An evaluation of the Riksbank's forecasting performance

Michael K Andersson, Gustav Karlsson and Josef Svensson
The authors work at the Riksbank's forecast division

This article analyses the Riksbank's forecasts for central variables during the period 2000-2006. The Riksbank's forecast precision is compared with several alternative forecasts, partly from other forecasters and partly from simple time series models. One of the results is that the Riksbank's forecasts are just as good as, and often better, than the competing forecasts. However, differences in forecasting performance are not statistically significant. Another result is that the Riksbank's inflation forecasts, in particular for UND1X, have shown appropriate qualities, such as relatively high precision and long predictability memory. The Riksbank's real economy forecasts are less exact than the inflation forecasts, but fully on a par with those of other forecasters.

1. Introduction

The Riksbank's views on economic developments are currently presented three times a year in the Monetary Policy Report.[1] The Report also includes forecasts for the relevant variables for monetary policy up to three years ahead. Previously the Riksbank has presented and evaluated the models used in the forecasting work. Andersson and Löf (2007) describe the Riksbank's indicator models and show the forecasting performance they possess. Similarly, the forecast precision of the Riksbank's general equilibrium model and the Bayesian VAR model are presented by Adolfson et al. (2007). In the context of the evaluation work, this article presents an analysis of the forecasts the Riksbank has published in the Inflation Reports during the period 2000-2006.

Extensive studies of forecasting performance are quite rare. An evaluation of the Riksbank's recent monetary policy, including a relatively brief comparison of forecasts, is presented annually in the year's first Monetary Policy Report. Evaluations of various forecasters' assessments of the Swedish economy have been presented earlier by, among others, Blix et al. (2001 & 2002) and Bergvall (2005).

[1] Prior to 2007, the report was called the Inflation Report and in that guise was published four times a year prior to 2006.

Naturally, it is important to evaluate the Riksbank's forecasts not just for external purposes, but also for the Bank's internal development work. E.g., by evaluating forecasts, one can detect where there is room for improvement, gain a better understanding as to which variables are difficult to predict, and obtain information about which variables the Riksbank is good at forecasting.

The purpose of this article is to report the precision in the forecasts the Riksbank has presented in its reports and thus based its monetary policy on. The Riksbank's forecasting performance will be related to alternative forecasts from time series models and other analysts of the Swedish economy. Moreover, the forecasts are evaluated with regard to several statistical tests.[2]

The study shows that the precision of the Riksbank's forecasts is good in comparison to that of other forecasters. Another result is that the Riksbank's inflation forecasts have appropriate properties while the real economy forecasts appear somewhat less precise. The results also show that the forecast memory generally extends one year ahead in the case of the variables studied here.

The article unfolds as follows; the data and methods that are used for analysis are described in section 2. An evaluation of the Riksbank's forecasts is presented in section 3 and these are compared with those of other forecasters in general and the Swedish National Institute of Economic Research in particular. The article is summarised in section 4.

2. Data and methods of analysis

2.1 DATA

The data used in the study is taken from assessments on quarterly observations by the Riksbank and the Swedish National Institute of Economic Research (henceforth Konjunkturinstitutet or NIER), and from the Consensus Forecasts' compilation of annual forecasts from other forecasters.

The variables studied quarterly are GDP, UND1X[3], CPI and employment, which are central factors of monetary policy analysis. Moreover, the GDP to employment ratio[4] is analysed, as well as the hypothesis that inaccurate assessments of productivity have had a bearing on the forecast errors for the above variables. Another interesting aspect that has been discussed, with regard to inflation forecast errors, is the unexpectedly low import prices. This issue is investigated by Assarsson (2007) and is, therefore, beyond the scope of this article.

---

[2] A more in-depth analysis of the Riksbank's forecasts is provided by Andersson et al. (2007).

[3] UND1X is a measure of core inflation.

[4] GDP/employment is used as a proxy for productivity since the most common measure of productivity, GDP/hours worked, has only been forecast quarterly for a limited part of the study period.

GDP, UND1X and CPI are investigated for the period 2000-2006 while the other variables are studied from 2002 and onwards. The period is determined, inter alia, by the sample of published (or documented) quarterly forecasts. E.g., annual forecast may be analysed for some variables over a longer period, while quarterly forecast have been produced for a more limited time span. Also see Andersson et al. (2007) for a more detailed description and a discussion on the data and the evaluation period.

The study includes a comparison of quarterly forecasts by the Riksbank and NIER. Quarterly forecasts have been provided by NIER for GDP, UND1X, CPI and employment, which has enabled a detailed analysis to be made for these variables.[5] The data includes NIER's forecasts for GDP from 2003 and onwards, while forecasts for the other variables begin in 2001.

In the case of GDP and CPI, a comparison is made of the performance of the Riksbank's forecasts for the year as a whole with several other forecasters, more precisely those who are in Consensus Forecasts' panel. This is done on the basis of the forecasts from October 2000 through October 2006, thus much the same period as for the analysis of quarterly forecasts. The intention is to compare various agents' forecasting accuracies at times when they all have access to the same amount of information. Achieving this in practice is, however, difficult on account of the considerable differences in the timing and regularity of the forecasts. In the present analysis we have striven to minimise this problem[6].

Chart 1 shows the forecasts published by the Riksbank for UND1X, GDP and employment in the whole economy. The forecasts are expressed as annual percentage change in order to be clear to study. The chart shows that during certain episodes the forecasts (fine lines in the chart) have missed the outcome (lines with squares), but also that periodically the forecasts have met the outcome relatively well. For example, the sharp upswing in inflation in spring 2001 was not foreseen in the assessments from the previous year, while the decline in the inflation rate during 2003 was predicted to a greater extent. Another example is the recent underestimation of employment. It can be difficult to extract a complete picture of the Riksbank's forecast precision from the charts, therefore the forecasts are analysed using certain statistical methods. These methods of analysis are described in the next section.

---

[5] The authors are grateful to the Swedish National Institute of Economic Research for providing their forecasts.

[6] The comparison is always made with the survey from Consensus which were published closest to the Riksbank's cut-off date and in addition, a sensitivity analysis has been made for the subsequent Consensus survey. However, it can be a disadvantage to other forecasters that the forecast which has been reported to Consensus may be slightly out-of-date. See Andersson et al. (2007) for a more detailed discussion on this.

2.2 METHODS OF ANALYSIS

The Riksbank's published forecasts constitute a set of data for which the average accuracy can be estimated. This is done using the root mean square error (RMSE), which summarises how the dispersion of forecast error and bias.[7] The mean error (ME or bias) is used to study whether there are tendencies to a systematic over- or underestimation in the forecasts. The forecast errors are consistently related to the standard deviation for the respective series during the evaluation period to provide an idea of how far into the future the forecast information content extends.[8] Galbraith and Tkacz (2006) have studied the forecast memory of some Canadian and American macro variables and found that the memory for several time series models is generally limited to the first forecast year, that is, four quarters ahead.

The forecasts are generally evaluated in the form of quarterly growth rates,[9] the main reason being that such observations do not overlap. Annual growth rates are made up of changes in the latest four quarters, which means that two consecutive quarterly-observed annual growth rates have three quarters (75 per cent) in common. This makes drawing statistical inferences much more complicated than in the case of quarterly growth rates. ME is analysed for both quarterly growth (for variables which are studied in differences) and for annual growth (which is a function of the four immediately preceding quarters), since bias in quarterly growth may be aggregated to a larger bias in annual growth.

The forecasts are evaluated against the first, preliminary outcomes for the variables which are revised, for instance, GDP. GDP figures are regularly revised and this is significant for the measured forecast errors.[10] A comparison with the first outcome is usually termed a real time evaluation.

In addition to NIER and Consensus Forecasts, the Riksbank's forecast errors are compared with those of a simple autoregressive time series model (henceforth autoregression or AR model) in order to give a furher perspective of the size of the forecast deviation.[11] Further details about the AR models are available in appendix A.1.

---

7 See description in Appendix A.1.

8 Here the forecasting memory is defined as the longest horizon where the forecast error variation (measured as the root mean square error) is lower than the series' variation (standard deviation). In the case of longer horizons, the conclusion is drawn that the (statistically) best forecast is the series' steady state (or average). Thus, a reasonable forecast for the longer horizons is to let the predicted variables move towards their respective averages in a coherent manner. Andersson och Löf (2007) describe forecast memory in more detail.

9 The evaluation is done for variables that are stationary (stable in mean and variation). Non-stationary variables are evaluated in growth rates.

10 By setting up the analysis with a focus on evaluation against the first outcomes, the effects of data revision can be distinguished. The data revisions properties from first to later outcomes may be studied separately as complement to this. See Andersson et al (2007) for further discussion on real time and final outcome evaluations and a description of revisions for GDP outcomes in the evaluation period.

11 An autoregression involves specifying a model so that a variable's value today is solely dependent on the variable's earlier outcomes. The autoregression is described in Andersson & Löf (2007).

Another question of interest is whether the forecast revisions made by the Riksbank over time have been reasonable. The Government (2002) and the Swedish National Audit Office (2006) suggest that an experiment with larger revisions than those that have actually been made for the Government's forecasts indicates that the forecast precision declines on average. This is, of course, a very complex issue. For example, revisions may have been warranted given the information available on the occasions the forecasts were made, while with hindsight it may look different. However, it may still be of interest to study afterwards how the revision pattern can be characterised. To make such a description of the revisions, correlations between observed forecast errors and forecast revisions are analysed here, (see Appendix A.2 for further information about this).

3. Forecasting performance

This section analyses the Riksbank's average forecasting performance in the period 2000 – 2006. The forecast performance is compared with NIER, Consensus Forecasts' panel and the autoregression.[12] Unlike the other forecasts, in the greater part of the evaluation period the Riksbank's predictions were based on the assumption of an unchanged policy rate in the forecast period. However, the assumption of a constant policy rate did produce relatively accurate policy rate forecasts in this period (although this was not the main purpose of the assumption). The accuracy of the policy rate forecasts is presented in Table 1, which shows that the constant-rate forecast was more accurate than the autoregressive for all horizons and that the predictability memory extends six quarter into the future.

3.1 INFLATION

Chart 2 shows that the Riksbank's forecasts for the average annual rate of increase in CPI in almost 75 per cent of the forecast occasions are more exact than half of the forecasters in the Consensus data.[13] A comparison of quarterly UND1X forecasts indicates that all in all the Riksbank has made slightly more accurate forecasts than NIER, see Table 1 which shows calculated RMSE. The differences vary somewhat for different forecast horizons (for example, the Riksbank's forecasts for annual growth in UND1X are nine per cent better than NIER's for the first forecast quarter, see figure 1.09 in Table 1) but on the whole they are small

[12] A more detailed analysis of the Riksbank's forecast accuracy is provided by Andersson et al. (2007).
[13] A more in-depth comparison between the Riksbank's, NIER's and Consensus's forecasts is given in Andersson et al. (2007).

and never statistically significant.[14] With regard to properties for quarterly forecasts, UND1X is mainly commented on here, but the tendencies for CPI are largely similar to those for UND1X (see Tables 1 and 2).

Compared with the AR model's forecasts, the Riksbank's RMSE forecasts for UND1X are consistently lower. For every horizon studied, the Riksbank's RMSE is smaller than the series' standard deviation for the evaluation period, which may possibly indicate a relatively strong forecasting capacity.[15] It is worth noting that the AR model is at something of a disadvantage in the comparison because it is ignorant of known monthly outcomes in the first quarter.[16]

Table 2 shows estimated mean error (ME or bias) for the Riksbank's forecasts. Bias in annual rate of increase for the horizons four and eight is also shown in Table 2. For every variable and forecast horizon, the hypothesis of no systematic forecast errors is tested, i.e., that the bias is zero.[17] For UND1X the estimates show a relatively small, and insignificant, bias for forecasts up to one year ahead. The bias is still insignificant in the case of longer forecasts, but the forecasts have, on average, been somewhat higher than the outcomes. Aggregated to annual percentage change, inflation has been overestimated by two tenths of a percentage point two years ahead. The bias for CPI two years ahead amounts to -0.6, the outcome has, on average, been lower than the forecasts, which is not negligible. However, these estimates for UND1X and CPI do not differ statistically from zero.

A review of the revisions made for UND1X show that forecast errors elicit distinct reactions; see Table 3 which shows the correlation between observed forecast errors and revisions. It is possible, however, that the Riksbank should have reacted less to the forecast error (for the four quarters ahead) and the revision actually made is correlated to 44 per cent with a hypothetical revision that would have eliminated forecast error. For the longer (eight quarter) horizon, the correlation between the Riksbank's revisions and the hypothetical revisions is just over 40 per cent. According to the correlations, it is possible that the Riksbank's revisions have, in general, been reasonable, given the limitations of the analysis (see section 2.2 above).

---

[14] RMSE measures the average forecast precision for survey period. In addition to RMSE, the variation in the square error can also be calculated. If the variation is large, this suggests that the estimation of RMSE is uncertain and that small deviations between the Riksbank's and NIER's forecast predictability, for example, are not statistically significant. This can be interpreted as the forecasters' precision is expected to be similar in a repeat study (for example in several years).

[15] However, the seasonal deterministic component in UND1X makes the interpretation of the forecast memory difficult. This is discussed further in Andersson et al. (2007).

[16] One or two montly outcomes are often known for the first forecast quarter. The number of known price outcomes in the current quarter varies somewhat but in an average forecast occasion approximately 45 per cent of the outcomes for the first forecast quarter been available during the evaluation period (see discussion in Andersson et al. (2007)).

[17] The period studied is here regarded as a realisation from the Riksbank's forecast process.

3.2 GDP

The Riksbank's GDP forecasts have often been among the better ones compared to the other participants in the Consensus panel, see Chart 2. For example, on about half of the occasions, the Riksbank has made more precise forecasts than 80 per cent of the other forecasters, which is more often than NIER and the average for the other analysts.[18]

Compared with NIER's quarterly GDP forecasts, the Riksbank's have been marginally more accurate, see RMSE comparison in Table 1. As with UND1X, there are, however, no statistically significant differences in the forecast precision. In a comparison with the AR model, the Riksbank's forecast error for GDP is somewhat higher for the horizon one step ahead, somewhat lower two to four quarters ahead and then the forecast error is relatively similar. The forecast error gradually approaches the serie's standard deviation in the evaluation period and in the horizon five quarters ahead RMSE exceeds the standard deviation. This can be taken to mean that the Riksbank's GDP forecasts have a memory of four steps. The reason the forecast error decreases somewhat for longer horizons can be that the estimations are based on fewer observations, rather than precision actually increasing (see appendix A.1 for further discussion about this).

ME estimations for GDP also display a similar picture to UND1X, that is, the bias increases the longer the forecast horizon. According to the test, no estimations differ significantly from zero, even if the estimated mean error for annual percentage change two years ahead shows that GDP has been overestimated by some four tenths, on average, which is not negligible.

The Government (2002) and the Swedish National Audit Office (2006) indicate that the revisions of GDP made in the government forecasts have been acceptable, on average. For the Riksbank's forecasts four quarters ahead there is a strong correlation between observed forecast errors, initially, and the revision that was made, see Table 3. The Riksbank's revision pattern seems reasonable at this horizon in that the correlation between observed forecast errors and the hypothetical revision that would have given a zero forecast error is 68 per cent. For the eight quarter horizon the correlation between observed forecast errors and revisions to the forecasts is considerably weaker, which is understandable since the revision that would have been required for a zero forecast error is virtually independent of observed forecast errors. The Riksbank's revision pattern is studied in more detail by Andersson et al. (2007).

[18] As with the CPI, Andersson et al. (2007) presents more evaluation results from the Consensus Forecasts´data.

3.3 EMPLOYMENT

Predictions for the number of employed are not included in the data from Consensus Forecasts, thus, the Riksbank is only compared with the NIER and an autoregression in this case. The employment forecasts are evaluated in real time since there is some revision of outcome data. Table 1 shows that NIER's assessments have been more accurate than the Riksbank's for horizons up to one year ahead, while the reverse is true for forecasts two years ahead.

In the Riksbank's employment forecasts, there is no statistically significant bias, either in quarterly or annual growth. However, the point estimates of ME are somewhat larger for the first forecast year than for the second and the Riksbank's forecasts for employment generally have a somewhat lower forecast error than the AR model. RMSE for the employment forecasts is less than the standard deviation for all horizons studied, which implies that the memory extends eight quarters ahead. However, this should be interpreted with some caution since RMSE is very close to the standard deviation in the second forecast year (that is, 5-8 quarters ahead).

The revision properties of the employment forecasts are generally poorer than those of the GDP and UND1X forecasts, particularly for the longest horizon (Table 3). A positive forecast error leads to an upward revision of the forecasts four quarters ahead, while the forecast eight quarters ahead is, on average, left unchanged. The correlation between the revisions made by the Riksbank and the adjustments that would have eliminated forecast error is considerably weaker than in the case of GDP and UND1X.

3.4 GDP/EMPLOYMENT

Productivity is one of the central variables in the Riksbank's monetary policy analysis and it is, therefore, of particular interest to evaluate the forecasting performance. Furthermore, it is conceivable that the Riksbank's forecast errors for productivity have had implications for forecast deviations on other central variables, which may be worth studying closer.

In practical work, productivity is mostly measured as so-called labour productivity, calculated as GDP divided by hours worked. Since quarterly forecasts for hours worked have not been made sufficiently far back in time, this precludes a meaningful study of labour productivity as defined above. Therefore, a related but less conceptually suitable measure, namely the ratio of GDP to employment, is used instead. It is possible to find support so that a forecast evaluation of the ratio GDP to employ-

ment should be able to be used as an approximation of the properties in the productivity predictions (see Andersson et al. (2007) for a discussion about this). Analyses based on GDP/employment can only be done from 2002 onwards because quarterly employment forecasts were not produced earlier. As in the case of the separate analyses of GDP and employment, the evaluation of the ratio between them is done in real time.

The forecasts contain some positive bias at most horizons (see Table 2), i.e., the Riksbank has underestimated the productivity growth. Measured as the percentage annual change, this bias is relatively large, 0.68, for forecasts two years ahead.[19] However, the bias is not statistically significant. The AR model is generally somewhat more accurate than the Riksbank's forecasts in this period.

If the Riksbank's forecast errors for labour productivity affected other forecast deviations, this should be reflected in the correlations between the forecast errors for the different variables. One expected result is a negative correlation between GDP/employment and UND1X. This is in fact one of the detected correlations, see Table 4. Thus there are indications that the underestimation of GDP/employment entailed an overestimation of UND1X. There is, moreover, a negative correlation between the forecast errors for GDP and UND1X, which are under- and overestimated respectively. This is also congruent with effects of an unexpected development of productivity (i.e., productivity shocks).

4. Summary

All in all, the study shows that the Riksbank's forecasts perform satisfactorily compared with both those of other forecasters and with simple AR models. In particular, the Riksbank's same-year GDP forecasts are often among the most accurate. The same applies to CPI inflation, though in this case the difference compared with NIER and the Consensus panel is smaller.

Compared with NIER's, the Riksbank's quarterly forecasts also perform well. Their average forecast errors are somewhat smaller than NIER's for a majority of the variables but the differences are generally very slight and not statistically significant.

The Riksbank's inflation forecasts (CPI and UND1X) also have a forecast potential up to and (possibly) including the second year. Forecast memory for GDP extends about four quarters ahead. The forecasts show no significant signs of systematic errors, although CPI inflation has been overestimated by an average of six tenths in a two-year horizon. The

[19] GDP/employment evaluation covers the period 2002-2006. For that particular sample GDP and employment also exhibit positive bias.

overestimation of UND1X inflation two years ahead is considerably lower (around two tenths). The employment forecasts have forecast memory that is probably limited to the first year. In other respects their properties broadly resemble those of the GDP forecasts, that is, no clear signs of systematic misjudgement.

Although the revisions to the Riksbank's forecasts for GDP, UND1X and employment seem to have been too little, too late in some periods, the study finds no clear indications that a different, more aggressive revision pattern would have resulted in forecasts that, on average, were more accurate.

The development of labour productivity in the evaluation period was more favourable than had been predicted. The analysis of the approximate indicator of this, GDP/employment, shows a relatively weak forecasting performance that is partly connected with a systematic underestimation of the rate of increase. There are also signs that the Riksbank's misjudgements of productivity have played a part in the co-variation of the forecast errors for GDP and inflation.

References

Adolfson, M., M. K. Andersson, J. Lindé, M. Villani & A. Vredin, (2007), "Modern forecasting models in action: Improving analyses at central banks", *International Journal of Central Banking*, forthcoming.

Andersson, M.K., G. Karlsson & J. Svensson, (2007), "The Riksbank's Forecasting Performance", Sveriges Riksbank Working Paper Series, *forthcoming*.

Andersson, M.K. & M. Löf (2007), "The Riksbank's new indicator procedures", *Economic Review* 2007:1, Sveriges Riksbank.

Assarsson, B. (2007), " Riksbankens prognoser på importpriser och inflation", *Economic Review* 2007:3, Sveriges Riksbank.

Bergvall, A., (2005), "Utvärdering av Konjunkturinstitutets prognoser" (Evaluation of NIER's forecasts), *Specialstudie*, no 5, March 2005, The Swedish National Institute of Economic Research.

Blix, M., J. Wadefjord, U. Wienecke & M. Ådahl, (2001), "How good is the forecasting performance of major institutions?", *Economic Review*, 2001:3, Sveriges Riksbank.

Blix, M., K. Friberg & F. Åkerlind, (2002), "An evaluation of forecasts for the Swedish economy", *Economic Review*, 2002:3, Sveriges Riksbank.

Galbraith, J. & G. Tkacz, (2006), How far can we forecast?: Forecast content horizons for some important macroeconomic time series, Department of Economics Working Paper 13, McGill University.

Regeringen (2002), Vårpropositionen 2002/03:100 Bilaga 1: Svensk Ekonomi (Spring Budget Bill, Annex: The Swedish economy).

Riksrevisionen, (2006), "Det makroekonomiska underlaget i budgetpropositionerna" (The macroeconomic foundation in the draft budgets).

Schwartz, G., (1978), "Estimating the order of a model", *The Annals of Statistics* 2, 461-464.

Appendix

A.1 AVERAGE FORECASTING PERFORMANCE

For the collection of Riksbank forecasts, the average accuracy can be estimated. The engaged measure of accuracy is the root mean squared error (RMSE), which summarises the dispersion of forecast errors and any average deviation.[20] The lower estimated RMSE is, the better the forecasting performance. For a forecasting method that is invariably accurate, RMSE is zero. The mean error (ME) is also studied. RMSE is used to measure the average size of forecast errors, while ME is used to study when the forecasts contain bias, that is, a systematic over- or underestimation.[21] To assess forecast memory, the forecast errors are related to the respective series' standard deviation in the evaluation period.[22]

The starting point as regards the AR models used in the evaluation has been two different variants; a so-called AR(1), with just the value for the preceding period (first lag) as the explanatory variable, and a second variant with the number of lags based on a model choice procedure.[23] The most accurate of the AR variants is chosen as a benchmark. The models are estimated on data from 1993 up to the latest observation that was available for the forecast in question. As the results suggest that in most cases the AR(1) specification performs somewhat better, it is mostly this which has been used as a benchmark[24].

It may be worth noting that the number of observations for an evaluation generally decreases with the length of the forecast horizon. The present database with the Riksbank's quarterly forecasts, for example, contain 27 one-quarter forecasts for GDP but only 18 ten-quarter forecasts. If the average forecast error seems to be remarkable for longer horizons, it is therefore important to be aware that this may be at least partly due to the sample's diminishing size. There are, for instance, some cases where forecast accuracy seems to improve appreciably at the longest horizons which should thus be interpreted with caution. To make this less of a problem, the present study focuses on forecasts that stop at eight quarters ahead. One problem (in a limited sample) that remains is that (possible) outcomes which are hard to predict at the start of an evaluation sample do not affect RMSE estimates in the longer horizons.

---

20 $RMSE(h) = \sqrt{\sum_{t=\tau_1}^{\tau_2} \left(y_{t+h} - y_{t+h}^{pred} \right)^2 / (\tau_2 - \tau_1 + 1)}$, where y_{t+h} is the outcome at time t+h and y_{t+h}^{pred} is the forecast at time t+h and h is the forecast horizon.

21 $MSE(h) = Bias^2(h) + pf \text{ var}(h)$, where pf var is the forecast error variance.

22 See Andersson & Löf (2007) for a detailed review of the forecast memory concept.

23 The procedure for the choice of lags (the information criterion) that is used here is BIC, (see Schwartz, 1978). BIC selects a specification on the basis of available data and a statistical criterion. In retrospect the selected model may, of course, turn out not to be the best in terms of average forecast accuracy.

24 The exceptions are UND1X and CPI where an AR(1) with seasonal dummies is used, since this functions better than both a common AR (1) and that which is generated by lag choice procedure.

For example, the unexpectedly high UND1X outcomes in 2001 do not affect the estimated precision in the longest horizons, and the estimated RMSE can, therefore, be lower for longer horizons.

A.2 REVISION PATTERNS

Economic forecasts are constructed from interpretations of data that are currently available, together with the forecaster's appraisal of the economic situation. The results in this article are an illustration of macroeconomic forecasts' considerable uncertainty. The forecasts are revised because forecast errors are observed when new outcomes become available. Revisions can, of course, be made for other reasons, too, such as new indicator statistics or a macroeconomic reassessment. These other reasons have been presented in the Inflation Reports but are normally very difficult to quantify and, accordingly, to analyse too. Of course, this sets certain limits on how informative a forecast revision analysis can be.

The Riksbank's average revision pattern is here characterised in terms of the correlation between the most recent observed forecast error for a variable and the revision that was actually made to the four- and eight-step forecasts. This correlation shows how old forecast errors coincided with the Riksbank's revisions but does not say anything about how well registered forecast errors were utilised. The correlation between the Riksbank's actual revisions and the hypothetical revisions that would have eliminated forecast error is also calculated.[25]

[25] The revision that eliminates forecast error is, of course, not feasible in practice. It is used here simply as a reference point to put the actual revisions into perspective.

Tables and Charts

Table 1: RMSE for quarterly forecasts 2000-2006, variables expressed as quarterly or annual per cent growth

			Forecast horizon (quarter)							
Variable	FC		1	2	3	4	5	6	7	8
Policy rate	RB		0.06	0.27	0.45	0.60	0.66	0.80	0.98	1.10
	NIER		2.17	0.80	0.70	0.78	1.06	1.12	1.17	1.31
	AR		4.24	1.68	1.38	1.25	1.23	1.13	1.08	1.04
	StD		0.95							
UND1X	RB		0.14	0.40	0.38	0.40	0.42	0.44	0.33	0.33
(quarterly rate)	AR		2.95	1.05	1.11	1.07	1.07	1.06	1.28	1.32
	StD		0.58							
	StD	SA	0.38							
UND1X	RB		0.10	0.49	0.54	0.50	0.47	0.53	0.62	0.76
(annual rate)	NIER		1.09	0.84	1.05	1.26	1.43	1.11	1.00	0.90
	StD		0.80							
CPI	RB		0.10	0.38	0.37	0.41	0.45	0.51	0.41	0.41
(quarterly rate)	AR		4.37	1.17	1.13	1.05	1.04	0.93	0.97	1.04
	StD		0.53							
CPI	RB		0.11	0.46	0.51	0.53	0.67	0.87	1.05	1.19
(annual rate)	NIER		0.73	0.91	1.09	1.18	1.11	1.03	1.01	1.04
	StD		0.90							
GDP	RB		0.30	0.31	0.28	0.28	0.36	0.37	0.34	0.31
	NIER		0.99	1.06	0.98	1.09	1.01	1.06	1.33	1.22
	AR		0.75	1.05	1.29	1.32	0.98	0.92	1.02	1.07
	StD		0.35							
Employm.	RB		0.35	0.32	0.36	0.36	0.38	0.40	0.38	0.37
	NIER		0.94	1.03	0.87	0.97	1.00	1.04	1.09	1.09
	AR		0.95	1.14	1.07	1.13	1.09	1.05	1.13	1.15
	StD		0.41							
GDP/employm.	RB		0.41	0.49	0.40	0.49	0.43	0.45	0.37	0.42
	AR		0.88	0.71	0.86	0.88	0.96	0.91	1.06	0.97
	StD		0.50							

Note. The table shows the forecast precision 1 to 8 steps into the future for the following forecasters (FC): the Riksbank (RB), the Swedish National Institute of Economic Research (NIER) and an autoregression (AR). For RB, RMSE is reported and for NIER and AR the ratio RMSE/RMSE(RB) is reported. A ratio greater than one indicates that RB's forecasts have been more precise (had lower estimated RMSE) and a ratio less than one shows that the Riksbank's forecasts have lower precision. StD is respective variables' standard deviation in the evaluation period. In the case of UND1X, seasonally adjusted standard deviation is shown for quarterly growth. Annual percentage change is used in a comparison with NIER's UND1X and CPI forecasts. GDP/employment is a transformation of other variables and is not reported for NIER.

Table 2: Estimated bias (ME) for quarterly forecasts 2000-2006, variables expressed as quarterly and annual per cent growth

		Forecast horizon (quarter)							
Variable		1	2	3	4	5	6	7	8
UND1X	Qu	-0.02	005	0.05	0.01	0.00	-0.04	-0.11	-0.12
	An				0.26				-0.19
CPI	Qu	0.04	0.04	0.00	-0.04	-0.05	-0.12	-0.19	-0.20
	An				0.06				-0.60
GDP	Qu	0.03	0.07	-0.09	-0.06	-0.13	-0.14	-0.09	-0.06
	An				-0.05				-0.37
Employm.	Qu	0.06	0.07	0.01	-0.05	-0.03	0.04	0.00	0.03
	An				0.27				0.20
GDP/employm.	Qu	0.05	-0.14	0.05	0.05	0.06	0.00	0.06	0.24
	An				0.12				0.68

Note. The table shows estimated bias (ME) for the Riksbank's forecasts. Qu indicates quarterly growth and An annual growth of the variable studied. Test of zero bias is adjusted for overlapping information. Employment and GDP/employment computations are based on data for the period 2002-2006.

Table 3. Revision correlations

Correlations between		Correlation (horizon) 4	8
GDP			
Obs FE	Revision	0.80	0.11
Rev (FE=0)	Revision	0.68	0.34
UND1X			
Obs FE	Revision	0.60	0.11
Rev. (FE.=0)	Revision	0.44	0.42
Employment			
Obs FE	Revision	0.39	-0.02
Rev. (FE.=0)	Revision	0.55	0.15

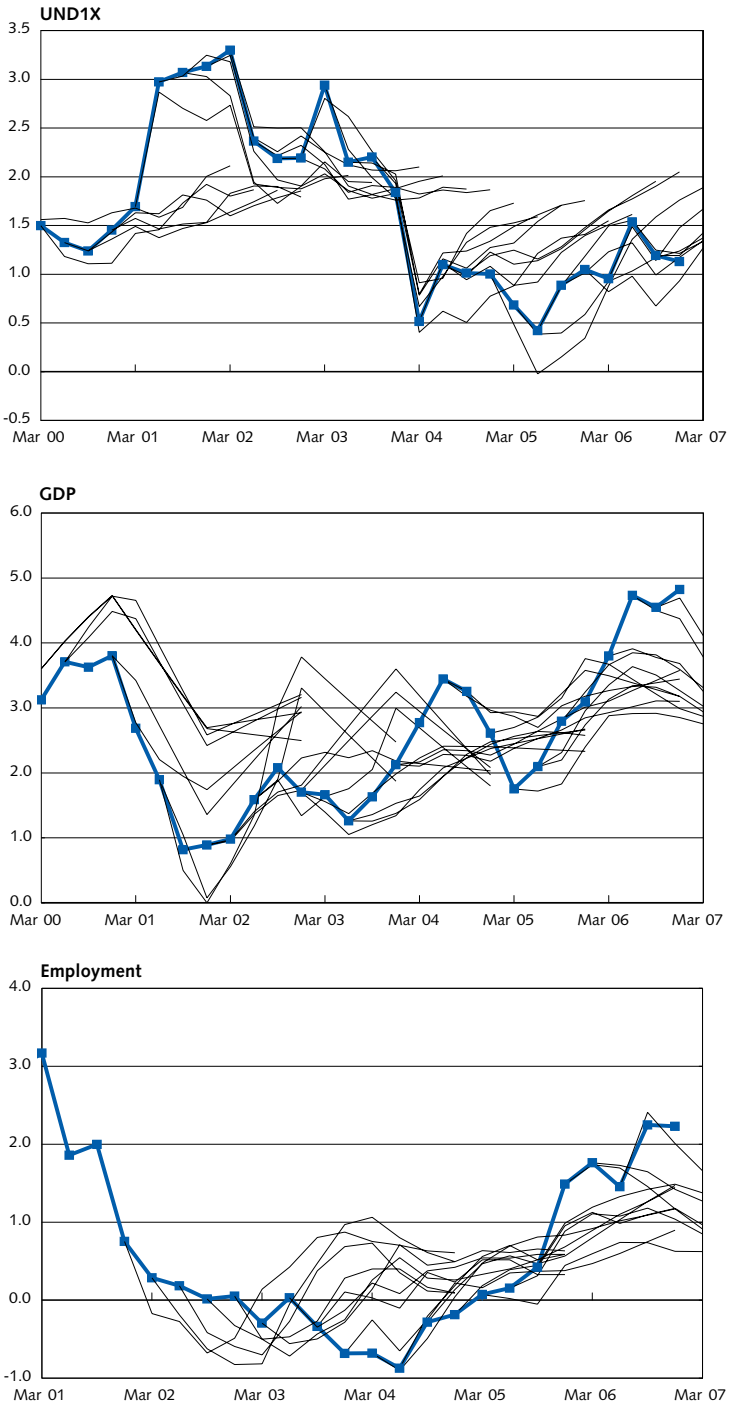
Note. The table shows estimated correlations between observed forecast errors (Obs FE.) and the Riksbank's revisions to forecasts (Revision), and the correlation between the Riksbank's (Revision) and the hypothetical revisions that would have eliminated forecast error (Rev (FE. =0)).

Table 4. Forecast error correlations

Forecast errors for		Horizon	Sign	Signif. level (%)
GDP	UND1X	2	-	5
GDP	Employment	1	-	5
		4	-	10
Employment	UND1X	1	+	10
		5	-	10
UND1X	GDP/Employm.	8	-	10
GDP	GDP/Employm.	2-5	+	1 to 5
Employment	GDP/Employm.	3	-	5

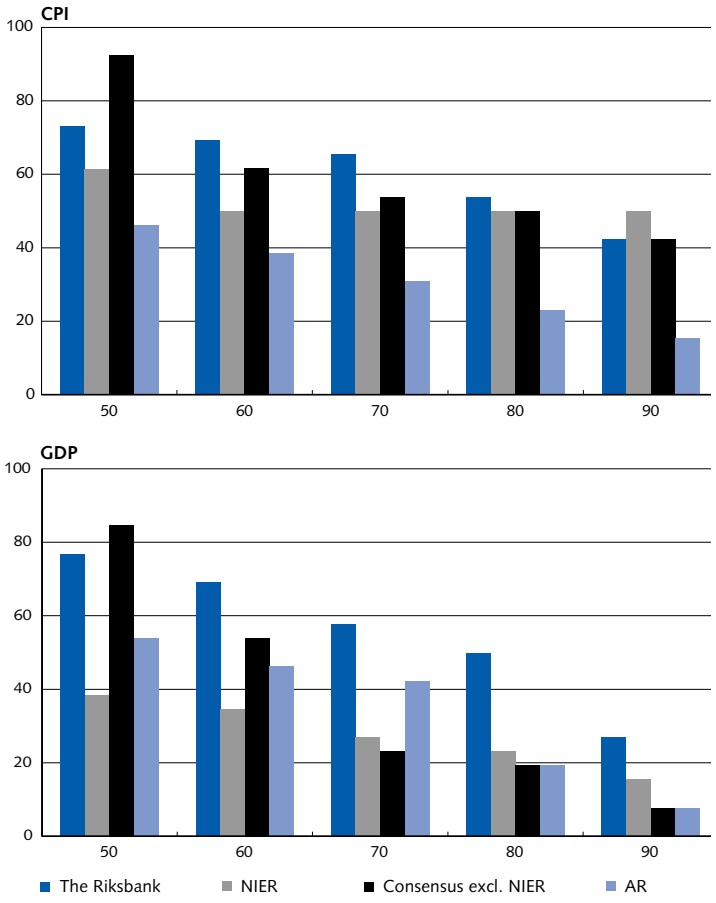
Note. The table shows the direction of correlations (Sign) between forecast errors for different variables. Signif. level denotes the (lowest) level of significance at which the zero correlation hypothesis is rejected.

Chart 1. GDP, UND1X and Employment: outcome and forecasts since 2000
Annual percentage change



Note. Lines with squares are outcomes. The other lines show the Riksbank's forecasts from the respective reporting occasions. Outcomes for GDP and UND1X are composed from the first version of data for each quarter (real time outcomes).

Chart 2. Ranking CPI and GDP, current year
Per cent



Note. The Y-axis shows how large a percentage of times analysts have been better than the percentage of analysts as illustrated in the X-axis. In order to see how large a proportion of times the Riksbank has been better than 50 per cent of other analysts, see 50 is on the X-axis, then study the blue column on the Y-axis. Here specifically, in barely