Evaluation of the Riksbank's forecasts

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Foreword

The Riksbank is an authority under the Riksdag, the Swedish Parliament, with responsibility for monetary policy in Sweden. The monetary policy to be conducted is normally determined six times a year 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, therefore form an important part of the material on which monetary policy decisions are based. This study evaluates the Riksbank's forecasts for a number of central economic variables. The Riksbank's accuracy is also compared with the forecasting performance of other economic analysts. The study is a complement to the report *Account of Monetary Policy, 2018*. The forecast evaluation focuses on the period 2007–2018, with a special analysis of the forecasts for 2018. The report has been produced by the Monetary Policy Department. Most of the work on this study has been performed by Mårten Löf, Ard Den Reijer and Annukka Ristiniemi.

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Summary

Monetary policy needs to be forward-looking and based on forecasts as it takes time for it to affect the real economy and inflation. As forecasts comprise an important part of the decision-making process, they should be evaluated systematically. Although the accuracy of the forecasts can vary from year to year, due to events that can (sometimes) be very difficult to predict, a systematic evaluation can nevertheless help to gradually improve it.

This study analyses and evaluates the Riksbank's forecasts for a number of central economic variables during the period 2007–2018.

GDP growth in Sweden was somewhat lower than expected

The report begins with a general description of economic developments in 2018 and a more in-depth analysis of the development of inflation.

The analysis shows that GDP growth and inflation abroad developed more or less in line with the Riksbank's forecast. At the same time, growth in Sweden in 2018 was somewhat lower than the assessments made by the Riksbank in 2017 and 2018. Unemployment was roughly as predicted, while the number of persons employed and the number of persons in the labour force increased much faster than expected. From the Monetary Policy Report in February 2017 to the report in December 2018, employment growth was continually revised upwards. Despite the positive situation on the labour market and the high domestic resource utilisation, wages increased more slowly than expected. However, unit labor costs increased faster and probably contributed to higher inflation. But higher wage increases were not the primary driver of this development. The rising unit labour costs can instead be explained by productivity growth, which was weaker than the Riksbank's assessment.

Compared with 2017, the contribution of service prices to CPIF inflation was lower in 2018. In turn, this explains why inflation in terms of the CPIF excluding energy fell back somewhat more than expected during the year. Compared with an average of the Riksbank's forecasts from 2017 and 2018, however, CPIF inflation was slightly higher than expected, which can be explained by higher energy prices.

Factors contributing to low inflation in 2013–2016 have subsided

The second section interprets the upturn in inflation in recent years with the aid of a macroeconomic model.

According to the model, the weak Swedish krona has contributed to higher inflation since 2014. Another factor that has helped boost inflation in 2017 and 2018 is stronger development abroad. Factors that contributed to lower inflation in 2013–2016, such as unusually low price mark-ups, have subsided and have been relatively minor over the last two years. According to the model, this is the most important explanation for why inflation has risen and has been close to the target since 2017.

Riksbank forecasts better than or in line with the average for GDP growth, unemployment and CPIF inflation in 2007–2018

The following section compares the Riksbank's forecasts with those made by other forecasters. First, the forecasts made by the Riksbank and other analysts between 2007 and 2018 are analysed. Then, the forecasts made in 2017 and 2018 for economic developments in 2018 are studied specifically.

During the period 2007–2018, the Riksbank had the highest accuracy for GDP growth and was also better than average for unemployment. The Riksbank was slightly better than average as regards forecasts for CPIF inflation but made the least accurate forecasts for the repo rate. By calculating an average of the different analysts' forecast error year by year, a measurement can be obtained of how difficult it has been for analysts to predict the development of different variables over time. The results indicate that 2018 was a relatively easy year when it came to making forecasts of GDP growth and CPIF

inflation. The Riksbank was better than average as regards forecasts for inflation in Sweden in 2018 and about average regarding forecasts for GDP growth, unemployment and the repo rate.

Accurate short-term forecasts for inflation
In the final section, the evaluation shows that the Riksbank's accuracy in the very short term is close to the average for other forecasters.

1. Economic developments in 2018

To structure the analysis of economic developments in 2018, a comparison is made between the outcomes and the forecasts published by the Riksbank in its monetary policy reports from February 2017 to December 2018 inclusive. The figure used in the comparison is an average of these twelve forecasts (Table 1 below). The first part of this section focuses on the variables that usually explain the development of inflation. After that, the development of the different components of the consumer price index with a fixed interest rate (CPIF) in 2018 is studied in relation to the historical average. In case of missing outcomes, a forecast from February 2018 is used.

GDP growth and inflation abroad in line with the forecast
The outcome for GDP growth in the United States was slightly higher than the forecasts published by the Riksbank over the past two years. The opposite is true for GDP growth in the euro area. Overall, in the countries included in the krona index (KIX), growth in 2018 was more in line with the forecasts (see Table 1).[1]

Overall, inflation in the euro area, the US and aggregate inflation abroad were more or less as expected.

Higher employment growth and lower wage increases than expected in Sweden
It can be noted that GDP growth in Sweden in 2018 was slightly lower than an average of the assessments made by the Riksbank over the past two years (see Table 1). It is primarily domestic demand and special household consumption that have been lower than expected. In Figure 1 below, the Riksbank's assessments for the twelve forecasting points in 2017 and 2018 are plotted for a few central domestic variables. At the lowest point, GDP growth was expected to amount to 2.3 per cent in 2018 (Monetary Policy Report, February 2017 and December 2018) and at the highest, to 3.1 per cent (Monetary Policy Report, October 2017). GDP growth was adjusted upwards quite considerably in September 2018. This upward revision is primarily explained by a larger predicted contribution from stock investment and net exports. The Riksbank's forecasts from Swedish growth in 2018 have been revised somewhat, but not as much as for 2017.[2]
As in the forecast for 2017, unemployment was roughly as predicted, while the number of persons employed and the number of persons in the labour force increased much faster than expected (see Table 1 and Figure 1). The forecast for employment growth has been continually revised up. The same applies to the forecast for the number of people in the labour force.

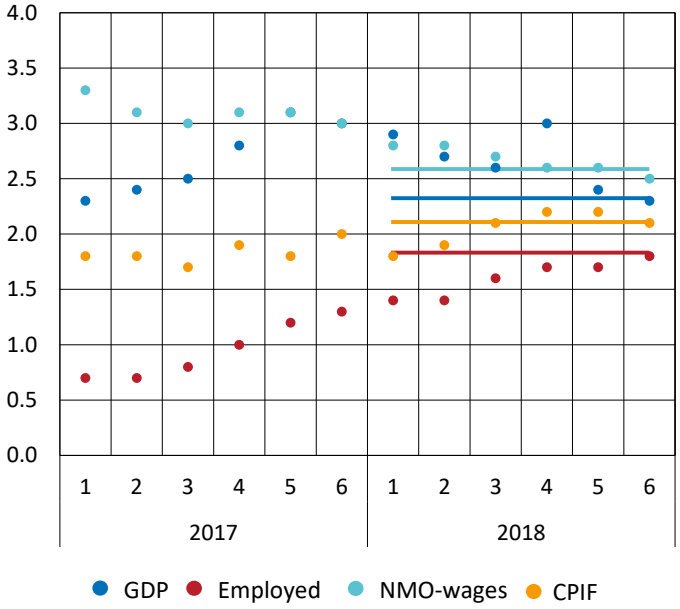
[1] GDP abroad is aggregated with the weights in the krona index (KIX).
[2] See Riksbank Study (2018): Evaluation of the Riksbank's forecasts

Table 1. The Riksbank's forecasts for 2018 published from February 2017 to December 2018 plus outcomes
Annual percentage change, unless otherwise specified

	Forecast			Outcome
	Min	Max	Average	
GDP in the euro area	1.7	2.4	**2.0**	1.8
GDP in the US	2.3	2.9	**2.6**	2.9
GDP abroad, KIX-weighted	2.3	2.7	**2.5**	2.5
Inflation in the euro area (HICP)	1.2	1.8	**1.5**	2.0
Inflation in the US	2.1	2.6	**2.4**	2.4
Inflation abroad, KIX-weighted	1.9	2.2	**2.0**	2.2
Policy rate abroad, KIX-weighted, per cent	0.0	0.1	**0.1**	0.1
Crude oil price, USD/barrel Brent	49.3	74.9	**63.2**	71.5
GDP, calendar-adjusted	2.3	3.1	**2.7**	2.4
Hours worked, calendar-adjusted	0.9	1.8	**1.5**	2.4
No. of employed, 15-74 years	0.7	1.8	**1.3**	1.8
Labour force, 15-74 years	0.6	1.4	**1.0**	1.4
Unemployment, 15–74 years, per cent of labour force	6.2	6.7	**6.4**	6.3
Hourly wage, NMO	2.5	3.3	**2.9**	2.6
Hourly labour costs, NA	2.8	3.6	**3.2**	2.6
Productivity	0.4	1.5	**1.2**	0.0
Unit labour costs	1.6	2.7	**2.0**	2.9
CPIF	1.7	2.2	**1.9**	2.1
CPIF excluding energy	1.4	1.9	**1.7**	1.4
CPI	1.7	2.1	**2.0**	2.0
KIX index, 18 November 1992 = 100	109.2	118.0	**113.3**	117.6
Repo rate, per cent	–0.5	–0.3	**–0.4**	–0.5

Note: NMO refers the National Mediation Office. Outcome for 2018 is the NMO's model forecast from February 2019. NA is the National Accounts. Labour costs per hour are defined as the sum of wages, social security contributions and payroll taxes (total labour cost) divided by the number of hours worked for employees, seasonally adjusted data. Unit labour costs are defined as labour costs divided by the seasonally adjusted value added in fixed prices. The policy rate abroad is an aggregate of rates in the US, the euro area, Norway and the United Kingdom.
Sources: Bureau of Economic Analysis, Eurostat, IMF, National Mediation Office, national sources, OECD, Statistics Sweden and the Riksbank

Figure 1. The Riksbank's forecasts (dots) and outcomes (lines) for 2018
Annual percentage change



Sources: National Mediation Office (NMO), Statistics Sweden and the Riksbank

But despite the positive situation on the labour market and the high domestic resource utilisation, wages have increased more slowly than expected, see Figure 1. In comparison with earlier periods of corresponding economic activity, wage increases have been unexpectedly moderate.[3]

However, labour costs in relation to production have increased more rapidly than expected by the Riksbank and have probably contributed to higher inflation. But wage increases have not been the primary driver of this development. The rising costs are mainly due to productivity that has been weaker than the Riksbank's assessment both in 2017 and 2018. The rate of increase in unit labour costs, i.e. the difference between the increase in total wage costs and the increase in productivity, has also been higher than the Riksbank had estimated.

Higher rate of increase in energy prices than in earlier years

CPIF inflation amounted on average to 2.1 per cent last year. Compared with the average of the Riksbank's forecasts from 2017 and 2018, this was somewhat higher than expected. Measured as the CPIF excluding energy, the rate of inflation was 1.4 per cent in 2018, which was somewhat higher than the average of the Riksbank's forecasts from 2017 and 2018. In other words, energy prices increased more rapidly than expected, which caused CPIF inflation to be higher than expected while CPIF excluding energy was lower than expected (see Table 1). Other measures of core inflation, which exclude or reduce the significance of sharply varying prices, also indicate that the permanent part of the inflation rate was lower than measured CPIF inflation in 2018.

Table 2 shows the average rate of price increase for various components in the CPIF for 2018 in relation to the period 2000 to 2017.

[3] See the article "Strong economic activity but subdued wage increases" in Monetary Policy Report, July 2017.

Table 2. Sub-indeces in the CPIF (weight and average annual rate of increase in per cent)

	Weight 2018	2000–2017	2018
Services	44.9	1.8	1.9
Goods excluding food	27.1	–0.5	–0.4
Food	17.7	1.8	2.2
Capital stock index	3.4	5.2	7.1
CPIF excluding energy	93.0	1.3	1.4
Energy	7.0	3.5	10.5
CPIF	100	1.5	2.1

Note. Weight refers to the weight in the CPI in 2018.
Sources: Statistics Sweden and the Riksbank

Service prices developed more or less in line with the historical rate of increase, as did prices for goods. Food prices rose somewhat more rapidly than their historical average in 2018 and overall, CPIF excluding energy also increased slightly faster than the historical average. Energy prices contributed to higher CPIF inflation in 2018 and increased significantly more rapidly than a historical average.

Figure 2 shows how various components have contributed to CPIF inflation in recent years. The contributions show, put simply, the annual rate of increase in each price index multiplied by the weight in the CPIF. Bars above zero indicate a positive contribution to CPIF inflation, while bars below zero indicate a negative contribution.

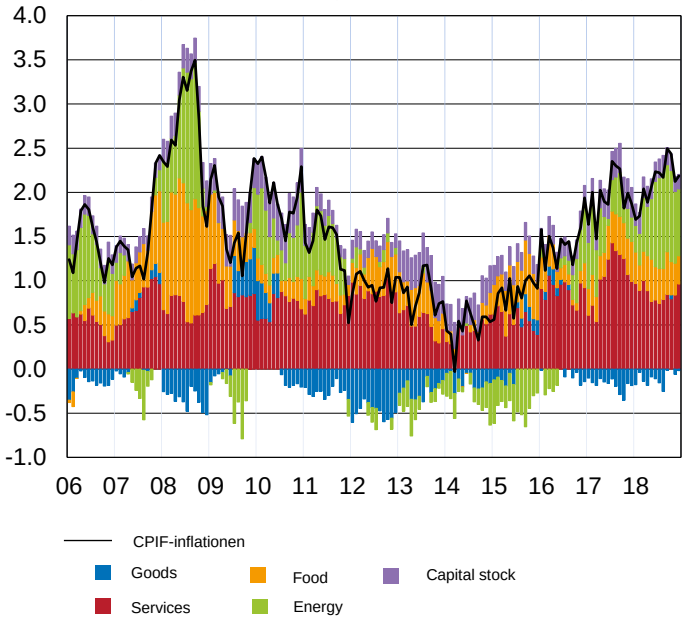
Compared with 2017, the contribution from service prices was lower in 2018. This, in turn, can be explained by the slower increase in prices within the component normally termed "other services.[4]" It is also clear that the contribution from energy prices to CPIF inflation was greater last year. Energy commodity prices are largely driven by temporary changes in supply and demand. Consumer prices, in turn, are directly affected by such changes via e.g. electricity and fuel prices. Therefore, such temporary variations can have quite a substantial effect on CPIF inflation.[5]

During the summer and autumn, the upturn in energy prices contributed to nearly 1 percentage point of CPIF inflation (see Figure 3). This can be compared with the period 2012–2015, when energy prices helped to hold back CPIF inflation. Since the autumn of 2018, the contribution from electricity prices has continued to grow while other energy prices, such as fuel, fuel oil and district heating, have fallen back (named oil related products in Figure 3). The contribution to inflation from electricity prices has not been this high since 2008.

In summary, the analysis shows that the service prices that contributed significantly to the upturn in CPIF inflation in 2017 were lower in 2018. Instead, higher energy prices made a significant contribution to higher inflation.

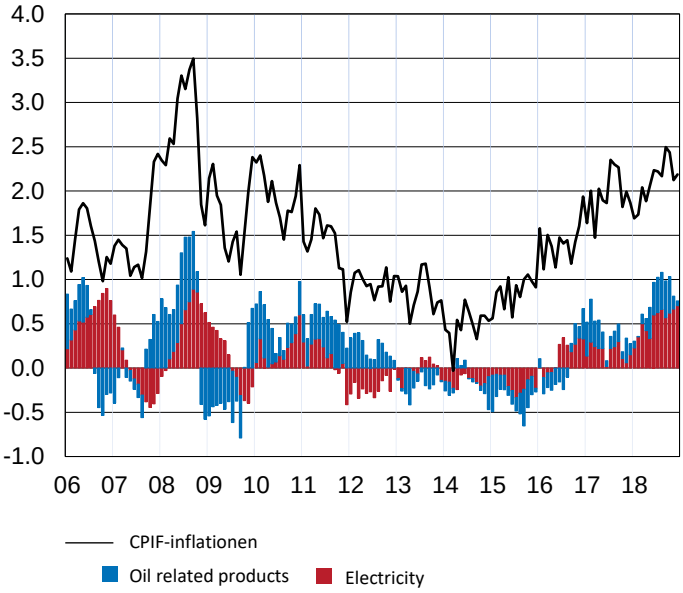
[4] Some price indices in the group are: mainly administratively priced services such as charges for water, waste management, and chimney cleaning, TV license, postal services, medical care, dentist fees. Other examples are restaurants, accommodation, entertainment, recreation, hygiene, vehicle and household repairs and bank services, insurance etc., and telephony.
[5] Energy prices can also have indirect effects on CPIF inflation. One example of an indirect effect is the rising price of bus tickets, when bus companies raise prices as a result of rising fuel costs.

Figure 2. Different price indices and their contribution to CPIF inflation
Annual percentage change and percentage points respectively, monthly data



Note. The bars illustrate each component's contribution to the rate of increase in the CPIF over the past twelve months. The contributions can be interpreted as the annual rate of increase in each group multiplied by the group's weight in the CPIF.
Sources: Statistics Sweden and the Riksbank

Figure 3. Contribution of energy prices to CPIF inflation
Annual percentage change and percentage points respectively, monthly data



Note. The bars illustrate each component's contribution to the rate of increase in the CPIF over the past twelve months. The contributions can be interpreted as the annual rate of increase in each group multiplied by the group's weight in the CPIF.
Sources: Statistics Sweden and the Riksbank

2. Model interpretation of the development of inflation since 2014

This section analyses the development of inflation since 2014 with the aid of a macroeconomic model. The model a so-called Dynamic Stochastic General Equilibrium Model (DSGE model), known as Ramses. First, we describe the model's properties and then how it interprets the development up until 2018.

Ramses is the DSGE model used at the Riksbank for forecasts and policy analyses. Since 2017, a modified version of Ramses has been used with a time-varying neutral interest rate.[6] The fact that the model is stochastic means that the correlations between different variables can shift over time depending on which underlying factors affect economic developments. These factors can be domestic or come from abroad. By studying them, it is possible to provide an explanation for why the economy has developed in the way it has. It also gives us an idea of how important an individual explanatory factor is compared with others, as all factors are studied within the same model. The model contains 18 time series, and the parameters have been calculated based on data from the first quarter of 1995 to the fourth quarter of 2016. Ramses contains 18 active shocks.[7] To simplify the discussion, we have sorted these into six main factors:[8]

- Domestic demand
- Domestic cost pressures
- Price mark-ups
- Monetary policy
- International situation
- Exchange rate

Inflation held back by lower price mark-ups in 2018

Figure 4 shows how different factors according to Ramses have contributed to the deviation of CPIF inflation from the target since 2014. The deviations in inflation and other variables that the model is to explain have been quite small in the past two years. Inflation has been close to target, while several other input variables were close to their long-term equilibrium levels.[9].[10]

[6] An earlier version of the DSGE model is described in Adolfson et al. (2013)

[7] The shocks drive the economy in the model and reflect events that cause developments to deviate from what economic correlations have looked like historically. The model also contains measurement errors for various variables (one for each of the 18 observed variables excluding Swedish and overseas policy rates). These represent movements that the model has difficulty combining with developments in the model variables. The contributions from measurement errors are usually small.

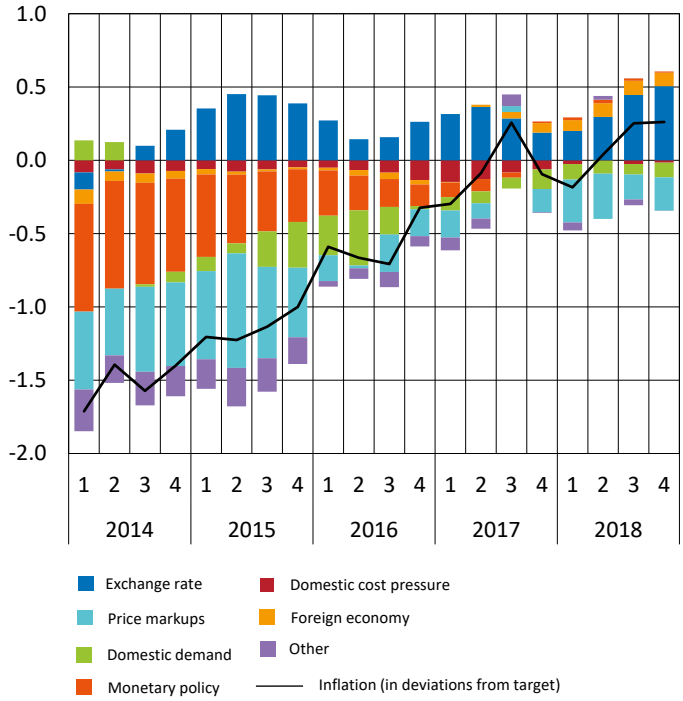
[8] In the domestic demand group, the shocks include those that impact private consumption and investment. Domestic cost pressures include shocks to technological developments in Sweden and certain labour market factors. The temporary changes that deviate in some way from the historical pattern in price mark-ups will be seen as shocks. Changes in the repo rate that deviate from an estimated policy rule are interpreted as a monetary policy shock. Monetary policy in the model is determined by a policy rule for the repo rate based on how inflation and resource utilisation develop. How much monetary policy reacts to changes in inflation and resource utilisation reflects how the Riksbank has actually reacted historically. The international group includes shocks to technological developments abroad and shocks that affect inflation abroad.

[9] The exchange rate is an exception. For a discussion on it, see "Development of the Swedish krona in the longer term", Monetary Policy Report October 2018.

[10] Neutral interest rate levels have fallen globally so policy rates in Sweden and abroad have not been so far from their equilibrium levels either.

Figure 4. The contributions of different shocks to the deviation of CPIF inflation from 2 per cent, according to Ramses

Annualised rate and percentage points respectively, quarterly data



The relatively weak exchange rate has contributed to higher inflation since 2014 (dark blue bars in Figure 4). In 2016, these contributions were particularly large. But the impact of the exchange rate depreciation in 2018 seems nevertheless not to have generated the price increases indicated by the model's historical correlations. This can explain why price mark-ups (light blue bars) have made a negative contribution to inflation and "counteracted" the effects of the weak exchange rate. Another factor contributing to the rise in inflation in 2017 and 2018 is stronger development abroad (orange bars), even though these contributions are minor. It should be noted, however, that this type of model for an open economy finds it difficult to capture effects from economic fluctuations abroad. This probably means that the significance of international developments is underestimated.[11] The most important explanation for why inflation has risen and has been close to target since 2017 is that the factors contributing to low inflation in previous years have subsided. One of these factors is price mark-ups, as mentioned above.

Another shock that, according to the model, contributed to the low inflation in the years before 2017 is monetary policy (light red bars). In the model, monetary policy is illustrated by a simple policy rule, by which the central bank allows the repo rate to respond to movements in inflation and resource utilisation around the repo rate's trend level, which in turn is determined by the real interest rate's trend level and the inflation target. How much monetary policy reacts to changes in these variables reflects how the Riksbank has actually reacted historically. Changes in the repo rate that deviate from the policy rule are perceived as monetary policy shocks and it is the effect of these that is illustrated in Figure 4. According to the model, the repo rate was higher than implied by the policy rule between 2010 and 2014, which had a dampening effect on inflation for a long time. It should be noted that the model does not consider monetary policy measures over and above repo rate adjustments, as the interest rate is the only monetary policy instrument in the model. The effect of other monetary policy measures, for example the Riksbank's purchases of government bonds, is therefore interpreted as other shocks in the model.

[11] For a discussion on this, see, for instance, Justiniano and Preston (2010).

The factor making the main contribution to holding back inflation in 2018 is lower price mark-ups and margins, both on domestic and on imported products (light blue bars in Figure 4). This was a factor that also held back inflation more clearly in 2014 and 2015. This explanation also emerged from the business surveys conducted by the Riksbank in those two years. In these surveys, companies replied that their margins were lower than normal. This in turn was thought to be due to weak demand and uncertainty about the future.

3. Forecast evaluation

At the beginning of this section, the Riksbank's forecasts are compared with assessments performed by other forecasters for the period 2007–2008. The results are less sensitive to random differences between different analysts when a slightly longer period is analysed. The period includes the financial crisis of 2008–2009, which affected the results for all analysts. 2018 is dealt with separately later in this section.[12]

The data compiled refers to forecasts of developments up to two years ahead. The accuracy for the whole of 2018 therefore refers to forecasts published in both 2017 and 2018.

Measures of forecasting performance

One of the most common evaluation measures when studying forecasts is average forecast error, or mean error. It describes how much forecasts on average have deviated from outcomes. It also shows that there is some systematic over- or underestimation of forecasts. A positive mean error indicates that outcomes have been higher than the forecasts, while a negative value points to outcomes being on average lower than the forecasts. Even if the mean error is close to zero, it does not mean to say that the forecasts have been accurate. Large positive and negative forecast errors can cancel one another out and give a mean error that is close to zero. It gives the impression of good accuracy despite this not having been the case. We therefore also report the mean absolute error, i.e. the average of the absolute value of the forecast errors.[13]

As forecasts are made at different frequencies and on different occasions, forecasters do not have access to the same information. This makes it difficult to compare their accuracy. A forecaster who bases their analysis on more information should have better accuracy. It is therefore important to consider these differences when comparing accuracy. This is why an adjusted absolute average error is reported that takes this into account.[14]

An evaluation of the Riksbank's forecasts for 2007–2018

Figure 5-9 show average forecast error (mean error) and adjusted mean absolute error for GDP growth, unemployment, CPI/CPIF inflation and the repo rate. The forecasts have been performed by Swedish forecasters for the period 2007–2018.[15] In the figures, forecasters have been sorted according to the size of the adjusted mean absolute error (blue bars), which is equal to zero on average. The red bars show systematic error or mean error, where forecast error has been consistently calculated in terms of: outcome minus forecast. It is clear from Figure 5-9 that the systematic errors are virtually all negative. In other words, the outcomes have been lower than expected compared with most forecasters' fore-

[12] It is difficult to evaluate the Riksbank's forecasts for the period before 2007.

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

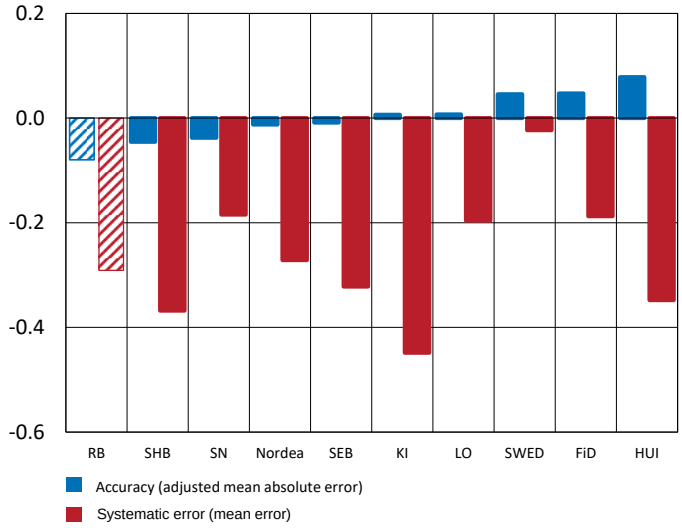
[14] The method has been developed at the Riksbank, see Andersson and Aranki (2009) and Andersson, Aranki and Reslow (2016). A brief description of the method is given in the Appendix.

[15] For GDP growth, unemployment and CPIF inflation, the evaluation is based on forecasts from 10 forecasters: the Riksbank (RB), the Ministry of Finance (FID), HUI Research AB, the National Institute of Economic Research (NIER), the Swedish Trade Union Confederation (LO), Nordea, Skandinaviska Enskilda Banken (SEB), Svenska Handelsbanken (SHB), the Confederation of Swedish Enterprise (HUI) and Swedbank (SWED). For CPIF inflation, there are no forecasts from the Retail and Wholesale Research Institute, and only five forecasters are included for the repo rate forecasts. The repo-rate forecasts also include forecasts based on market expectations (Market), according to market pricing of forward rates, calculated from derivative contracts (RIBA and FRA).

casts for all variables. For GDP, this means that economic growth has on average been lower than expected. The negative bars in Figure 6 also show that unemployment has on average been lower than expected. Similar to other forecasters, the Riksbank has also overestimated inflation and the level of the repo rate during this period.

Figure 5. GDP growth, accuracy and systematic error in forecasts from various analysts, 2007–2018

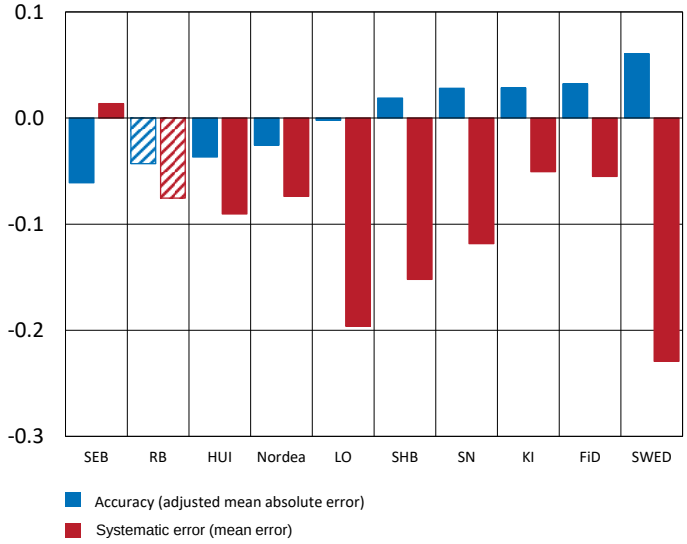
Percentage points



Sources: Respective analysts and the Riksbank

Figure 6. Unemployment, accuracy and systematic error in forecasts from various analysts, 2007–2018

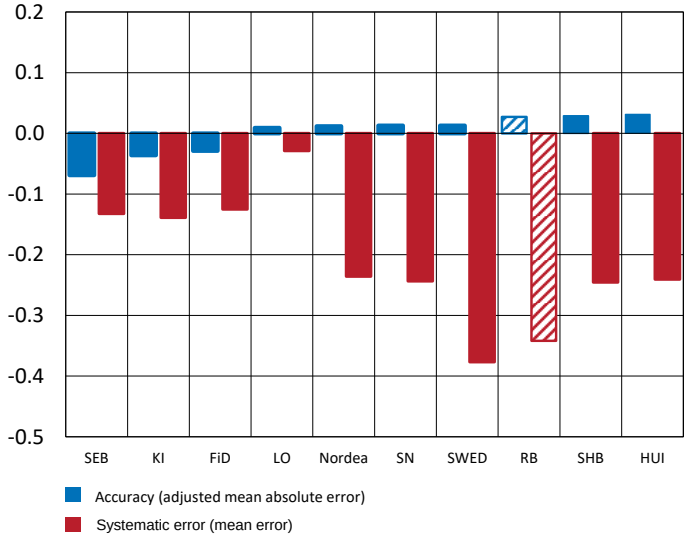
Percentage points



Sources: Respective analysts and the Riksbank

Figure 7. CPI inflation, accuracy and systematic error in forecasts from various analysts, 2007–2018

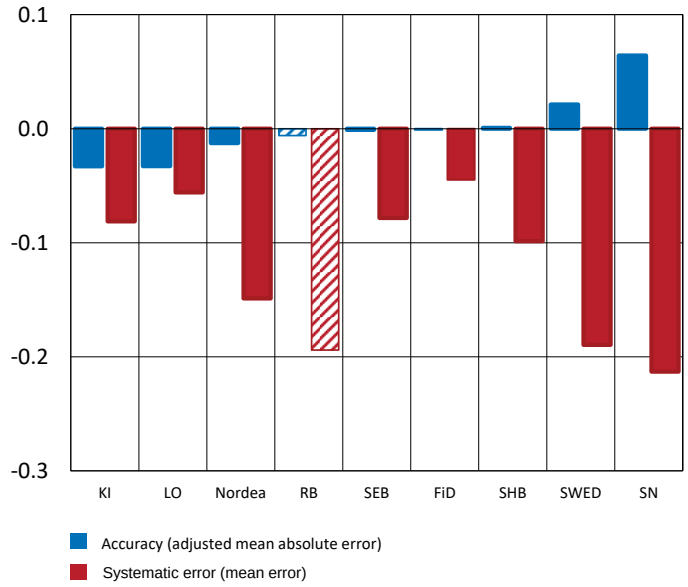
Percentage points



Sources: Respective analysts and the Riksbank

Figure 8. CPIF inflation, accuracy and systematic error in forecasts from various analysts, 2007-2018

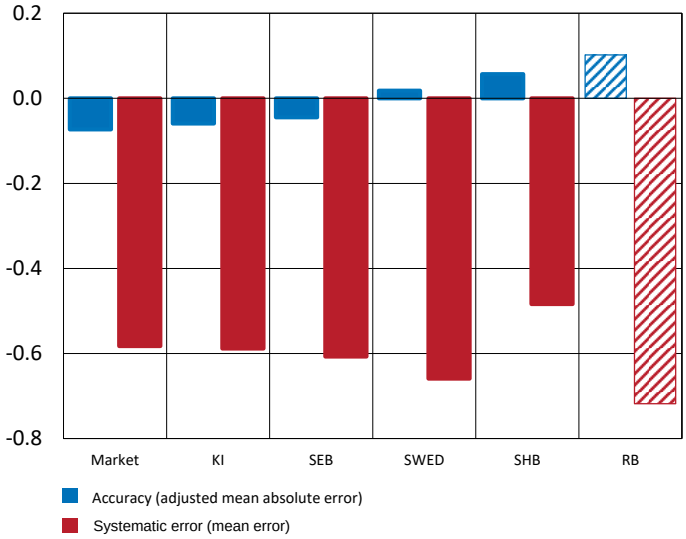
Percentage points



Sources: Respective analysts and the Riksbank

Figure 9. Repo rate, accuracy and systematic error in forecasts from various analysts, 2007–2018

Percentage points



Sources: Respective analysts and the Riksbank

The blue bars in Figure 5-9 above show the adjusted mean absolute error. The measure is reported as a deviation from the mean value for all forecasters. A negative value can hence be interpreted as the accuracy of a certain forecaster being better than average. A positive value indicates the opposite. In the figures, forecasters are sorted according to the adjusted mean absolute error with the best accuracy furthest to the left. There are some differences in accuracy among the various participants, but they are small. The difference between the best and worst forecaster, for example for CPI and CPIF inflation, is only 0.1 percentage points (see Figure 7 and 8).

During the period, the Riksbank has been the most accurate for GDP growth and has also been significantly better than average for unemployment. The Riksbank is also somewhat better than average as regards forecasts for CPIF inflation but has been the least accurate for the repo rate.[16]

The ranking in the analysis above is based on forecasts for all years from 2007 to 2018. In a comparison of forecasting performance for individual years, however, the ranking varies quite considerably. Table 3 shows the Riksbank's ranking year by year. In certain years (2010, 2011, 2017 and 2018), for example, the Riksbank has made comparatively good forecasts for CPIF inflation. Other years (2007, 2015, 2016), it has been less successful.

[16] The repo rate plays a crucial role for the difference between CPI and CPIF inflation. Poorer forecasts for the repo rate tend to directly affect the forecasts for CPI inflation. This is because the repo rate forecast steers the forecasts for mortgage rates. The CPI is directly affected when mortgage rates change while these are held constant when calculating the CPIF.

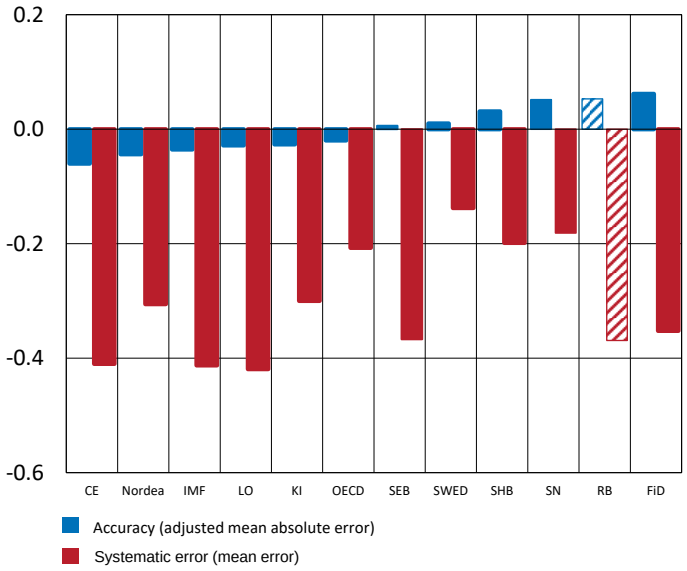
Table 3. Annual ranking of the Riksbank's forecasts for the Swedish economy, 2007-2018

	GDP	Unemploy-	CPI	CPIF	Repo rate
2007	1	5	4	9	4
2008	5	2	3	4	4
2009	5	7	10	7	6
2010	2	6	3	1	3
2011	3	3	4	2	4
2012	2	8	8	4	5
2013	5	2	8	6	5
2014	8	1	7	7	4
2015	3	2	7	8	5
2016	4	2	9	9	4
2017	6	1	2	2	4
2018	6	8	1	2	3
2007–2018	**1**	**2**	**8**	**4**	**6**
Of no. institutions:	10	10	10	9	6

Note. The figures in the table give the Riksbank's ranking, based on estimated accuracy according to the adjusted mean absolute error. The highest ranking is 1. The assessment of the repo-rate forecasts includes market expectations according to market pricing of forward rates. Forward rates are calculated from derivative contracts (RIBA and FRA).
Sources: Respective forecasters, Statistics Sweden and the Riksbank

Figure 10–13 show the corresponding result for GDP growth and inflation in the US and the euro area. On average, the forecasts for GDP growth in both the US and the euro area have been too high during the period 2007–2018 (see the red bars). The same is true of inflation in the euro area (see Figure 13). As regards inflation in the US, there are no clear systematics (see Figure 12). The blue bars in Figure 10 and 11 show that the Riksbank's accuracy for GDP growth in the US and in the euro area has been worse than average. The Riksbank has also had slightly worse accuracy than average for inflation in the US and in the euro area. However, in all cases, the differences between the forecasters are very small.

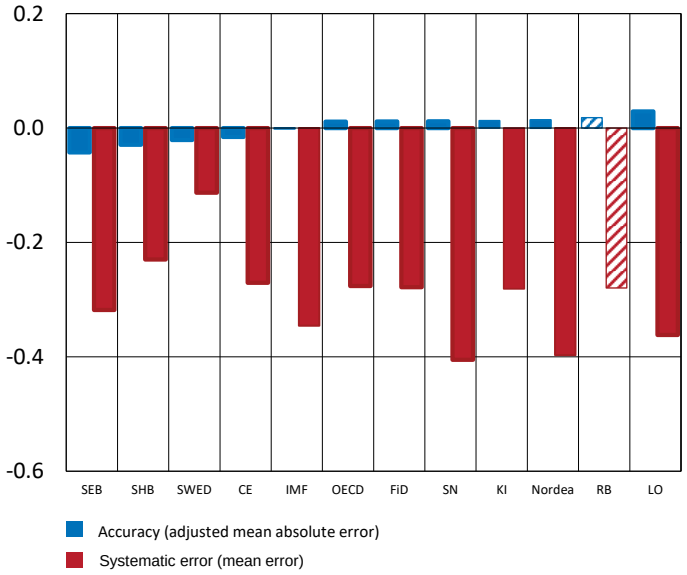
Figure 10. GDP growth in the United States, accuracy and systematic error in forecasts from various analysts, 2007–2018[17]
Percentage points



Sources: Respective analysts and the Riksbank

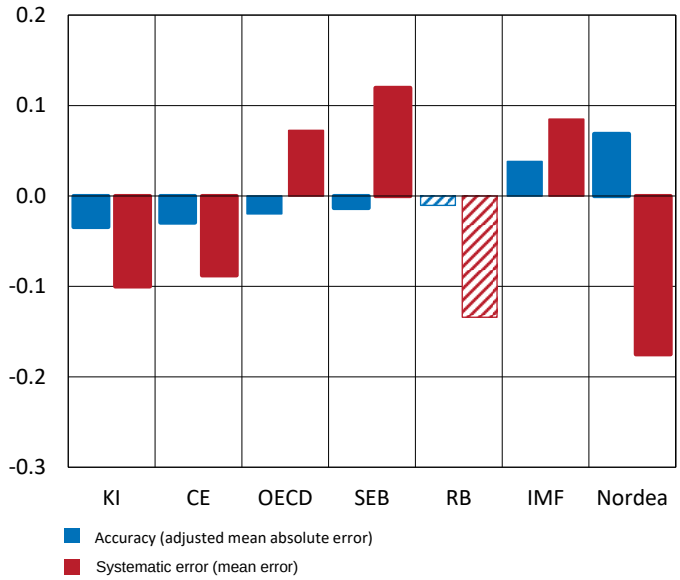
[17] CE refers to the forecasts reported by Consensus Economics monthly.

Figure 11. GDP growth in the euro area, accuracy and systematic errors in forecasts from various analysts, 2007-2018
Percentage points



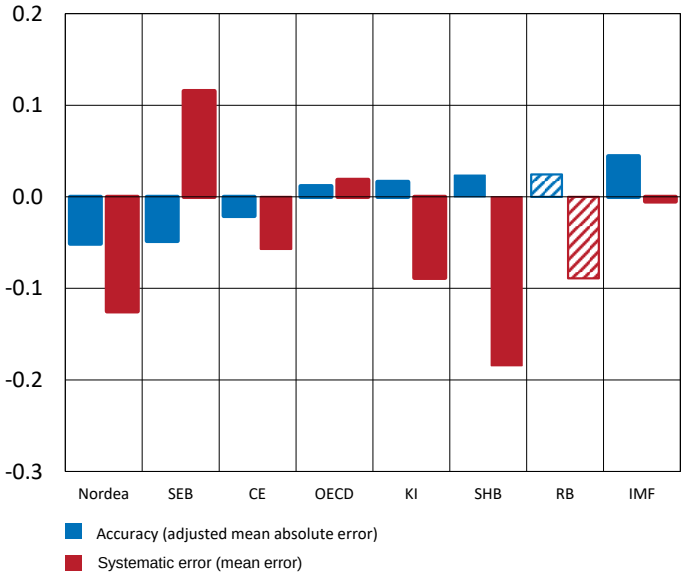
Sources: Respective analysts and the Riksbank

Figure 12. CPI inflation in the US, accuracy and systematic errors in forecasts from various analysts, 2007–2018
Percentage points



Sources: Respective analysts and the Riksbank

Figure 13. HICP inflation in the euro area, accuracy and systematic errors in forecasts from various analysts, 2007–2018
Percentage points

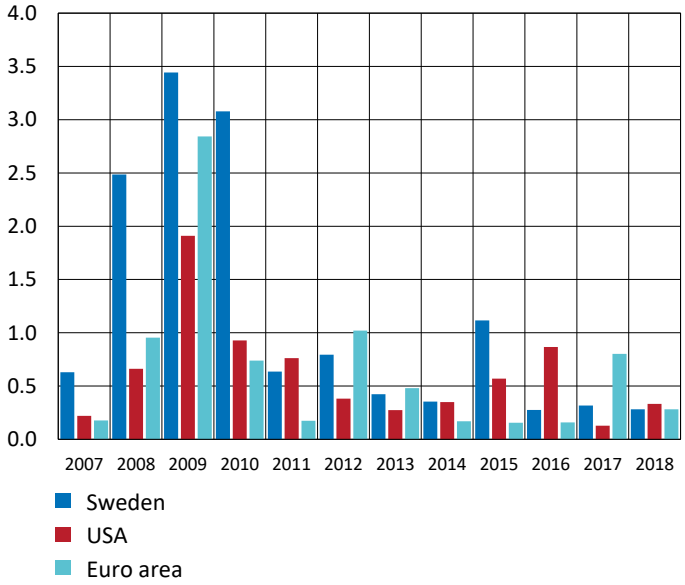


Sources: Respective analysts and the Riksbank

An evaluation of the Riksbank's forecasts for 2018

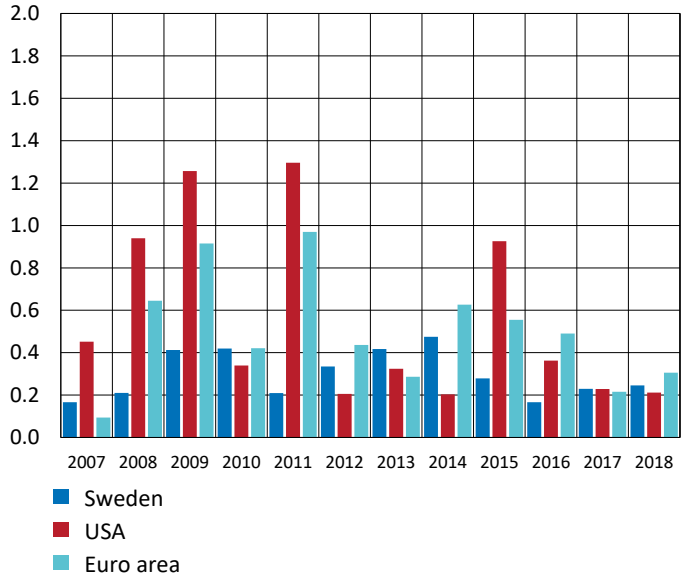
To gain a measure of how difficult it has been for forecasters to predict various variables over time, we calculate here an average of the different forecasters' mean absolute error year by year. Such average mean absolute errors are shown for GDP growth and inflation in Sweden, the US and the euro area in Figure 14 and 15 below. It is quite clear that it was difficult to make accurate forecasts during the financial crisis. The forecast errors for GDP growth in Sweden were highest in 2008–2010. In 2018, the average mean absolute error for GDP growth was relatively small in all regions. Figure 15 plots corresponding figures for inflation. The average mean absolute errors are low in 2018 even in this case, which suggests that it was relatively easy to make forecasts for this particular year.

Figure 14. Average mean absolute errors for GDP growth 2007–2017



Sources: Respective analysts and the Riksbank

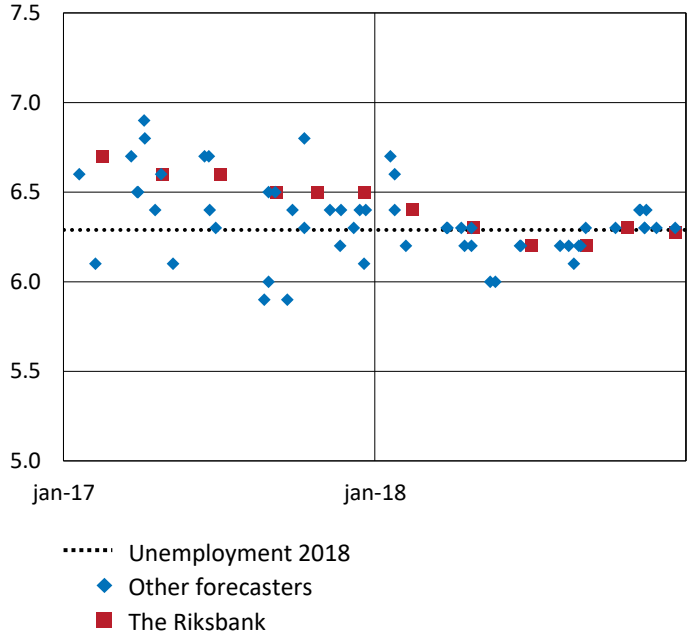
Figure 15. Average mean absolute errors for inflation 2007–2017



Sources: Respective analysts and the Riksbank

Figure 16 below shows the forecasts of the Riksbank and other analysts over time for unemployment in 2018. The figure illustrates how the forecasts changed between the various forecasting points, from the beginning of 2017 up until the end of 2018. The outcome is represented by a broken line in the figures. There was some uncertainty about labour market prospects, at least at the beginning. This is reflected in the dispersion of the forecasts. Many expected unemployment would remain at approximately the same level as in 2017, or even increase slightly. Others were more optimistic and predicted even lower unemployment in 2018 than turned out to be the case.

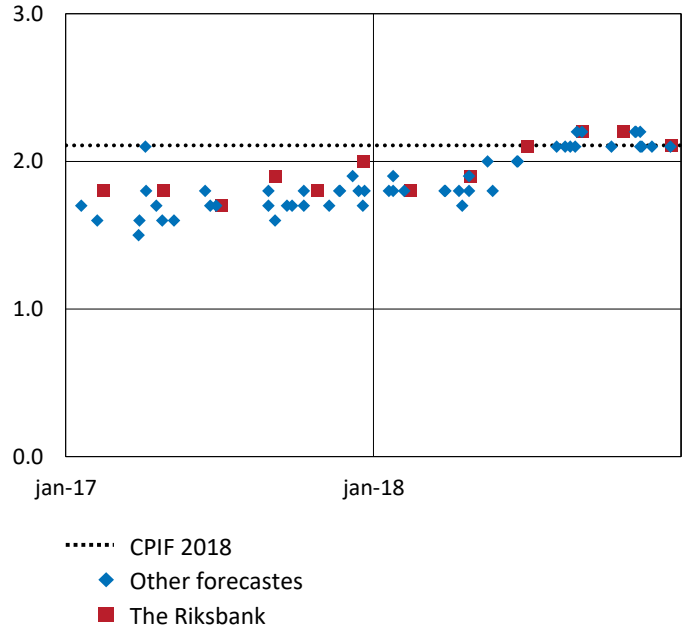
Figure 16. Forecasts 2017 and 2018 for unemployment in 2018
Per cent of labour force, annual average



Note. Other analysts refers to the Swedish Ministry of Finance, HUI Research AB, the National Institute of Economic Research, LO (the Swedish Trade Union Confederation), Nordea, SEB, Svenska Handelsbanken, the Confederation of Swedish Enterprise and Swedbank.
Sources: Respective forecasters, Statistics Sweden and the Riksbank

Figure 17 below shows forecasts over time for CPIF inflation in 2018. In 2017, basically all analysts predicted lower inflation in 2018 than turned out to be the case.

Figure 17. Forecasts 2017 and 2018 for CPI inflation in 2018
Annual percentage change, annual average



Note. Other analysts refers to the Swedish Ministry of Finance, HUI Research AB, the National Institute of Economic Research, LO (the Swedish Trade Union Confederation), Nordea, SEB, Svenska Handelsbanken, the Confederation of Swedish Enterprise and Swedbank.
Sources: Respective forecasters, Statistics Sweden and the Riksbank

We investigate the forecasts for 2018 in the same way as for the entire period.[18] The results are shown in Figure 20–28 in Appendix 1. All forecaster had expected higher GDP growth in Sweden than turned out to be the case. The Riksbank's forecasts are among the more accurate ones, but the differences between the analysts are small. All the analysts had also expected the repo rate to be higher than it actually was and CPIF inflation to be lower.

The difference in accuracy between forecasters is greatest for unemployment and GDP growth according to the blue bars in Figure 20–24. The difference between the best and worst forecaster for CPI and CPIF inflation is slightly smaller and amounts to just under 0.2 percentage points. In a comparison with others, the Riksbank's accuracy was best for CPI inflation and second best for CPIF inflation.

The red bars in Figure 25 show that GDP growth was unexpectedly high in the US. Inflation was also higher than the forecasts in the US and the euro area. The blue bars in Figure 25–28 show that the Riksbank's accuracy for international variables has been close to average or slightly better.

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

In this section, we study how accurate inflation forecasts have been in the short term, i.e. three months ahead. The analysis above showed that CPI and CPIF inflation were higher than what most forecasters had expected in 2018.[19] This pattern does not emerge when analysing the short-term forecasts made for January to December in 2018. Here, results are presented for a number of forecasters who normally report their monthly forecasts on a regular basis. These forecasts are compared with the Riksbank's published forecasts.[20]

As the Riksbank does not publish forecasts every month, two, or sometimes three, CPI outcomes may often be published before a new forecast from the Riksbank is available. The analysis below therefore includes forecasts one to three months ahead as far as the Riksbank is concerned. These mixed forecast horizons are compared with assessments from other forecasters, who often make forecasts more frequently. In this analysis, the other forecasters thus have as much, or more, information than the Riksbank has had access to.[21] The annual average of monthly forecast errors for CPIF inflation has been compiled in Figure 18. The results indicate that the Riksbank overestimated short-term inflation during the period 2013–2016 and last year. In 2017, on the other hand, the short-term development of inflation was underestimated. The red line, labelled "Mean value forecast", shows average forecast errors (outcome – forecast) when a mean value of other analysts' forecasts has been calculated as a first step. Such a mean value forecast is normally the most reliable seen over longer periods.[22] The mean value forecast shows the same pattern as the Riksbank's forecasts, but with fewer forecast errors.

[18] The forecasts for 2018 were made over the period 2017 to 2018.

[19] It was also higher than expected in 2017.

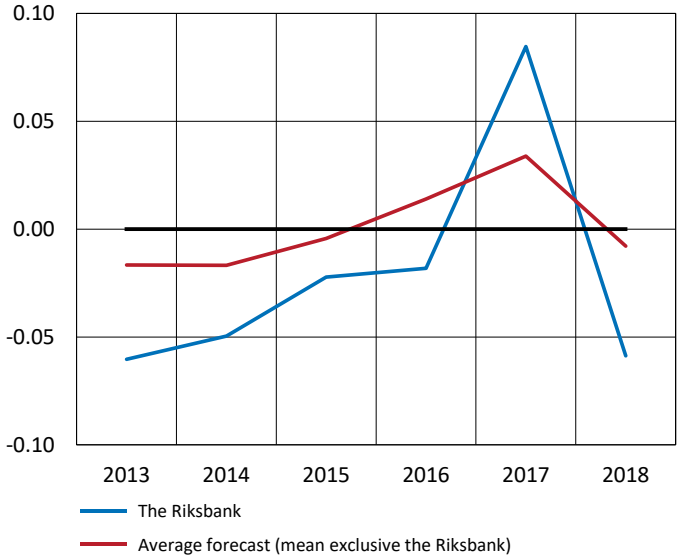
[20] Bloomberg publishes one-step forecasts (forecasts one month ahead) every month from a number of forecasters. The number of forecasters, excluding the Riksbank, is eighteen during the studied period 2013–2017. They include the major Swedish banks and other private financial agents.

[21] Forecasts from other forecasters are mostly one-step forecasts and should therefore, in most cases, be more accurate than the Riksbank's most recently published forecast. Even in cases in which the Riksbank's forecast refers to inflation one month ahead, other forecasters have a certain advantage, as their forecasts are often made only a couple of days ahead of the CPI outcome. The amount of information available on the development of factors such as fuel prices, electricity prices and exchange rates in recent days is often important.

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

Figure 18. Annual average of monthly forecast errors for CPIF inflation, 2013–2018

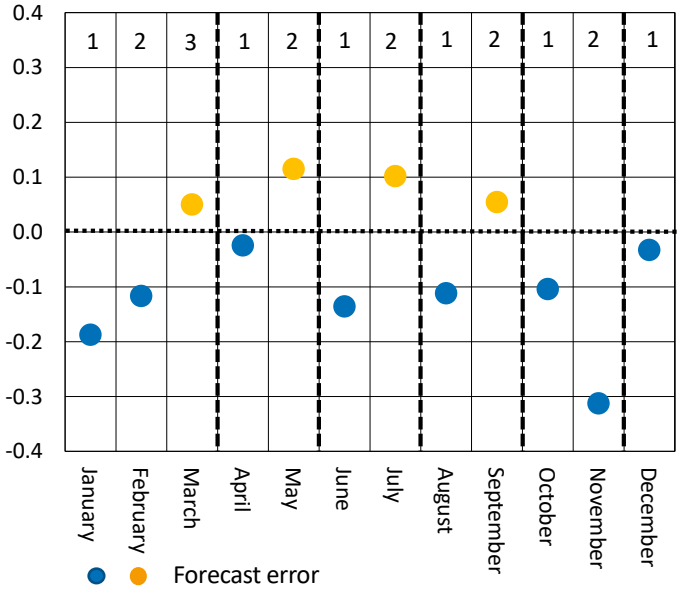
Percentage points



Sources: Bloomberg and the Riksbank

Figure 19 shows forecast errors for CPIF inflation for January to December 2018. The figures at the top of the figure show the information that was available to the Riksbank. A one (1) indicates a one-step forecast. When the outcome for April was published, it was compared with a forecast published in the Monetary Policy Report in April. When the forecast was made, the outcome for March was available (a 'one-step' forecast). When the outcome for May was published, no new forecast had been made so the estimated forecast error was again based in the forecast published in April (a 'two-step' forecast). The inflation outcome was lower than expected eight out of twelve months (see the blue dots below the zero mark). The forecast errors were relatively small in most months but somewhat larger in January and November. Inflation was overestimated for these months.

Figure 19. The Riksbank's forecast errors for CPIF inflation in 2017
Percentage points



Source: The Riksbank

In January, the forecast error amounted to almost –0.2 percentage points. In the forecast, which was published in the Monetary Policy Report on 15 February, the Riksbank had access to CPIF information for December 2017, which means that it was a one-step forecast. The lower outcome was primarily explained by unexpectedly low growth in service prices. As well as being affected by actual changes, the change in the CPIF in January was affected by Statistics Sweden's annual update of weights (the so-called 'basket effect'). Normally the CPI is drawn down by the basket effect as households normally buy relatively more goods and services that have become relatively cheaper, which are given a greater weight. The total basket effect was –0.16 percentage points in the monthly change in January 2018, which is slightly more than in recent years. The forecast error was partly offset by energy prices increasing slightly more rapidly than expected.

In November, inflation was also overestimated by a relatively substantial margin. The forecast error could not be explained by any specific component in the CPIF. The forecast errors for the various components were relatively small, but by and large negative. The largest negative contribution to the forecast error was from the volatile fruit and vegetable group, and from other services. Clothes and shoe prices and other goods also came in slightly lower than expected.

The accuracy of different forecaster in the short term is compared in Table 4. Here, both average forecast error (mean error) and mean absolute error (MAE) are presented for the period January 2013–December 2018. If forecasts had been made for all months, there would be 72 of them. Eleven forecasters including the Riksbank are also analysed here. The row marked "Mean value forecast" shows the result when an average of all forecasts (excluding the Riksbank) has been calculated as a first step. In this analysis, the mean value forecast takes third place in the ranking. The row marked "Average MAE" shows an average of the various analysts' mean absolute error. Over this period, the most accurate analyst has a mean absolute error of 0.15. The Riksbank comes in ninth place with a mean absolute error of 0.18. Six individual forecasters have thus on average made more accurate forecasts than the Riksbank during this period, but the differences are small.[23] It can also be noted that the Riksbank, on average, has forecast a slightly too high level of inflation in the short term.

[23] The mean value forecast and Average MAE are not individual forecasters.

Table 4. Evaluation of short-term forecasts for CPIF inflation on a 1–3 month horizon, 2013–2018

Ranking	Forecaster	Average error	MAE	# Forecasts
1	Forecaster with lowest MAE	–0.02	0.15	69
3	Mean value forecast	0.00	0.15	72
4	Average MAE	0.00	0.18	**72**
9	**The Riksbank**	**–0.02**	**0.18**	**72**
13	Forecaster with highest MAE	0.01	0.21	58

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

In Table 5, the Riksbank's two- and three-step forecasts have been omitted, as have the corresponding monthly forecasts from the other analysts. Comparability among forecasters is now greater, but there are now fewer forecasts and the results are more uncertain. The Mean value forecast is not the most accurate forecast and the best forecaster comes in third place. The Riksbank comes in seventh with a mean absolute error of 0.16. Four individual forecasters have made more accurate forecasts on average. It is even clearer here that the Riksbank, on average, has forecast slightly too high inflation.

Overall, this analysis shows that the Riksbank's accuracy in the very short term is close to the average for other forecasters.

Table 5. Evaluation of short-term forecasts for CPIF inflation on a 1-month horizon, 2013–2018

Ranking	Forecaster	Average error	MAE	# Forecasts
3	Forecaster with lowest MAE	–0.03	0.16	35
1	Mean value forecast	–0.02	0.15	36
2	Average MAE	–0.02	0.18	36
7	**The Riksbank**	**–0.05**	**0.16**	**36**
13	Forecaster with highest MAE	–0.01	0.22	30

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

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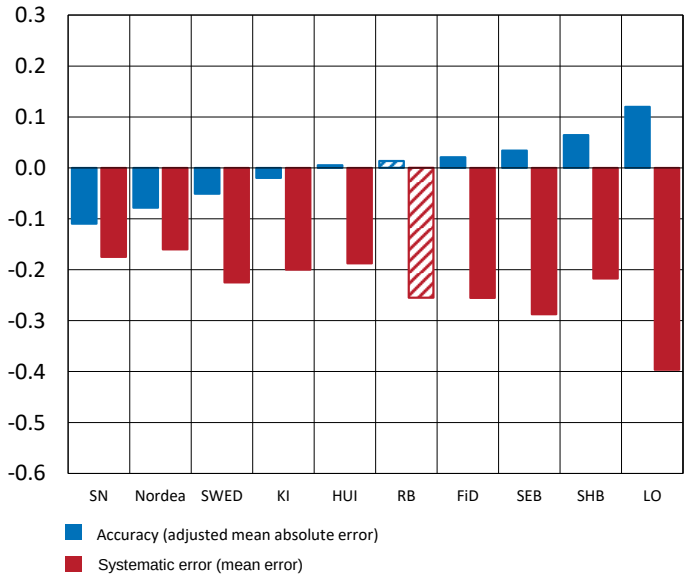
Appendix 1: Forecasts for 2018

Figure 20. GDP growth, accuracy and systematic errors in forecasts for 2018 from various analysts, 2017–2018

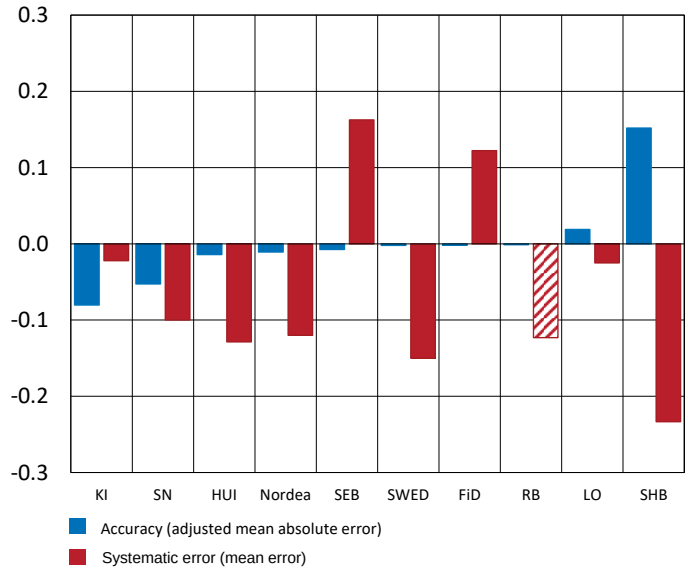
Percentage points



Sources: Respective analysts and the Riksbank

Figure 21. Unemployment, accuracy and systematic errors in forecasts for 2018 from various analysts, 2017–2018

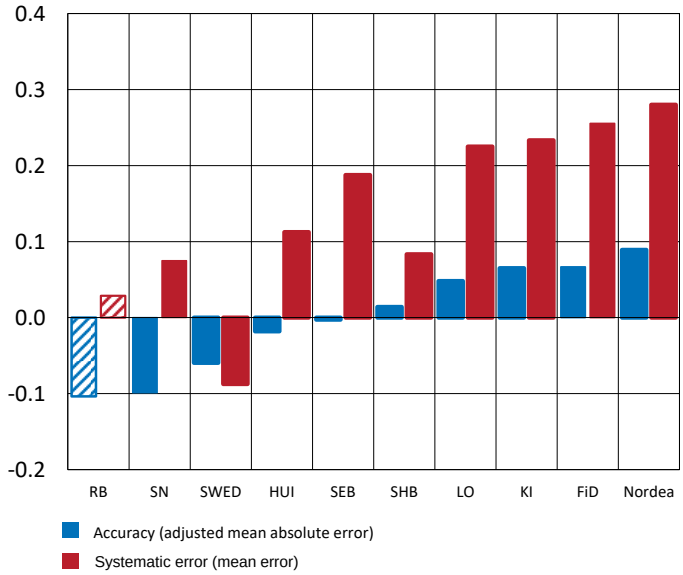
Percentage points



Sources: Respective analysts and the Riksbank

Figure 22. CPI inflation, accuracy and systematic errors in forecasts for 2018 from various analysts, 2017–2018

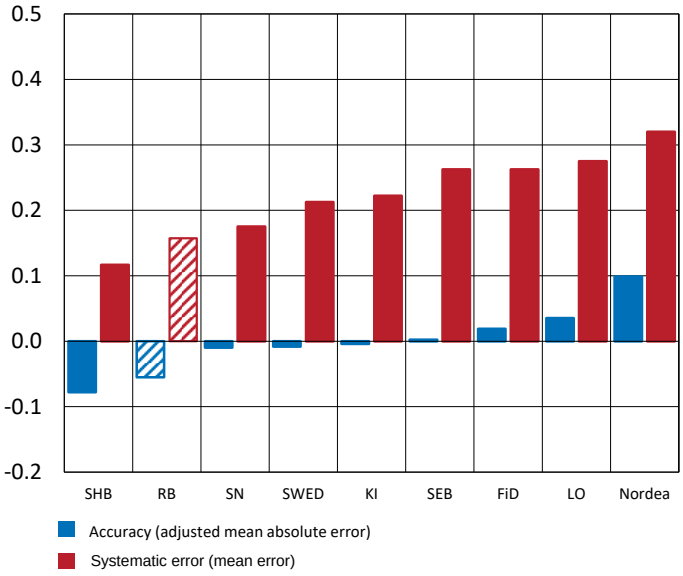
Percentage points



Sources: Respective analysts and the Riksbank

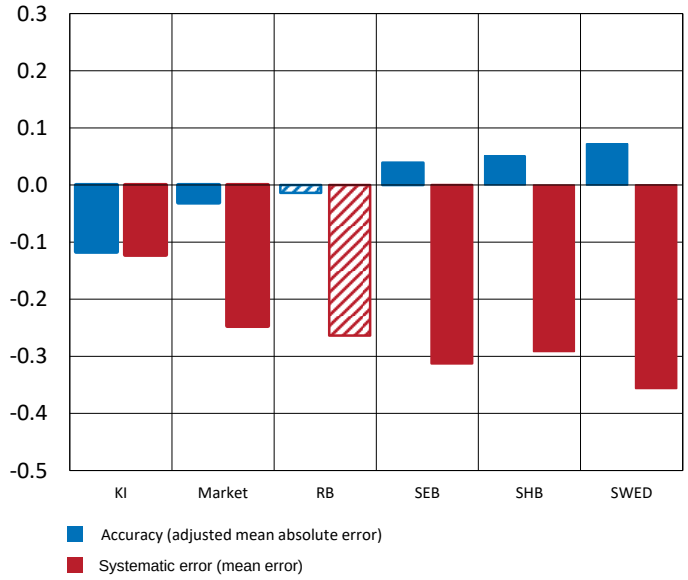
Figure 23. CPIF inflation, accuracy and systematic errors in forecasts for 2018 from various analysts, 2017–2018

Percentage points



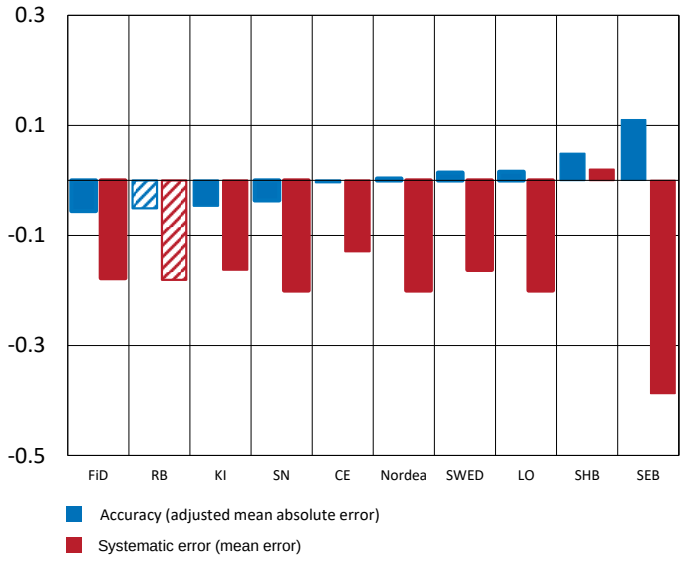
Sources: Respective analysts and the Riksbank

Figure 24. Repo rate, accuracy and systematic errors in forecasts for 2018 from various analysts, 2017–2018
Percentage points



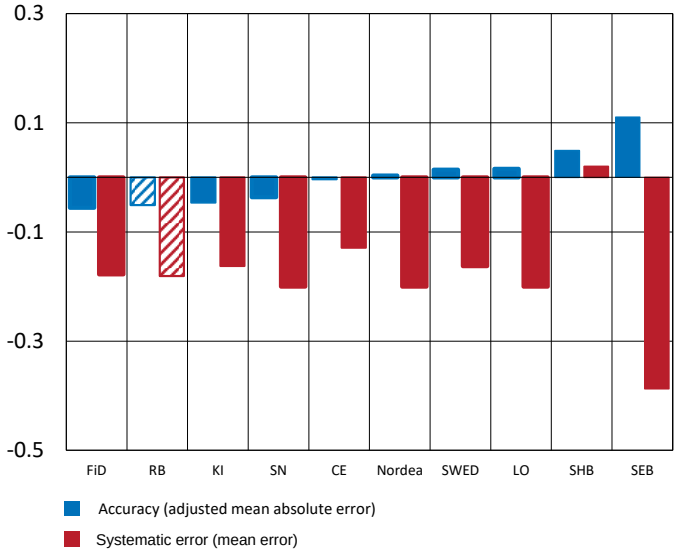
Sources: Respective analysts and the Riksbank

Figure 25. GDP growth in the United States, accuracy and systematic errors in forecasts for 2018 from various analysts, 2017–2018
Percentage points



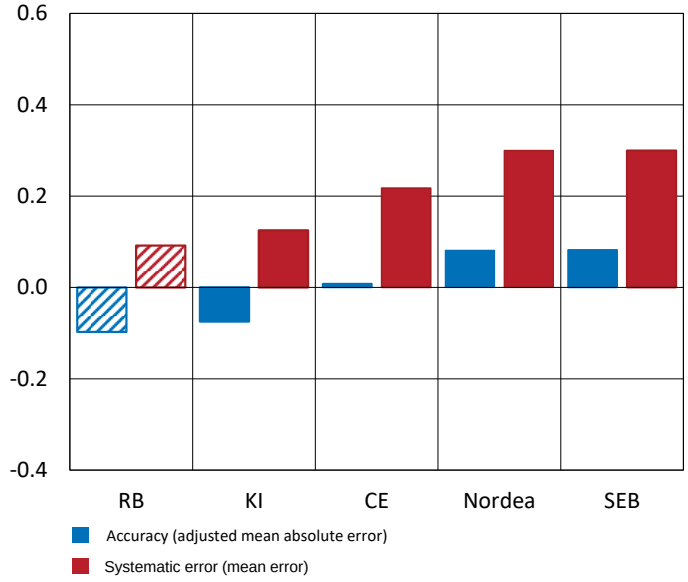
Sources: Respective analysts and the Riksbank

Figure 26. GDP growth in the euro area, accuracy and systematic errors in forecasts for 2018 from various analysts, 2017–2018
Percentage points



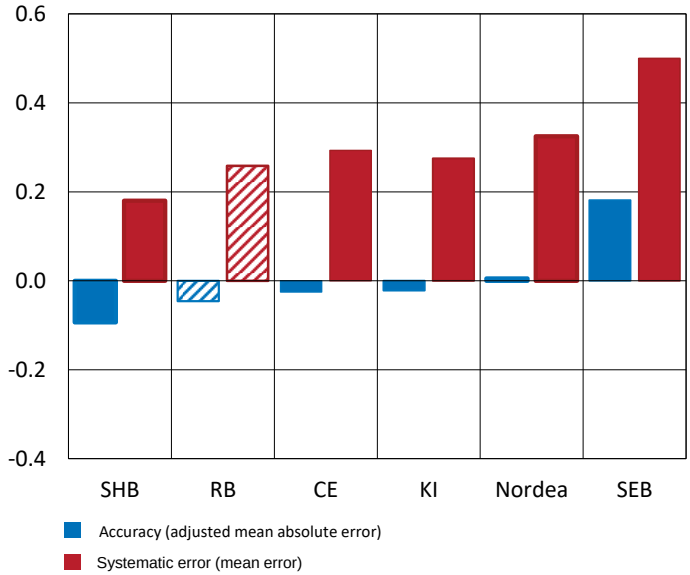
Sources: Respective analysts and the Riksbank

Figure 27. CPI inflation in the United States, accuracy and systematic errors in forecasts for 2018 from various analysts, 2017-2018
Percentage points



Sources: Respective analysts and the Riksbank

Figure 28. HICP inflation in the euro area, accuracy and systematic errors in forecasts for 2018 from various analysts, 2017-2018
Percentage points



Sources: Respective analysts and the Riksbank

Appendix 2: Measuring accuracy

Let x_t be an outcome for economic variable x,, for instance the rate of inflation or GDP growth For a certain period, t. Assume also that $x_{it,h}$ is a forecast for x_t,, made by forecaster *i* a certain number of months h before the outcome is published. The absolute forecast 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, e.g. GDP growth in 2008, and the forecasts that Are evaluated refer to the current or next year. This means therefore $h \leq 24$ months. In order to summarise the accuracy of forecaster *i*, its mean absolute error (MAE) can be calculated as

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

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

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

In order to correct the measure of accuracy because forecasters have access to different amounts of information when they make their forecasts, Andersson et al. (2016) propose dividing the absolute forecast error into different components. The results from this decomposition are then used to calculate accuracy or forecasting performance 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 performance. The average accuracy of forecaster *i* is described by μ_i whereas the term $\mu_{i,t=c}$ captures the forecasting performance when individual years,*c*, are evaluated. 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 forecast error that the equation is not able to capture. It is assumed to be randomly allocated, with the mean value of zero and constant variance.

The annual growth rate for a specific year, *T*, is a function of all quarterly or monthly growth rates during years *T–1* and *T*. Andersson et al. (2016) show that the growth rates at the higher frequencies also have different weights in terms of annual growth.[24] This weighting scheme is used to construct $M_{it,h}$ in equation (3). The volume of information possessed by forecaster *i* in the publication month is here approximated by the accumulated weight up to a certain month, $W_{it,h}$. The weight increases, the closer one is in time to the definitive outcome. The time effect in equation (3) is defined as

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

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

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

Equation (3) 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.

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