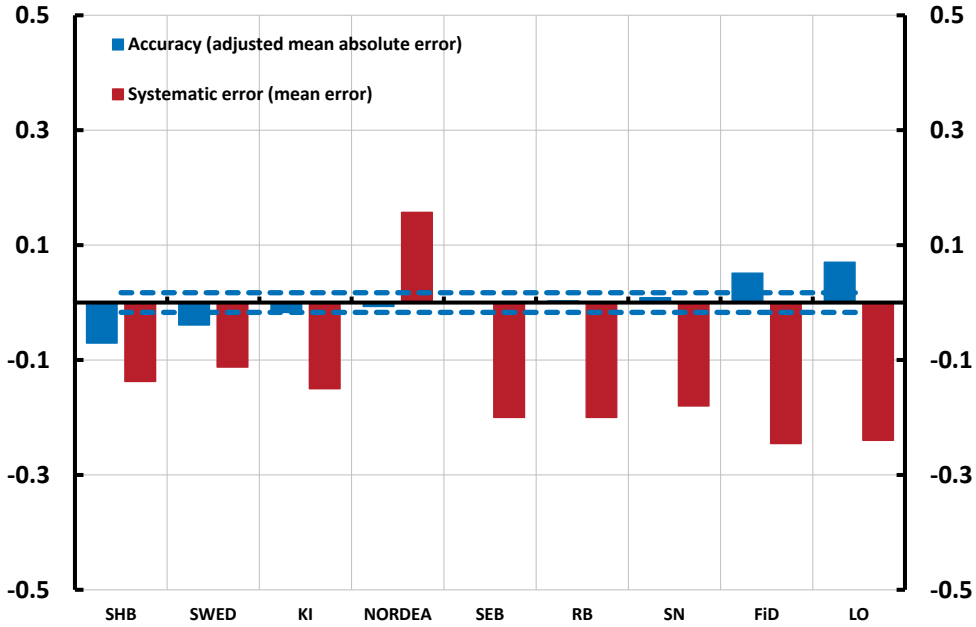


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 24. Unemployment, accuracy and systematic errors in forecasts for 2022 made by various analysts, 2021–2022

Percentage points

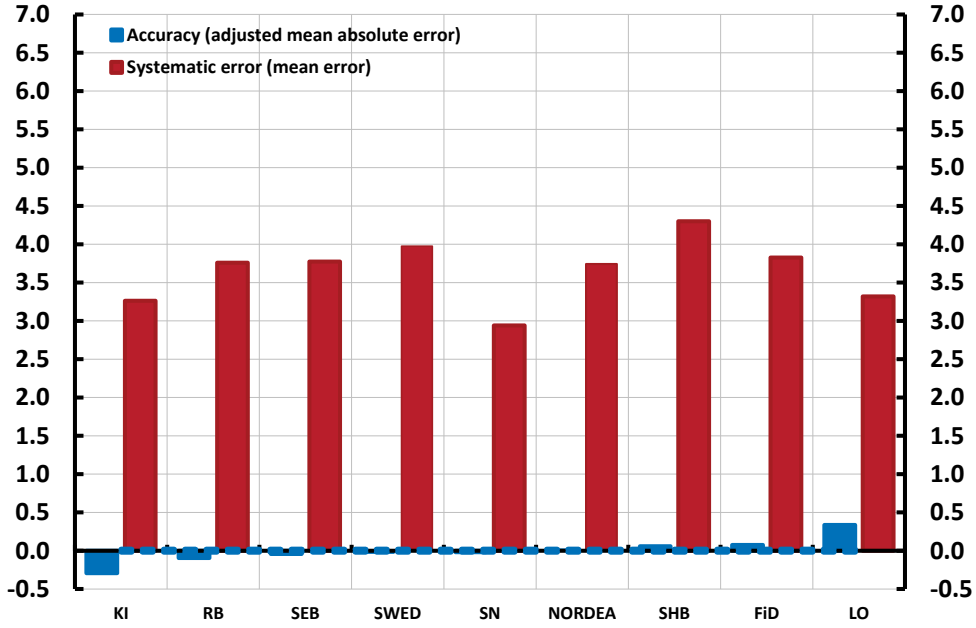


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012–2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 25. CPIF inflation, accuracy and systematic errors in forecasts for 2022 made by various analysts, 2021–2022

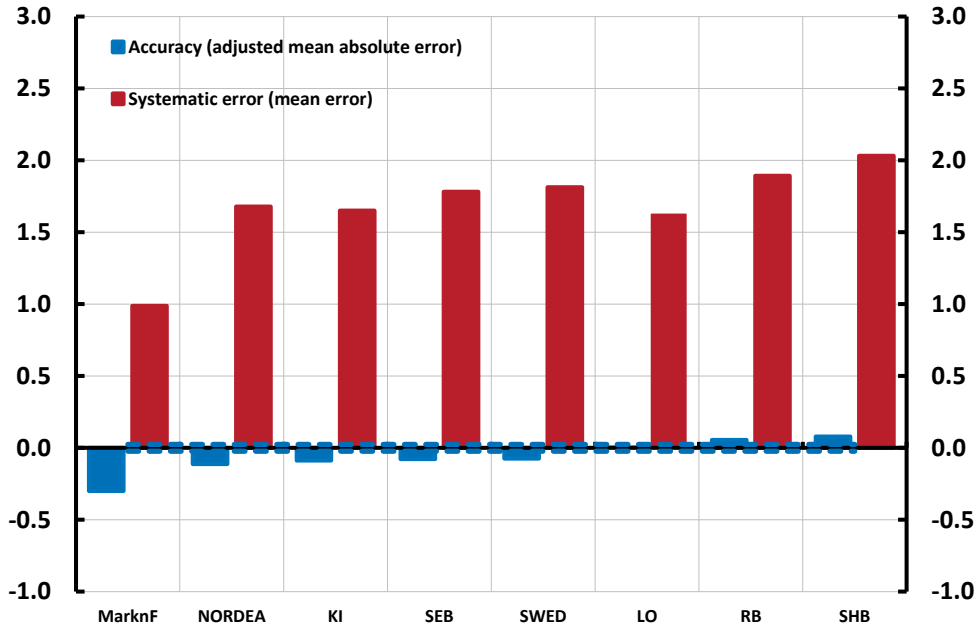
Percentage points



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. Policy rate, accuracy and systematic errors in forecasts for 2022 made by various analysts, 2021–2022

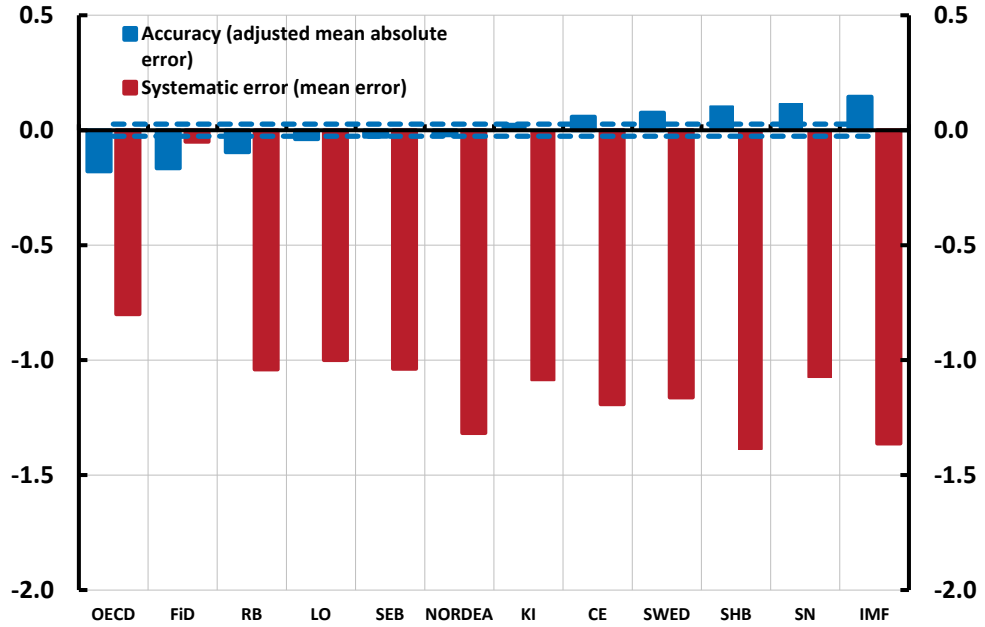
Percentage points



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 27. GDP growth in the United States, accuracy and systematic errors in forecasts for 2022 made by various analysts, 2021–2022

Percentage points

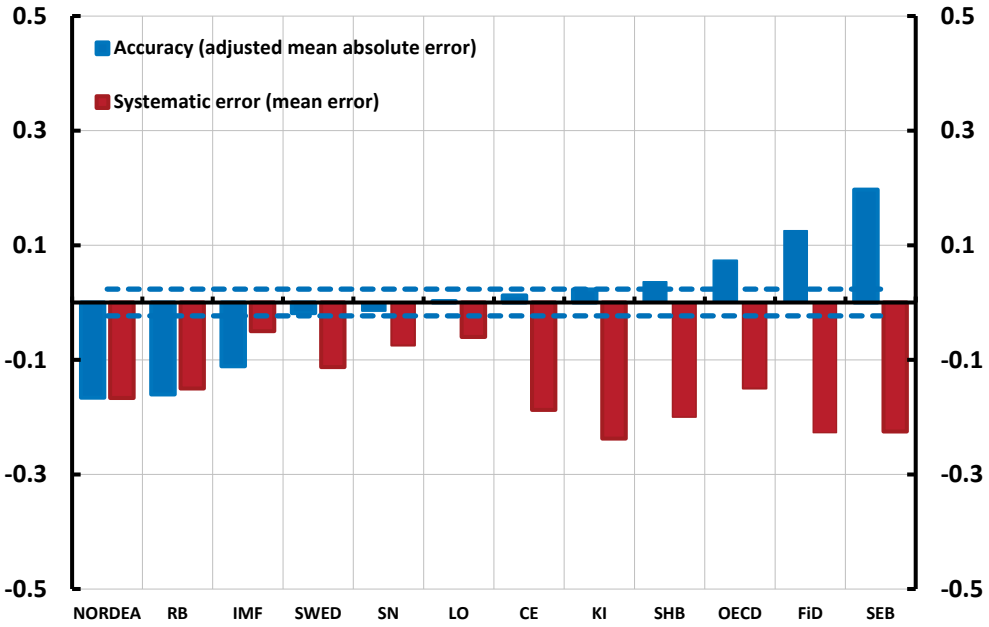


Note: The broken lines show a 95-per cent confidence interval calculated using the standard deviation in all adjusted mean absolute errors for all forecasters over the period 2012– 2021. The interval is calculated as 2*standard deviation/square root of number of forecasting errors.

Sources: Respective analyst and the Riksbank.

Figure 28. GDP growth in the euro area, accuracy and systematic errors in forecasts for 2022 made by various analysts, 2021–2022

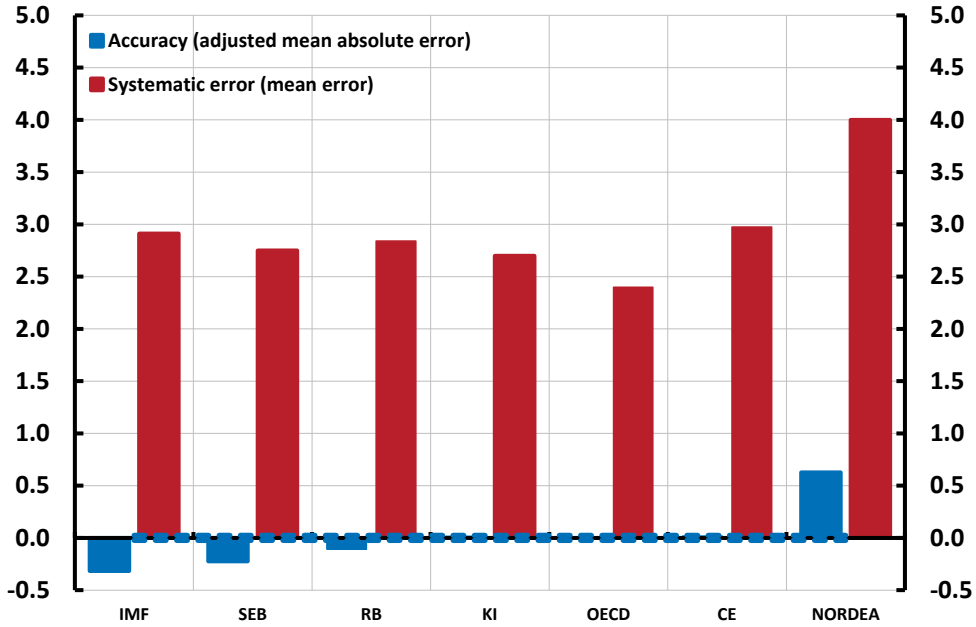
Percentage points



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 29. CPI inflation in the United States, accuracy and systematic errors in forecasts for 2022 made by various analysts, 2021–2022

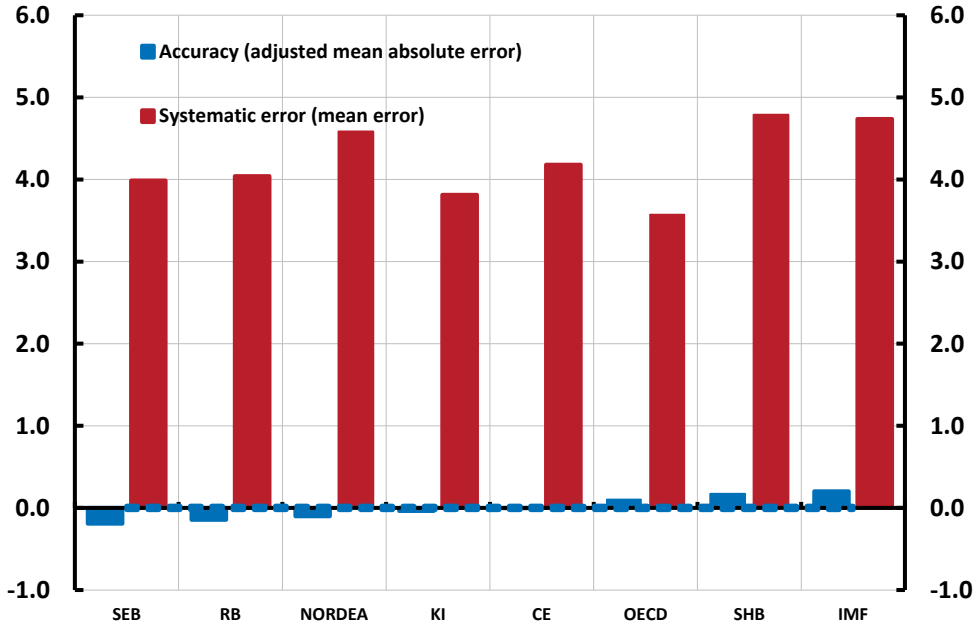
Percentage points



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 30. HICP inflation in the euro area, accuracy and systematic errors in forecasts for 2022 made by various analysts, 2021–2022

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.[18] 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.

[18] 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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