

Comparing the Predictive Accuracy of Macroeconomic Forecasts for Austria from 1998 to 2006

This study for the first time presents an analysis of the predictive accuracy of all forecasts available for the Austrian economy. To be precise, the fall 1998 to fall 2006 forecasts of the following three national and three international institutions are compared: the Oesterreichische Nationalbank (OeNB), the Austrian Institute of Economic Research (WIFO), the Institute for Advanced Studies (IHS), the Organisation for Economic Co-operation and Development (OECD), the International Monetary Fund (IMF) and the European Commission. The forecasts of the various institutions tend to paint a relatively similar picture of the economy. As a case in point, all institutions markedly underestimated both the magnitude and the duration of the 2001 slowdown. Credit for the most accurate forecasts is due to the national institutions; none of the international institutions reach or significantly surpass their performance. WIFO posts the smallest error in the GDP forecasts for the current year, the OeNB for the year ahead. The OeNB outperforms all institutions in predicting inflation, recording the smallest mean forecast error.

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1 Introduction

Macroeconomic forecasts are an important input for economic policymakers and are likewise essential in guiding monetary, fiscal and wage policy decision making. Also, budget preparation, interest rate decisions and wage bargaining would be severely hampered without forecasts. Economic policymakers in Austria have been able to draw on periodic forecasts since 1963, when the WIFO published its first macroeconomic forecast.

Many factors driving economic developments are subject to a high degree of uncertainty, which is why predictions and outcomes hardly ever match perfectly. It is common wisdom that forecasts are prone to errors. Given that macroeconomic forecasts are meant to provide an accurate snapshot of the economy at future points in time, they must pass muster

in an ex-post quantitative evaluation of their predictive power.

Several authors compared the predictive accuracy of forecasts for the Austrian economy already in the 1970s, 1980s and 1990s (Thury, 1970; Fleissner, 1980; Kramer, 1980; Schebeck and Thury, 1980; Hofer and Koman, 1991; Wörz, 1994). More recently, Rabitsch (2002) and Baumgartner (2002a) assessed the forecasting performance of WIFO and the IHS. Baumgartner (2002b) also included the OECD forecasts. In light of the relatively short forecasting history of the OeNB, no study had as yet considered the OeNB forecasts. Both the IHS and the OECD started publishing periodic forecasts in 1972, while the OeNB followed suit only in the fall of 1998. This study is the first to present an analysis of the predictive accuracy of all six institutions (OeNB, WIFO, IHS,

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OECD, IMF and the European Commission) that prepare macroeconomic forecasts for Austria.

We discuss the characteristics of the forecasts under investigation in section 2. In section 3, we present an overview of the movements of the GDP forecasts over time. Section 4 centers on the quantitative assessment of the predictive power of forecasts by the various institutions. Here, we first shed light on the measures we used to assess forecasting performance and then ascertain the average predictive accuracy across all institutions for the variables under investigation, namely GDP, inflation, the unemployment rate, the budget balance, private consumption, government consumption, investment, exports and imports. We then round out this section by juxtaposing the forecasting performance of the individual institutions. Section 5 concludes with a summary of the key findings.

2 Characteristics of the Macroeconomic Forecasts under Investigation

To ensure forecast comparability, it is important to consider several basic characteristics, such as the *number of forecasts released per year*, the *forecast horizons*, the *dates of publication*² as well as the *cutoff dates*, since these factors may vary from institution to institution (table 1).

While WIFO and the IHS release quarterly forecasts, the other four institutions, i.e. the OeNB, the European Commission, the IMF and the OECD, publish forecasts twice a year. Consequently, we use only the June

and December forecasts of WIFO and the IHS when comparing predictive accuracy in section 4. In the same vein, *forecast horizons* differ across the surveyed institutions. The OeNB is the only institution whose spring forecast provides predictions for two years ahead ($t+2$) apart from the current year (t) and the next year ($t+1$), i.e. the two forecast horizons common to all spring predictions. The fall forecasts of all institutions except the IMF cover the three horizons t , $t+1$ and $t+2$. In light of these differences, we limit our assessment of predictive accuracy to the current-year and next-year forecasts.

This brings us to the *dates of publication*: the international institutions publish their forecasts up to two or three months ahead of the national forecasters, which puts the former at a clear informational disadvantage.

The latest information available when formulating the forecast, reflected by the *cutoff date*, also plays an important role. Here, not only the date of publication is relevant, but also the length of time an institution uses for producing a forecast. Neither WIFO nor the IHS has to coordinate its economic predictions with other country forecasts. By contrast, the European Commission, the OECD and the IMF – and also the OeNB – use a markedly longer forecasting process that precludes them from factoring in recent developments. The cutoff dates for the OeNB forecasts under investigation were, for instance, mid-May and mid-November, respectively. By contrast, WIFO and the IHS had the advantage of using an additional quarterly System of

² Over time, there have repeatedly been minor shifts in the dates of publication.

Box 1

The OeNB Projections

Its strong conditional nature stands out as the most distinctive feature of the OeNB forecast. Drawn up in cooperation with the other national central banks in the euro area and the ECB, its results are used in the Eurosystem staff macroeconomic projections for the euro area, which serve as an important input into the assessment of economic developments and the risks to price stability of the Governing Council of the ECB. Meant to anticipate economic developments under a given monetary policy stance, the projections were based on the assumption of a constant level of short-term interest rates and exchange rates up to 2005. Assumptions on long-term interest rates reflect market expectations for ten-year government bonds. Since June 2006, the underlying short-term interest rate for the forecast horizon has been based on market expectations for the three-month EURIBOR. The OeNB forecast, or rather projection, has been much more conditional by nature (especially until 2005) than the forecasts released by the other institutions surveyed in this study. A comparison of OeNB predictions with actual outcomes is therefore, strictly speaking, inadmissible.

National Accounts (SNA) observation.³ Since fall 2005 GDP flash estimates have been available; they serve as an input for the OeNB projections.

3 Forecast Errors for GDP over Time

The forecasts for Austria examined in this study cover a period which saw a pronounced yet atypical business cycle. The global economy slowed down sharply in 2001, reflecting the recession in the U.S.A., which was attributable to surging crude oil prices, the appreciation of the U.S.

dollar, the correction of irrationally high prices on technology stock exchanges, sinking consumer confidence and the terrorist attacks of September 11, 2001. GDP growth in Austria plunged from a remarkable 3.4% in 2000 to 0.8% in 2001 and remained very subdued until 2003. In 2004, however, GDP growth accelerated markedly thanks to the robust global economy, and following a brief slowdown in early 2005 recorded an even faster clip in 2006.⁴

Chart 1 shows the movements from 1999 to 2006 of *GDP growth predictions averaged across all institutions*.

Table 1

Dates of Publication and Forecast Horizons of the Forecasts for Austria

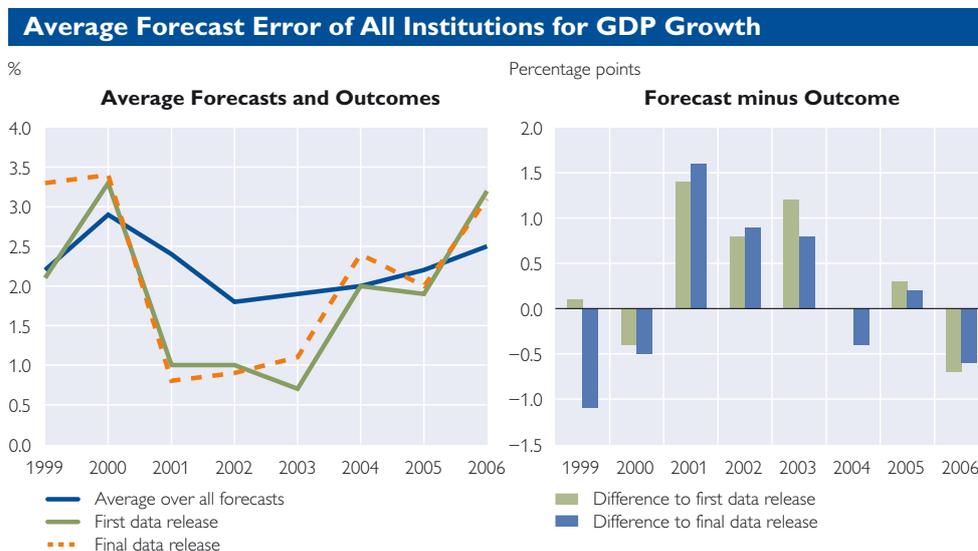
| | Winter | Spring | Summer | Fall |
|---------------------|---------------|-------------------|--------------|-------------------|
| OeNB | x | June: t, t+1, t+2 | x | Dec.: t, t+1, t+2 |
| WIFO | March: t, t+1 | June: t, t+1 | Sep.: t, t+1 | Dec.: t, t+1, t+2 |
| IHS | March: t, t+1 | June: t, t+1 | Sep.: t, t+1 | Dec.: t, t+1, t+2 |
| European Commission | x | April: t, t+1 | x | Oct.: t, t+1, t+2 |
| IMF | x | April: t, t+1 | x | Sep.: t, t+1 |
| OECD | x | April: t, t+1 | x | Nov.: t, t+1, t+2 |

Source: OeNB.

³ In this respect, above all the IMF is at a disadvantage, given its extremely long forecasting process. The IMF produces its global economic forecast on the basis of individual country forecasts. To allow the IMF to ensure consistency between the country forecasts, the latter are released with a pronounced lag. The information disadvantage is as large as two quarters.

⁴ For an analysis of past business cycles in Austria and for dating turning points, see Scheiblecker (2002, 2007).

Chart 1



Source: Forecasts of all surveyed institutions, Statistics Austria, authors' calculations.

To this end, we calculated the mean of all forecast values for every year. The left panel also includes the movements of the outcomes, namely the quarterly SNA data both as first and finally released by WIFO.⁵ The right panel illustrates the forecast errors resulting for each year.

All institutions failed to foresee the magnitude and duration of the economic slump in 2001. They also clearly underpredicted growth for the boom years 2000 and 2006. Analyzing the forecast errors over time, we see that growth tends to be underpredicted during a boom and overpredicted during a recession. Thus, the forecasts smooth out the peaks and troughs evident in the actual GDP series.

Chart 2 shows the ranges of real GDP growth forecasts for the period from 1999 to 2006 across all institutions.⁶ The lowest and highest values per publication date are indicated for each forecast year.⁷ For example, the lowest prediction presented in the fall 1998 forecasts for 2000 ("98 f") came to 1.9%; the highest prediction was 3.0%. The OeNB forecasts are plotted in addition. As a rule, forecasts for two years ahead start out at around 2½% for all forecast years and over time gradually converge toward the actual values. At an average 0.4 percentage points, the forecast ranges may be considered relatively small. The unusually large range evident for the fall 2001 forecasts for the year 2002 stems from the fact that

⁵ Frequent far-reaching data revisions and conceptual changes sometimes result in pronounced changes in the assessment of the current economic situation. For this reason, we examine the forecasts relative to the first data release when we conduct the quantitative assessment of the forecasting performance in section 4.

⁶ As mentioned before, the OeNB has been releasing periodic forecasts only since fall 1998. To ensure consistency across the institutions, we did not include forecasts for the years 1999 and 2000 published earlier than 1998 by the other institutions in chart 2.

⁷ Note that not all six institutions produce forecasts for every indicated publication date (table 1).

the IMF was the only institution which released its forecast prior to the September 11 terrorist attacks.

The forecasts were gradually revised to reflect the downturn of 2001. Even though the slowdown became evident from the data of the first quarter of 2001 at the latest, all institutions interpreted it as only a temporary dent in growth. They consequently overpredicted growth for 2001 to 2003 up until the final forecasts. By contrast, the predictions for 2004 and 2005 largely corresponded with the outcomes. It took forecasters rather long to edge up GDP growth predictions for the year 2006, which was above all ascribable to an overly cautious outlook for exports.

The OeNB forecasts for 2002 and 2003 – two years of slow growth – were more conservative than the predictions of the other institutions, and developments justified this restraint. OeNB experts remained cautious also for 2004, when the economy picked up again. The forecasts for 2005 were very similar across all publication dates. The OeNB was almost invariably more optimistic in its outlook for 2006 than the other institutions.

4 Evaluation of Predictive Accuracy

In this section, we compare the predictive accuracy of the forecasts produced by the various institutions. To this end, we put the forecast values in relation to the first release of WIFO's quarterly SNA data. We chose this method because frequently, far-reaching revisions and restructuring of SNA data completely change the economic picture as it presented itself at the time a given forecast was drawn up. For this reason, the first data release provides a more accurate snapshot of the information available at

the time of forecast production than the final outcomes (Baumgartner, 2002a, 2002b).

4.1 Measures for Comparing Predictive Accuracy

Several measures are used to assess the quality of forecasts, the most common being the *root mean squared error* (RMSE). Giving greater weights to larger deviations of the forecast values (\hat{x}_t) from the actual values (x_t), the RMSE implicitly penalizes large forecast errors.

$$RMSE = \sqrt{\frac{1}{N} \sum_{t=1}^N (\hat{x}_t - x_t)^2}$$

The absolute size of the average error is shown by the *mean absolute error* (MAE). This measure has the advantage that it may be interpreted directly as the mean deviation of the forecast from the outcome in percentage points.

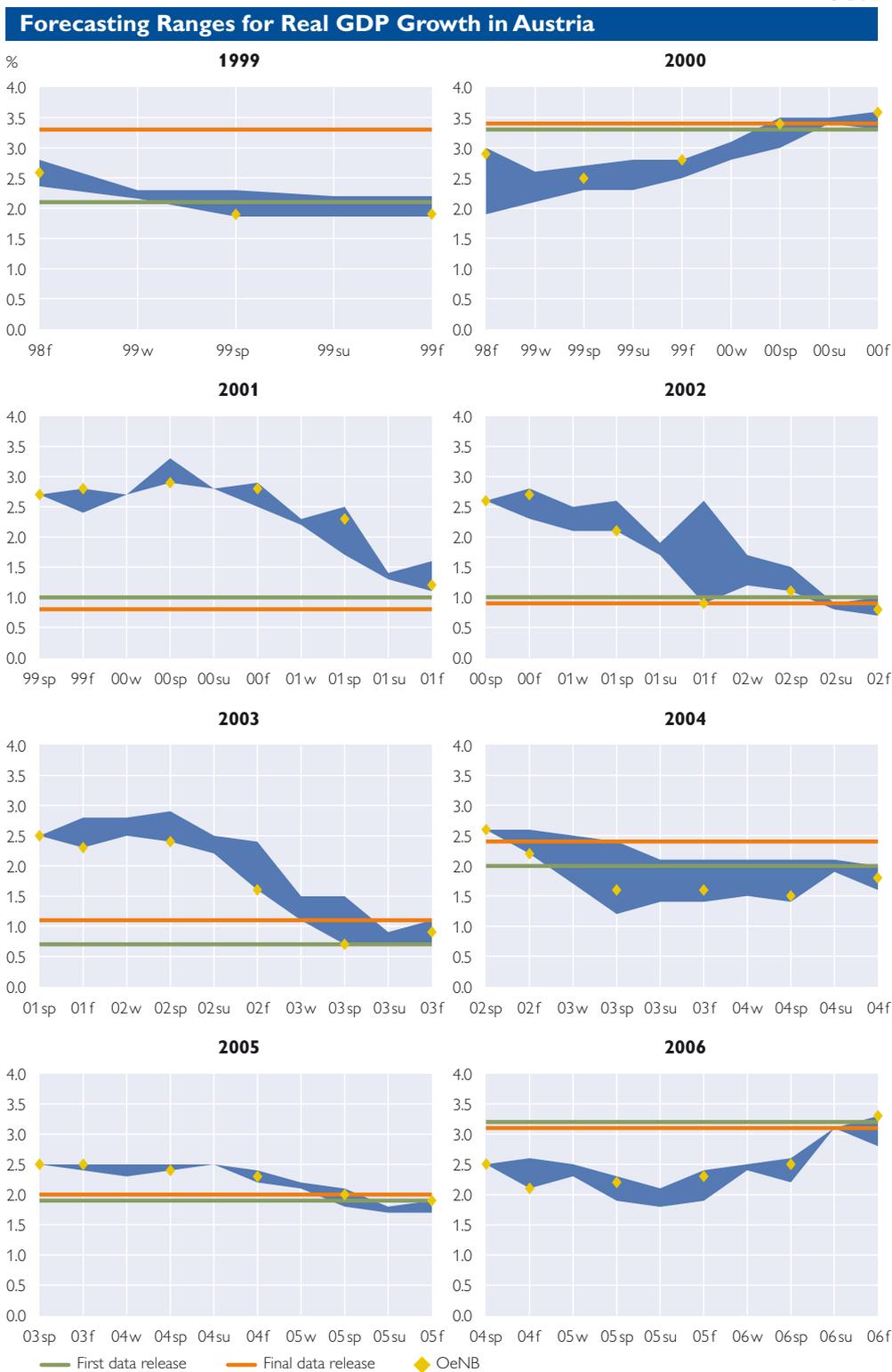
$$MAE = \frac{1}{N} \sum_{t=1}^N |\hat{x}_t - x_t|$$

The *bias* is calculated as the mean deviation of the forecast values from the actual values. It indicates by how much the forecasts on average over- or underpredicted the actual outcomes.

$$Bias = \frac{1}{N} \sum_{t=1}^N (\hat{x}_t - x_t)$$

Theil's inequality coefficient (*Theil's U*) assesses the forecast errors relative to the error of a naive forecast. Under the naive model, we assume a continuation of the previous year (level of unemployment and budget balance, growth rates of the other variables). A value smaller than 1 shows that the

Chart 2



Source: Forecasts of all surveyed institutions, Statistics Austria.

Note: The x axis denotes the forecast dates (sp(ring), su(mmer), f(all) and w(inter)). The respective forecast values are compared with the first release of WIFO's quarterly SNA data for the indicated years and the final release (= most recent data revision) of the GDP growth rate outcomes (y axis).

Table 2

Contingency Table for the Sign Test

| | | | |
|------------------------------|-----|----------------------------------|-----|
| | | Sign of the change (forecast) | |
| | | ≥ 0 | < 0 |
| Sign of the change (outcome) | ≥ 0 | a | b |
| | < 0 | c | d |

Source: Spiegel and Stephens (1998).

forecast at hand is superior to the naive forecast.

$$Theil's\ U = \frac{\sqrt{\frac{1}{N} \sum_{t=1}^N (\hat{x}_t - x_t)^2}}{\sqrt{\frac{1}{N} \sum_{t=1}^N (x_{t-1} - x_t)^2}}$$

In an evaluation of forecasting performance, it is also interesting to examine whether forecasters predicted the

direction of a year-on-year change accurately.⁸ For this purpose we use a *sign test* in the form of a chi-square test of independence. In table 2, we differentiate between four scenarios (a–d).

The success rate

$$SR = \frac{a + d}{a + b + c + d}$$

is defined as the share of correctly predicted signs. The null hypothesis

Box 2

Other Factors in Analyzing Predictive Accuracy

While the above-mentioned measures for assessing forecasting performance provide important information about the accuracy of predictions, they do not tell the whole story.

A subjective evaluation of forecast errors depends on the objectives of the forecast at hand and may even turn out to be **asymmetric**. As a case in point, failing to predict economic downturns might be regarded as a greater error than not foreseeing upturns. On the other hand, under inflation targeting, underestimating inflation might be rated worse than overestimating it.

In addition, a forecast error is not necessarily indicative of a “wrong” forecast. Any forecast is to a certain extent a **conditional forecast** resting on given assumptions about the development of exogenous variables. A forecast error may thus reflect a right forecast under wrong assumptions. Vice versa, wrong assumptions combined with a wrong conditional forecast might balance one another out, eventually resulting in an accurate forecast.

Moreover, economic forecasts may have direct repercussions on economic developments. The prediction of a downturn may, for instance, affect expectations in such a way that the economy actually slows down. Up to a certain degree, forecasts may therefore play out as **self-fulfilling prophecies**. The opposite – a **self-destructive forecast** – is likewise feasible. Faced with an unfavorable forecast, economic policymakers might for instance take measures that stimulate growth.

Last, but not least, it is not really clear to what extent forecast errors may be attributable to **data revisions**. Naturally, it takes time to collect current economic data. Very often data are only preliminary and are revised over time. Furthermore, data reflecting fundamental ex post changes in the collection and computation methods may differ greatly from preliminary figures.

⁸ We examine the sign of the level of unemployment and of the budget balance. With the other variables, we focus on the sign of the changes in the growth rates.

underlying the test is whether the signs of the change in the forecast and the realization are independent from each other. We compute the test statistic

$$\chi^2 = \frac{(a+b+c+d)(a \cdot d - b \cdot c)^2}{(a+b)(c+d)(a+c)(b+d)}$$

Table 3 indicates the success rate, i.e. the share of sign changes correctly forecast (*sign r*), and the error probability of the sign test (*sign p*) when the null hypothesis is rejected.

When we compare forecast A with forecast B, we want to know whether the differences in the forecast errors are statistically significant. The null hypothesis of the one-sided *Diebold-Mariano test* (Diebold and Mariano, 1994) is that forecast A is not better than forecast B (one-sided test). The result denotes the error probability upon the rejection of the null hypothesis.

4.2 Comparison with Time Series Models

Apart from comparing the surveyed forecasts with a naive forecast, juxtaposing them with simple time series models provides further evidence about their relative predictive power. The ARMA (autoregressive moving average) models we use are given as follows:

$$\hat{x}_t = \sum_{p=1}^P \alpha_p x_{t-p} + \sum_{q=1}^Q \beta_q \varepsilon_{t-q} + \varepsilon_t$$

The forecast variable (\hat{x}_t) is explained by its lags (x_{t-p}) to the order of P as well as the lags of the error term (ε_{t-q}) to the order of Q . We chose the optimal model for each variable

and for each forecast date. The number of autoregressive and moving average lags was determined as follows: for every forecast date, we estimated all the different ARMA models up to the ARMA order (P, Q), using the quarterly time series available at the respective date⁹ ($P = Q = 8$). We estimated the models for the unemployment rate and the budget balance in levels, the inflation model using annual growth rates and the other models using quarterly growth rates. Of these models, we chose the model with the maximum value of Akaike's information criterion and used it to produce the forecast for the given date for up to eight quarters. We then aggregated the quarterly forecast to annual figures. The forecast of the budget balance was carried out on an annual basis.

4.3 Mean Forecast Error per Variable

Before analyzing the forecasting performance of the individual institutions in subsection 4.4, we investigate the aggregate mean forecast error. To this end, we calculate the mean bias and mean MAE across all forecasts for each forecast horizon. The results are indicative of the degree of predictability of the various variables and illustrate that the predictive accuracy differs markedly from variable to variable (chart 3, upper panel).

Some of the forecasts for the individual variables show a large bias (vis-à-vis the first data release) over the examined horizon. On average, GDP, private consumption and investment were overestimated for both the cur-

⁹ We had real-time data for all forecast dates back to the spring 2001 forecast at our disposal. The data series start in the first quarter of 1988. We used the shortened time series of the 2001 spring forecast for the forecasts between fall 1998 to fall 2000 as a proxy for the respective real-time data series. The ARMA forecast of the budget balance is based on annual figures dating back to the year 1977.

rent year and the year ahead. Overprediction of investment for the year ahead was particularly prominent, with the mean bias (1.6) four times as large as the bias for the current year (0.4). Among the variables which were underestimated for both forecast horizons are government consumption, unemployment and the budget balance. Interestingly, both exports and imports post one positive and one negative bias each for the two horizons. All forecasters pronouncedly underestimated current-year exports, while markedly overestimating next-year imports, largely because they overpredicted investment for the year ahead.

When it comes to the size of the MAE, we may distinguish between two categories of variables. The MAE is very small for private and government consumption, the budget balance and the unemployment rate, i.e. these variables were predicted quite accurately, whereas this error is large for the cyclical components investment, exports and imports. For these variables, the forecast error for the year ahead is especially sizeable. The forecast error for current-year GDP is relatively small, yet for next-year GDP, it clearly exceeds the error of private consumption.

Dividing the bias and the MAE, respectively, by the standard deviation of a given variable, we arrive at standardized results, which allow for a better comparison across the variables (chart 3, lower panel). Note that now the standardized bias is largest for next-year private and government consumption. The standardized MAE is very similar for all variables, ranging from 0.3 to 0.5 for the current year and from 0.8 to 1.0 for the year ahead. Government consumption is the one exception, posting an MAE

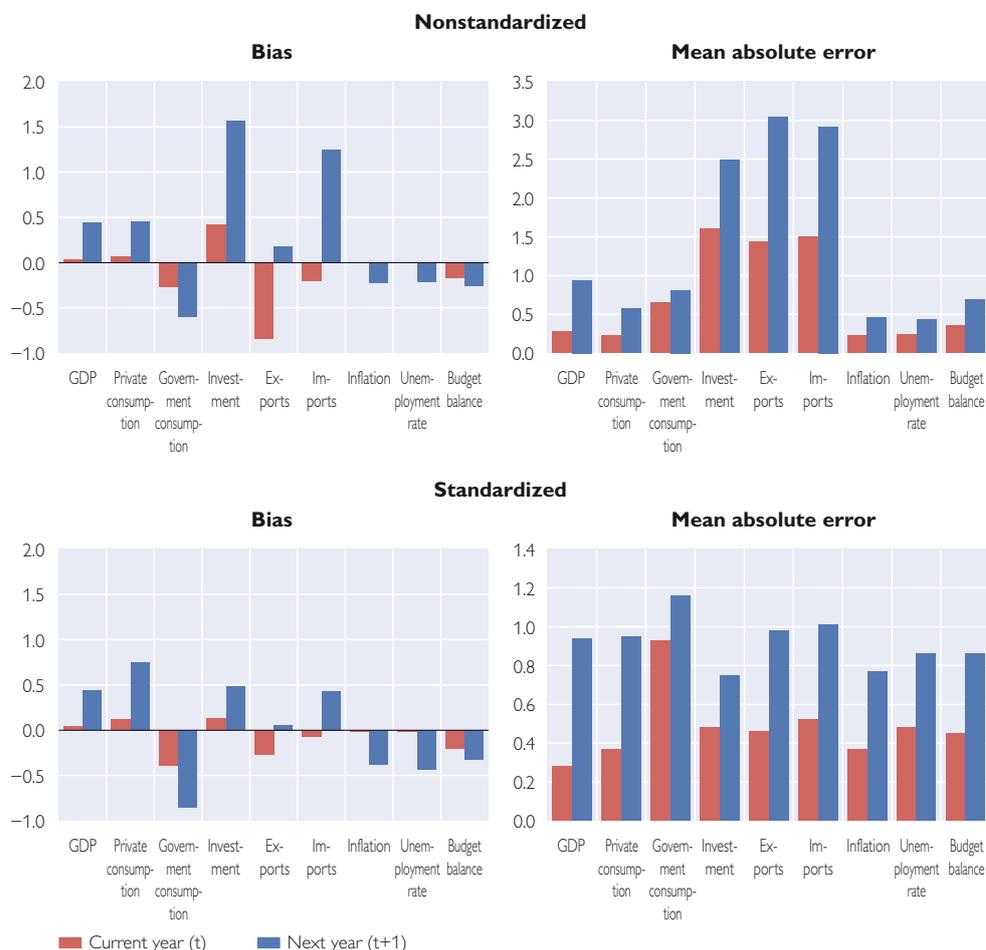
of 1.0 for the current year and no less than 1.2 for the next year. We must bear in mind, however, that, compared with the other variables, much fewer observations are available for forecasting government consumption.

A comparison of the forecasts with the naive forecast (*Theil's U*) reveals pronounced differences in the predictability of the individual variables (table 2). The lowest Theil's U is, on average, evident for the demand components private consumption, investment, exports and imports. In other words, the prediction of these variables by the forecasting institutions yields the largest benefits compared to naive forecasts. The smallest advantage over the naive forecast is evident for the unemployment rate. Yet another interesting finding comes to light in this comparison. The next-year forecasts not only have a larger absolute forecast error than the current-year forecasts, but also a larger error (i.e. increasing Theil's U) relative to the naive forecast. This result confirms the fact that predictability decreases as the forecast horizon increases. However, the increase in Theil's U does not apply to all variables to the same extent, with GDP posting the by far strongest increase. The fact that quarterly SNA data provide forecasters with valuable information about intrayear developments most likely accounts for the low Theil's U of the current-year GDP forecasts. Since such information is also available for the other variables (excluding the budget balance), one might arrive at the conclusion that forecasters apparently pay greater heed to the intrayear developments of GDP than of the other variables.

When we contrast the forecasts with the *time series forecasts*, we iden-

Chart 3

Mean Predictive Accuracy per Variable across All Institutions



Source: Forecasts of all surveyed institutions, Statistics Austria, authors' calculations.
 Note: The errors were calculated relative to WIFO's first quarterly SNA data release.

tify considerable differences in terms of the relative predictive quality. The time series forecasts perform worst relative to the institutional forecasts for the variables budget balance and government consumption, which does not come as a surprise given the great importance of discretionary measures. Likewise, the time series models did markedly worse in predicting private consumption. The mean forecast error for GDP and inflation of the time series models across the forecast horizons is only slightly larger than the mean error of the institutional forecasts. We see

differences in the relative predictive quality from one horizon to another, however. The time series models did best in forecasting the unemployment rate and actually beat all institutions in terms of forecasting accuracy. The models likewise provide significantly better next-year estimates of exports and imports than the lion's share of institutional forecasters.

4.4 Relative Predictive Accuracy per Institution

In this subsection, we compare the predictive accuracy of the various institutions. First we contrast GDP, the

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Table 3

Predictive Accuracy for Real GDP, Inflation Rate, Unemployment Rate and Budget Deficit Forecasts

GDP, real

| | Total | | | | | t | | | | | | | t+1 | | | | | | |
|---------------------|-------|------|------|------|------|----|-------|------|------|------|--------|--------|-----|------|------|------|------|--------|--------|
| | n | Bias | MAE | RMSE | TU | n | Bias | MAE | RMSE | TU | Sign r | Sign p | n | Bias | MAE | RMSE | TU | Sign r | Sign p |
| OeNB | 32 | 0.16 | 0.56 | 0.76 | 0.66 | 17 | 0.01 | 0.29 | 0.42 | 0.37 | 0.94 | 0.00 | 15 | 0.33 | 0.85 | 1.02 | 0.87 | 0.60 | 0.46 |
| WIFO | 32 | 0.17 | 0.53 | 0.79 | 0.69 | 17 | 0.04 | 0.18 | 0.27 | 0.24 | 0.88 | 0.00 | 15 | 0.33 | 0.93 | 1.11 | 0.95 | 0.73 | 0.04 |
| IHS | 32 | 0.25 | 0.54 | 0.78 | 0.68 | 17 | 0.07 | 0.22 | 0.35 | 0.31 | 0.94 | 0.00 | 15 | 0.45 | 0.90 | 1.08 | 0.92 | 0.73 | 0.04 |
| European Commission | 32 | 0.26 | 0.58 | 0.84 | 0.73 | 17 | 0.08 | 0.29 | 0.45 | 0.40 | 0.82 | 0.01 | 15 | 0.46 | 0.91 | 1.12 | 0.96 | 0.73 | 0.04 |
| IMF | 32 | 0.29 | 0.74 | 0.97 | 0.85 | 17 | 0.00 | 0.40 | 0.52 | 0.46 | 0.88 | 0.00 | 15 | 0.62 | 1.13 | 1.31 | 1.11 | 0.67 | 0.10 |
| OECD | 32 | 0.23 | 0.58 | 0.84 | 0.73 | 17 | 0.02 | 0.28 | 0.42 | 0.38 | 0.88 | 0.00 | 15 | 0.46 | 0.93 | 1.14 | 0.98 | 0.67 | 0.10 |
| Average | | 0.20 | 0.59 | 0.83 | 0.72 | | 0.04 | 0.28 | 0.41 | 0.36 | x | x | | 0.44 | 0.94 | 1.13 | 0.96 | x | x |
| NAIVE | 32 | 0.02 | 0.94 | 1.15 | 1.00 | 17 | -0.04 | 0.91 | 1.13 | 1.00 | x | x | 15 | 0.07 | 0.98 | 1.17 | 1.00 | x | x |
| ARMA | 32 | 0.08 | 0.68 | 0.86 | 0.75 | 17 | -0.16 | 0.57 | 0.66 | 0.58 | 0.69 | 0.13 | 15 | 0.36 | 0.81 | 1.05 | 0.89 | 0.47 | 1.00 |

Inflation

| | Total | | | | | t | | | | | | | t+1 | | | | | | |
|---------------------|-------|-------|------|------|------|----|-------|------|------|------|--------|--------|-----|-------|------|------|------|--------|--------|
| | n | Bias | MAE | RMSE | TU | n | Bias | MAE | RMSE | TU | Sign r | Sign p | n | Bias | MAE | RMSE | TU | Sign r | Sign p |
| OeNB | 32 | -0.14 | 0.27 | 0.38 | 0.49 | 17 | -0.03 | 0.01 | 0.14 | 0.22 | 1.00 | 0.00 | 15 | -0.28 | 0.46 | 0.54 | 0.58 | 0.60 | 0.40 |
| WIFO | 32 | -0.06 | 0.29 | 0.40 | 0.50 | 17 | 0.01 | 0.14 | 0.21 | 0.33 | 1.00 | 0.00 | 15 | -0.25 | 0.45 | 0.53 | 0.57 | 0.67 | 0.14 |
| IHS | 32 | -0.16 | 0.28 | 0.42 | 0.53 | 17 | -0.04 | 0.09 | 0.16 | 0.25 | 1.00 | 0.00 | 15 | -0.29 | 0.49 | 0.59 | 0.64 | 0.73 | 0.06 |
| European Commission | 32 | -0.10 | 0.36 | 0.47 | 0.60 | 17 | 0.00 | 0.25 | 0.34 | 0.53 | 0.81 | 0.01 | 15 | -0.23 | 0.48 | 0.59 | 0.64 | 0.60 | 0.40 |
| IMF | 32 | -0.01 | 0.42 | 0.46 | 0.58 | 17 | 0.04 | 0.42 | 0.47 | 0.73 | 0.71 | 0.09 | 15 | -0.05 | 0.41 | 0.46 | 0.49 | 0.67 | 0.19 |
| OECD | 32 | -0.19 | 0.40 | 0.54 | 0.69 | 17 | -0.13 | 0.33 | 0.51 | 0.79 | 0.69 | 0.13 | 15 | -0.26 | 0.48 | 0.58 | 0.63 | 0.60 | 0.45 |
| Average | | -0.12 | 0.34 | 0.45 | 0.57 | | -0.00 | 0.22 | 0.30 | 0.47 | x | x | | -0.23 | 0.46 | 0.55 | 0.59 | x | x |
| NAIVE | 32 | -0.18 | 0.64 | 0.79 | 1.00 | 17 | -0.08 | 0.53 | 0.64 | 1.00 | x | x | 15 | -0.28 | 0.78 | 0.93 | 1.00 | x | x |
| ARMA | 32 | 0.21 | 0.37 | 0.50 | 0.63 | 17 | 0.07 | 0.16 | 0.22 | 0.34 | 0.63 | 0.32 | 15 | 0.36 | 0.62 | 0.68 | 0.73 | 0.60 | 0.44 |

Unemployment rate

| | Total | | | | | t | | | | | | | t+1 | | | | | | |
|---------------------|-------|-------|------|------|------|----|-------|------|------|------|--------|--------|-----|-------|------|------|------|--------|--------|
| | n | Bias | MAE | RMSE | TU | n | Bias | MAE | RMSE | TU | Sign r | Sign p | n | Bias | MAE | RMSE | TU | Sign r | Sign p |
| OeNB | 32 | -0.05 | 0.34 | 0.43 | 0.81 | 17 | 0.04 | 0.24 | 0.33 | 0.71 | 0.81 | 0.01 | 15 | -0.16 | 0.45 | 0.51 | 0.87 | 0.47 | 1.00 |
| WIFO | 32 | -0.03 | 0.31 | 0.40 | 0.76 | 17 | 0.03 | 0.23 | 0.33 | 0.71 | 0.81 | 0.01 | 15 | -0.11 | 0.39 | 0.47 | 0.79 | 0.53 | 0.71 |
| IHS | 32 | -0.05 | 0.34 | 0.42 | 0.80 | 17 | 0.02 | 0.23 | 0.33 | 0.71 | 0.75 | 0.06 | 15 | -0.14 | 0.45 | 0.50 | 0.85 | 0.47 | 1.00 |
| European Commission | 32 | -0.10 | 0.40 | 0.51 | 0.97 | 17 | 0.03 | 0.34 | 0.41 | 0.89 | 0.69 | 0.15 | 15 | -0.25 | 0.46 | 0.61 | 1.03 | 0.40 | 1.00 |
| IMF | 32 | -0.11 | 0.37 | 0.48 | 0.91 | 17 | 0.02 | 0.23 | 0.31 | 0.67 | 0.88 | 0.00 | 15 | -0.26 | 0.54 | 0.62 | 1.05 | 0.40 | 1.00 |
| OECD | 32 | -0.09 | 0.39 | 0.52 | 0.99 | 17 | -0.03 | 0.27 | 0.35 | 0.75 | 0.56 | 0.52 | 15 | -0.16 | 0.54 | 0.67 | 1.12 | 0.60 | 0.26 |
| Average | | -0.08 | 0.36 | 0.46 | 0.87 | | 0.02 | 0.26 | 0.34 | 0.74 | x | x | | -0.18 | 0.47 | 0.56 | 0.95 | x | x |
| NAIVE | 32 | -0.10 | 0.43 | 0.53 | 1.00 | 17 | -0.04 | 0.35 | 0.46 | 1.00 | x | x | 15 | -0.18 | 0.52 | 0.59 | 1.00 | x | x |
| ARMA | 32 | -0.09 | 0.22 | 0.30 | 0.56 | 17 | -0.02 | 0.11 | 0.14 | 0.30 | 0.69 | 0.15 | 15 | -0.18 | 0.34 | 0.41 | 0.69 | 0.20 | 1.00 |

Budget balance

| | Total | | | | | t | | | | | | | t+1 | | | | | | |
|---------------------|-------|-------|------|------|------|----|-------|------|------|------|--------|--------|-----|-------|------|------|------|--------|--------|
| | n | Bias | MAE | RMSE | TU | n | Bias | MAE | RMSE | TU | Sign r | Sign p | n | Bias | MAE | RMSE | TU | Sign r | Sign p |
| OeNB | 32 | -0.26 | 0.55 | 0.73 | 0.77 | 17 | -0.20 | 0.39 | 0.50 | 0.68 | 0.88 | 0.00 | 15 | -0.34 | 0.73 | 0.92 | 0.81 | 0.53 | 0.67 |
| WIFO | 32 | -0.21 | 0.46 | 0.63 | 0.67 | 17 | -0.13 | 0.31 | 0.41 | 0.56 | 1.00 | 0.00 | 15 | -0.29 | 0.64 | 0.81 | 0.72 | 0.53 | 0.83 |
| IHS | 32 | -0.17 | 0.47 | 0.62 | 0.66 | 17 | -0.16 | 0.29 | 0.40 | 0.55 | 0.94 | 0.00 | 15 | -0.17 | 0.66 | 0.80 | 0.70 | 0.53 | 1.00 |
| European Commission | 32 | -0.21 | 0.56 | 0.74 | 0.79 | 17 | -0.19 | 0.38 | 0.49 | 0.67 | 0.94 | 0.00 | 15 | -0.23 | 0.77 | 0.95 | 0.84 | 0.67 | 0.26 |
| IMF | 31 | -0.14 | 0.54 | 0.68 | 0.72 | 17 | -0.09 | 0.42 | 0.51 | 0.70 | 0.81 | 0.02 | 14 | -0.19 | 0.67 | 0.84 | 0.75 | 0.50 | 1.00 |
| OECD | 32 | -0.32 | 0.51 | 0.70 | 0.74 | 17 | -0.26 | 0.35 | 0.46 | 0.63 | 0.88 | 0.00 | 15 | -0.37 | 0.69 | 0.90 | 0.79 | 0.73 | 0.10 |
| Average | | -0.21 | 0.51 | 0.68 | 0.73 | | -0.17 | 0.36 | 0.46 | 0.63 | x | x | | -0.27 | 0.69 | 0.87 | 0.77 | x | x |
| NAIVE | 32 | -0.17 | 0.78 | 0.94 | 1.00 | 17 | -0.12 | 0.65 | 0.73 | 1.00 | x | x | 15 | -0.22 | 0.93 | 1.13 | 1.00 | x | x |
| ARMA | 32 | -1.24 | 1.35 | 1.64 | 1.75 | 17 | -0.77 | 0.98 | 1.15 | 1.58 | 0.69 | 0.04 | 15 | -1.77 | 1.77 | 2.06 | 1.82 | 0.40 | 1.00 |

Source: Authors' calculations based on first data release.

Note: n: Number of forecasts since fall 1998

Bias: Mean deviation of forecasts from outcomes

MAE: Mean absolute error

RMSE: Root mean squared error

t / t+1: Forecast horizon (t: current year, t+1: next year)

TU: Theil's U

Sign r: Share of correctly predicted sign changes (sign test)

Sign p: Error probability of the sign test (H0: signs of change in forecast and outcome are independent from each other)

See table A-1 for the demand component results.

inflation rate, the unemployment rate and the budget deficit, then the individual demand components.

Table 3 shows the results of the test statistics for the forecasts of the various institutions for the current year (t), the next year ($t+1$) and for both horizons (aggregate). n denotes the number of forecasts.

The predictive accuracy of the *GDP forecasts* averaged out over the forecast horizons (RMSE and MAE) differs only marginally from institution to institution. The current-year *inflation forecasts* post decidedly smaller errors than the GDP forecasts, which may be due to several factors. For one thing, more data points are available for current-year inflation forecasting than for predicting GDP. For another, unlike the SNA data, the inflation data do not undergo noteworthy data revisions. The errors of the next-year inflation forecasts, too, are distinctly smaller than those of the GDP forecasts for the year ahead. On average, inflation was slightly underpredicted, apparently because of the stronger-than-expected rise in the oil price in the review period. Here, the OeNB has the smallest mean forecast error of all institutions. The forecast errors identified for the *unemployment rate* forecasts are markedly larger than those for the inflation forecasts, but they are still pronouncedly smaller than the errors calculated for GDP and the *budget deficit*.

The forecasts of the individual variables have a *bias* that points in the same direction for each institution.

GDP growth was, on average, overpredicted, while all other variables were underpredicted. The forecasts did better than a simple naive forecast with just a few exceptions, namely the IMF forecast of next-year GDP and the next-year unemployment forecasts of the three international institutions.

The results of the *sign test* evidence a consistently high share of correct sign changes (acceleration/slowdown of growth, increase/decrease of the budget balance or the unemployment rate). Ranking the institutions according to this criterion places some institutions in completely different positions than when they are listed according to the MAE or RMSE, with the change particularly prominent for the GDP forecasts.

When we test the *differences in the predictive accuracy among the institutions for significance*¹⁰ (table 4), we find that only a few of the differences are significant. A striking feature is that the international institutions do not outperform the national forecasters for any of the four variables, not even once. The significant differences in predictive accuracy reflect the fact that the national institutions have an informational advantage.

WIFO's *GDP forecast* for the current year exhibits a significantly smaller forecast error over the examined horizon than the comparable OeNB forecast. This may be due to the fact that WIFO disposes of one additional observation of the quarterly SNA when drawing up its forecasts.¹¹ Furthermore, as the producer

¹⁰ We cannot test the differences of the aggregate predictive accuracy averaged over both horizons for significance, because the tests are defined for a single horizon only.

¹¹ A comparison of the WIFO and IHS April and September forecasts with the spring and fall forecasts of the other institutions attests to the effects of the informational advantage of the two former forecasting institutions. Yet, at 0.86 and 0.89, respectively, both WIFO and the IHS have a markedly larger RMSE (spring and fall forecasts: 0.79 and 0.78, respectively). WIFO's and the IHS's forecasting performance worsens notably, above all for the current year (0.42 and 0.50 versus 0.27 and 0.35).

Table 4

Significance of Differences in Predictive Accuracy

| | GDP | | | | | | | | | Inflation | | | | | | | | | | | | | | | |
|-----------------|------|------|-----|-----------------|-----|------|-------|------|------|-----------|-----|-----------------|-----|------|-------|------|------|------|-----|-----------------|-----|------|-------|------|--|
| | t | | | t+1 | | | | | | t | | | t+1 | | | | | | | | | | | | |
| | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | |
| OeNB | | | | | | | | | | | | | | | | | | | | | | | | | |
| WIFO | x | | | | | | | | | | | | | | | | | | | | | | | | |
| IHS | | | | | | | | | | | | | | | | | | | | | | | | | |
| EC ¹ | | | | | | | | | | | | | | | | | | | | | | | | | |
| IMF | | | | | | | | | | | | | | | | | | | | | | | | | |
| OECD | | | | | | | | | | | | | | | | | | | | | | | | | |
| NAIVE | | | | | | | | | | | | | | | | | | | | | | | | | |
| ARMA | | | | | | | | | | | | | | | | | | | | | | | | | |

| | Unemployment rate | | | | | | | | | Budget balance | | | | | | | | | | | | | | | |
|-----------------|-------------------|------|-----|-----------------|-----|------|-------|------|------|----------------|-----|-----------------|-----|------|-------|------|------|------|-----|-----------------|-----|------|-------|------|--|
| | t | | | t+1 | | | | | | t | | | t+1 | | | | | | | | | | | | |
| | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | |
| OeNB | | | | | | | | | | | | | | | | | | | | | | | | | |
| WIFO | | | | | | | | | | | | | | | | | | | | | | | | | |
| IHS | | | | | | | | | | | | | | | | | | | | | | | | | |
| EC ¹ | | | | | | | | | | | | | | | | | | | | | | | | | |
| IMF | | | | | | | | | | | | | | | | | | | | | | | | | |
| OECD | | | | | | | | | | | | | | | | | | | | | | | | | |
| NAIVE | | | | | | | | | | | | | | | | | | | | | | | | | |
| ARMA | | | | | | | | | | | | | | | | | | | | | | | | | |

| | Private consumption | | | | | | | | | Investment | | | | | | | | | | | | | | | |
|-----------------|---------------------|------|-----|-----------------|-----|------|-------|------|------|------------|-----|-----------------|-----|------|-------|------|------|------|-----|-----------------|-----|------|-------|------|--|
| | t | | | t+1 | | | | | | t | | | t+1 | | | | | | | | | | | | |
| | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | |
| OeNB | | | | | | | | | | | | | | | | | | | | | | | | | |
| WIFO | x | | | | | | | | | | | | | | | | | | | | | | | | |
| IHS | | | | | | | | | | | | | | | | | | | | | | | | | |
| EC ¹ | | | | | | | | | | | | | | | | | | | | | | | | | |
| IMF | | | | | | | | | | | | | | | | | | | | | | | | | |
| OECD | | | | | | | | | | | | | | | | | | | | | | | | | |
| NAIVE | | | | | | | | | | | | | | | | | | | | | | | | | |
| ARMA | | | | | | | | | | | | | | | | | | | | | | | | | |

| | Exports | | | | | | | | | Imports | | | | | | | | | | | | | | | |
|-----------------|---------|------|-----|-----------------|-----|------|-------|------|------|---------|-----|-----------------|-----|------|-------|------|------|------|-----|-----------------|-----|------|-------|------|--|
| | t | | | t+1 | | | | | | t | | | t+1 | | | | | | | | | | | | |
| | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | OeNB | WIFO | IHS | EC ¹ | IMF | OECD | NAIVE | ARMA | |
| OeNB | | | | | | | | | | | | | | | | | | | | | | | | | |
| WIFO | x | | | | | | | | | | | | | | | | | | | | | | | | |
| IHS | | | | | | | | | | | | | | | | | | | | | | | | | |
| EC ¹ | | | | | | | | | | | | | | | | | | | | | | | | | |
| IMF | | | | | | | | | | | | | | | | | | | | | | | | | |
| OECD | | | | | | | | | | | | | | | | | | | | | | | | | |
| NAIVE | | | | | | | | | | | | | | | | | | | | | | | | | |
| ARMA | | | | | | | | | | | | | | | | | | | | | | | | | |

Source: Authors' calculations.

¹ European Commission.

Note: An "x" indicates that the forecast given in the row is significantly better than the forecast given in the column. This is the case when, in comparing the RMSE or the MAE, we can reject the null hypothesis of equal predictive accuracy in the Diebold-Mariano test at the 5% significance level. For detailed results, see the annex. Since the IMF does not publish forecasts for the demand components, the respective fields are shaded.

Example: The "x" in the row "OeNB" and the column "WIFO" for GDP growth at the t+1 horizon indicates that the OeNB's forecast error for the next year is significantly lower than WIFO's error. It is evident from table A-2 that this result stems from rejecting the null hypothesis of a same-size RMSE in the Diebold-Mariano test at the 5% level.

of the quarterly SNA data, WIFO has the advantage of being familiar with the details of the data at the recent end of the time series. Of all institutions, the OeNB has the smallest forecast error for the next year. In this category, the difference to all institutions – except the IHS – is significant. The predictive quality of the IHS next-year forecasts for the examined horizon was significantly better than that of the WIFO forecasts (according to the Diebold-Mariano test for the RMSE). The forecast errors identified for the European Commission and the OECD are significantly smaller only relative to the IMF. The IMF's forecast error is significantly greater than the errors of all the other institutions, which is probably due to the early date of publication and long production process.

In contrast to the GDP forecasts, the *inflation forecasts* are characterized by noticeably fewer significant differences among the Austrian institutions. With only one exception, the inflation forecasts drawn up by the national institutions for time t are significantly better than those of their international counterparts. No significant differences are in evidence for the time $t+1$. Given that inflation rates are strongly influenced by international developments, the national institutions do not have an informational advantage, which might account for the lack of significant differences.

The predictive quality of the *unemployment rate* forecasts is very similar for all institutions. For time t – with the exception of the European Commission's forecasts, which are significantly worse than the forecasts of all the other institutions – we do not find a difference in predictive accuracy. For time $t+1$, WIFO has a sig-

nificantly smaller forecast error than the OeNB and the IHS. The error of the IMF is, however, significantly larger than that of the national institutions.

The WIFO and IHS current-year *budget balance* forecasts show a significantly lower forecast error than the forecasts of the OeNB and the European Commission. We did not identify significant differences for the forecasts for the next year ($t+1$).

We describe the comparison of the predictive accuracy of the demand components only briefly. As already mentioned, WIFO's current-year GDP forecasts have been significantly better than those of the OeNB since the fall of 1998, but the next-year forecasts of the OeNB have been significantly better than those of WIFO. The demand components mirror this result. The current-year forecasts of private consumption and investment by WIFO are significantly better than those of the OeNB and the IHS. The OeNB's more accurate GDP forecast for the year ahead is traceable above all to a significantly better estimate of private consumption. Since the IMF does not predict demand components, we can only compare the predictive quality of the national institutions with the OECD and the European Commission. Here we have a repeat of the result for the previously examined variables: there is no incident in which the predictive accuracy of the international institutions was significantly better than that of the national forecasters.

5 Summary

This study for the first time presents a comparison of the macroeconomic forecasts the OeNB started to draw up in fall 1998 with the forecasts released by WIFO, the IHS, the OECD,

the IMF and the European Commission.

An analysis of the *GDP forecasts over time* confirms for all institutions that in booming years forecasters exercise too much caution and are too optimistic in times of economic downturns. Hence, the forecasts smooth out the peaks and troughs evident in the actual GDP series. The mean forecast error for the *demand components*, the *unemployment rate* and the *budget balance* show considerable differences: private consumption was, on average, slightly overpredicted and had the smallest forecast error among the demand components. Slightly underestimated, government consumption likewise exhibits a small forecast error. The rise in unemployment that started in 2002 was underpredicted in the next-year forecasts. As expected, we identified large forecast errors for the cyclical components investment, exports and imports. Here, above all investment was markedly overestimated.

A comparison of the *relative predictive accuracy* of the various institutions shows that the mean predictive accuracy of GDP forecasts averaged over the forecast horizons (current and next year) differs only slightly across the institutions. WIFO posts the smallest forecast error in the GDP forecasts for the current year, the OeNB for the year ahead. In contrast to the GDP forecasts, the *inflation forecasts* for the current year exhibit distinctly smaller errors. Here, the OeNB records the smallest mean forecast error of all institutions. The forecasting performance of the Austrian institutions is not surpassed significantly by any of the international forecasters with regard to *all variables*.

A final word of caution: when interpreting our findings, bear in mind that the observation period (1998 to 2006) is short and comprises just one, albeit a very pronounced, business cycle. Forecasting performance comparisons ideally rely on data covering several business cycles.

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Annex

Table A-1

Comparison of the Mean Forecast Errors for the Demand Components of the Spring and Fall Forecasts for Austria from Fall 1998 to Fall 2006 (Comparison with First Data Release)

Private consumption

| | Total | | | | | t | | | | | t+1 | | | | | | | | |
|---------------------|-------|-------|------|------|------|----|-------|------|------|------|--------|--------|----|------|------|------|------|--------|--------|
| | n | Bias | MAE | RMSE | TU | n | Bias | MAE | RMSE | TU | Sign r | Sign p | n | Bias | MAE | RMSE | TU | Sign r | Sign p |
| OeNB | 32 | 0.17 | 0.33 | 0.42 | 0.51 | 17 | 0.03 | 0.24 | 0.28 | 0.43 | 0.88 | 0.00 | 15 | 0.33 | 0.43 | 0.54 | 0.54 | 0.73 | 0.06 |
| WIFO | 32 | 0.25 | 0.33 | 0.50 | 0.60 | 17 | 0.08 | 0.14 | 0.22 | 0.35 | 0.88 | 0.00 | 15 | 0.45 | 0.54 | 0.69 | 0.69 | 0.73 | 0.06 |
| IHS | 32 | 0.33 | 0.42 | 0.55 | 0.66 | 17 | 0.13 | 0.24 | 0.29 | 0.44 | 0.82 | 0.01 | 15 | 0.55 | 0.63 | 0.74 | 0.74 | 0.73 | 0.06 |
| European Commission | 32 | 0.25 | 0.42 | 0.54 | 0.66 | 17 | 0.08 | 0.27 | 0.33 | 0.52 | 0.82 | 0.01 | 15 | 0.43 | 0.58 | 0.71 | 0.72 | 0.73 | 0.06 |
| IMF | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| OECD | 32 | 0.27 | 0.44 | 0.60 | 0.72 | 17 | 0.05 | 0.23 | 0.31 | 0.48 | 0.88 | 0.00 | 15 | 0.51 | 0.69 | 0.81 | 0.82 | 0.67 | 0.20 |
| Average | | 0.20 | 0.39 | 0.52 | 0.53 | | 0.07 | 0.22 | 0.29 | 0.37 | x | x | | 0.45 | 0.57 | 0.70 | 0.59 | x | x |
| NAIVE | 32 | -0.03 | 0.63 | 0.83 | 1.00 | 17 | -0.07 | 0.52 | 0.65 | 1.00 | x | x | 15 | 0.01 | 0.77 | 0.99 | 1.00 | x | x |
| ARMA | 32 | 0.42 | 0.72 | 0.93 | 1.12 | 17 | 0.20 | 0.60 | 0.69 | 1.06 | 0.50 | 1.00 | 15 | 0.66 | 0.86 | 1.15 | 1.16 | 0.27 | 1.00 |

Government consumption

| | Total | | | | | t | | | | | t+1 | | | | | | | | |
|---------------------|-------|-------|------|------|------|----|-------|------|------|------|--------|--------|----|-------|------|------|------|--------|--------|
| | n | Bias | MAE | RMSE | TU | n | Bias | MAE | RMSE | TU | Sign r | Sign p | n | Bias | MAE | RMSE | TU | Sign r | Sign p |
| OeNB | 32 | -0.38 | 0.80 | 1.01 | 1.00 | 17 | -0.36 | 0.88 | 1.11 | 0.94 | 0.59 | 0.40 | 15 | -0.41 | 0.71 | 0.87 | 1.16 | 0.20 | 1.00 |
| WIFO | 12 | -0.58 | 0.77 | 0.87 | 0.87 | 6 | -0.28 | 0.62 | 0.72 | 0.61 | 0.17 | 1.00 | 6 | -0.88 | 0.92 | 1.00 | 1.33 | 0.50 | 1.00 |
| IHS | 12 | -0.35 | 0.85 | 1.00 | 1.00 | 6 | -0.10 | 0.60 | 0.77 | 0.65 | 0.67 | 0.22 | 6 | -0.60 | 1.10 | 1.19 | 1.58 | 0.75 | 0.25 |
| European Commission | 12 | -0.48 | 0.69 | 0.74 | 0.74 | 6 | -0.30 | 0.70 | 0.75 | 0.63 | 0.00 | 1.00 | 6 | -0.65 | 0.68 | 0.74 | 0.97 | 0.75 | 0.25 |
| IMF | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| OECD | 12 | -0.38 | 0.53 | 0.66 | 0.65 | 6 | -0.32 | 0.45 | 0.55 | 0.46 | 0.33 | 1.00 | 6 | -0.45 | 0.62 | 0.75 | 0.99 | 0.50 | 1.00 |
| Average | | -0.36 | 0.73 | 0.86 | 0.71 | | -0.27 | 0.65 | 0.78 | 0.55 | x | x | | -0.60 | 0.81 | 0.91 | 1.01 | x | x |
| NAIVE | 32 | 0.01 | 0.80 | 1.00 | 1.00 | 17 | 0.02 | 0.92 | 1.18 | 1.00 | x | x | 15 | -0.01 | 0.66 | 0.75 | 1.00 | x | x |
| ARMA | 32 | 0.28 | 1.08 | 1.41 | 1.41 | 17 | 0.10 | 1.09 | 1.28 | 1.08 | 0.69 | 0.13 | 15 | 0.50 | 1.08 | 1.55 | 2.07 | 0.67 | 0.18 |

Investment

| | Total | | | | | t | | | | | t+1 | | | | | | | | |
|---------------------|-------|------|------|------|------|----|-------|------|------|------|--------|--------|----|------|------|------|------|--------|--------|
| | n | Bias | MAE | RMSE | TU | n | Bias | MAE | RMSE | TU | Sign r | Sign p | n | Bias | MAE | RMSE | TU | Sign r | Sign p |
| OeNB | 32 | 1.07 | 2.12 | 2.83 | 0.61 | 17 | 0.43 | 1.65 | 2.18 | 0.53 | 0.94 | 0.00 | 15 | 1.79 | 2.65 | 3.42 | 0.66 | 0.47 | 1.00 |
| WIFO | 32 | 0.74 | 1.77 | 2.45 | 0.53 | 17 | 0.32 | 1.24 | 1.68 | 0.41 | 0.94 | 0.00 | 15 | 1.21 | 2.37 | 3.10 | 0.60 | 0.60 | 0.26 |
| IHS | 32 | 0.87 | 1.93 | 2.69 | 0.58 | 17 | 0.31 | 1.57 | 2.07 | 0.51 | 0.94 | 0.00 | 15 | 1.50 | 2.33 | 3.25 | 0.63 | 0.47 | 1.00 |
| European Commission | 32 | 1.05 | 2.21 | 2.93 | 0.63 | 17 | 0.60 | 1.94 | 2.33 | 0.57 | 0.94 | 0.00 | 15 | 1.55 | 2.51 | 3.48 | 0.67 | 0.67 | 0.06 |
| IMF | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| OECD | 32 | 1.06 | 2.07 | 2.78 | 0.60 | 17 | 0.42 | 1.62 | 2.10 | 0.51 | 0.94 | 0.00 | 15 | 1.79 | 2.57 | 3.39 | 0.65 | 0.53 | 0.21 |
| Average | | 0.82 | 2.02 | 2.74 | 0.49 | | 0.42 | 1.60 | 2.07 | 0.42 | x | x | | 1.57 | 2.49 | 3.33 | 0.53 | x | x |
| NAIVE | 32 | 0.13 | 3.75 | 4.63 | 1.00 | 17 | -0.05 | 3.16 | 4.08 | 1.00 | x | x | 15 | 0.33 | 4.41 | 5.19 | 1.00 | x | x |
| ARMA | 32 | 0.38 | 2.27 | 2.91 | 0.63 | 17 | 0.08 | 1.98 | 2.45 | 0.60 | 0.56 | 0.61 | 15 | 0.71 | 2.61 | 3.36 | 0.65 | 0.53 | 0.78 |

Note: IHS: Gross capital formation, other institutions: gross fixed capital formation.

Exports

| | Total | | | | | t | | | | | t+1 | | | | | | | | |
|---------------------|-------|-------|------|------|------|----|-------|------|------|------|--------|--------|----|-------|------|------|------|--------|--------|
| | n | Bias | MAE | RMSE | TU | n | Bias | MAE | RMSE | TU | Sign r | Sign p | n | Bias | MAE | RMSE | TU | Sign r | Sign p |
| OeNB | 32 | -0.45 | 2.13 | 2.61 | 0.59 | 17 | -1.01 | 1.59 | 2.02 | 0.44 | 1.00 | 0.00 | 15 | 0.18 | 2.75 | 3.15 | 0.77 | 0.80 | 0.01 |
| WIFO | 32 | -0.68 | 2.10 | 2.72 | 0.62 | 17 | -0.96 | 1.25 | 1.62 | 0.35 | 1.00 | 0.00 | 15 | -0.37 | 3.05 | 3.58 | 0.87 | 0.73 | 0.03 |
| IHS | 32 | -0.77 | 2.09 | 2.66 | 0.61 | 17 | -1.04 | 1.24 | 1.56 | 0.34 | 1.00 | 0.00 | 15 | -0.46 | 3.06 | 3.51 | 0.86 | 0.67 | 0.06 |
| European Commission | 32 | 0.13 | 2.35 | 2.83 | 0.65 | 17 | -0.51 | 1.68 | 2.25 | 0.49 | 0.94 | 0.00 | 15 | 0.85 | 3.11 | 3.37 | 0.82 | 0.73 | 0.03 |
| IMF | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| OECD | 32 | -0.06 | 2.29 | 2.86 | 0.65 | 17 | -0.75 | 1.45 | 1.79 | 0.39 | 0.94 | 0.00 | 15 | 0.72 | 3.25 | 3.72 | 0.91 | 0.73 | 0.03 |
| Average | | -0.30 | 2.19 | 2.74 | 0.52 | | -0.85 | 1.44 | 1.85 | 0.33 | x | x | | 0.18 | 3.04 | 3.47 | 0.70 | x | x |
| NAIVE | 32 | 0.04 | 3.80 | 4.39 | 1.00 | 17 | -0.12 | 4.24 | 4.63 | 1.00 | x | x | 15 | 0.22 | 3.31 | 4.11 | 1.00 | x | x |
| ARMA | 32 | -1.15 | 2.08 | 2.48 | 0.56 | 17 | -1.69 | 2.05 | 2.46 | 0.53 | 0.63 | 0.30 | 15 | -0.54 | 2.12 | 2.50 | 0.61 | 0.47 | 1.00 |

Imports

| | Total | | | | | t | | | | | t+1 | | | | | | | | |
|---------------------|-------|-------|------|------|------|----|-------|------|------|------|--------|--------|----|------|------|------|------|--------|--------|
| | n | Bias | MAE | RMSE | TU | n | Bias | MAE | RMSE | TU | Sign r | Sign p | n | Bias | MAE | RMSE | TU | Sign r | Sign p |
| OeNB | 32 | 0.53 | 2.06 | 2.52 | 0.58 | 17 | -0.27 | 1.65 | 1.98 | 0.46 | 1.00 | 0.00 | 15 | 1.43 | 2.52 | 3.01 | 0.70 | 0.87 | 0.00 |
| WIFO | 32 | 0.23 | 2.01 | 2.40 | 0.56 | 17 | -0.29 | 1.26 | 1.59 | 0.37 | 1.00 | 0.00 | 15 | 0.81 | 2.87 | 3.07 | 0.71 | 0.80 | 0.01 |
| IHS | 32 | -0.13 | 1.99 | 2.40 | 0.56 | 17 | -0.51 | 1.26 | 1.49 | 0.34 | 1.00 | 0.00 | 15 | 0.30 | 2.82 | 3.13 | 0.73 | 0.80 | 0.01 |
| European Commission | 32 | 0.93 | 2.32 | 2.76 | 0.64 | 17 | 0.11 | 1.69 | 2.04 | 0.47 | 1.00 | 0.00 | 15 | 1.87 | 3.02 | 3.40 | 0.79 | 0.80 | 0.01 |
| IMF | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| OECD | 32 | 0.83 | 2.45 | 3.00 | 0.69 | 17 | -0.07 | 1.65 | 2.04 | 0.47 | 0.94 | 0.00 | 15 | 1.85 | 3.36 | 3.81 | 0.88 | 0.67 | 0.10 |
| Average | | 0.43 | 2.17 | 2.62 | 0.51 | | -0.21 | 1.50 | 1.83 | 0.35 | x | x | | 1.25 | 2.92 | 3.28 | 0.63 | x | x |
| NAIVE | 32 | 0.19 | 3.54 | 4.32 | 1.00 | 17 | -0.02 | 4.11 | 4.32 | 1.00 | x | x | 15 | 0.43 | 2.89 | 4.31 | 1.00 | x | x |
| ARMA | 32 | -0.46 | 2.06 | 2.55 | 0.59 | 17 | -1.00 | 2.09 | 2.42 | 0.56 | 0.69 | 0.13 | 15 | 0.16 | 2.03 | 2.69 | 0.62 | 0.33 | 1.00 |

Source: Authors' calculations based on the first data release.

Note: n: Number of forecasts since fall 1998

Bias: Mean deviation of forecasts from outcomes

MAE: Mean absolute error

RMSE: Root mean squared error

t / t+1: Forecast horizon (t: current year, t+1: next year)

TU: Theil's U

Sign r: Share of correct sign changes (sign test)

Sign p: Error probability of the sign test (H0: signs of change in forecast and outcome are independent from each other)

See table 3 for the results on GDP, inflation, the unemployment rate and the budget balance.

**Significance of the Differences in Predictive Accuracy of the Spring and Fall Forecasts for Austria
from Fall 1998 to Fall 2006 (Comparison with First Data Release)**

| GDP | | | | OeNB | WIFO | IHS | European Commission | IMF | OECD | NAIVE | ARMA |
|---------------------|-----|------|--------|----------|----------------|--------------|---------------------|----------|----------|----------|----------|
| OeNB | t | RMSE | [0.42] | | | | 0.31 | 0.03 ** | 0.47 | 0.00 *** | 0.00 *** |
| OeNB | t | MAE | [0.29] | | | | | 0.05 * | | 0.00 *** | 0.00 *** |
| OeNB | t+1 | RMSE | [1.02] | | 0.01 ** | 0.11 | 0.02 ** | 0.02 ** | 0.04 ** | 0.26 | 0.35 |
| OeNB | t+1 | MAE | [0.85] | | 0.06 * | 0.25 | 0.19 | 0.03 ** | 0.17 | 0.29 | |
| WIFO | t | RMSE | [0.27] | 0.06 * | | 0.09 * | 0.11 | 0.01 *** | 0.07 * | 0.00 *** | 0.00 *** |
| WIFO | t | MAE | [0.18] | 0.01 *** | | 0.12 | 0.04 ** | 0.00 *** | 0.02 ** | 0.00 *** | 0.00 *** |
| WIFO | t+1 | RMSE | [1.11] | | | | 0.44 | 0.03 ** | 0.29 | 0.40 | |
| WIFO | t+1 | MAE | [0.93] | | | | | 0.04 ** | 0.41 | | |
| IHS | t | RMSE | [0.35] | 0.09 * | | | 0.14 | 0.00 *** | 0.10 | 0.00 *** | 0.00 *** |
| IHS | t | MAE | [0.22] | 0.07 * | | | 0.09 * | 0.01 *** | 0.11 | 0.00 *** | 0.00 *** |
| IHS | t+1 | RMSE | [1.08] | | 0.03 ** | | 0.26 | 0.02 ** | 0.11 | 0.35 | |
| IHS | t+1 | MAE | [0.90] | | 0.35 | | 0.43 | 0.01 *** | 0.29 | 0.38 | |
| European Commission | t | RMSE | [0.45] | | | | | 0.15 | | 0.01 *** | 0.01 *** |
| European Commission | t | MAE | [0.29] | 0.46 | | | | 0.04 ** | | 0.00 *** | 0.00 *** |
| European Commission | t+1 | RMSE | [1.12] | | | | | 0.06 * | 0.35 | 0.43 | |
| European Commission | t+1 | MAE | [0.91] | | 0.44 | | | 0.04 ** | 0.40 | 0.40 | |
| IMF | t | RMSE | [0.52] | | | | | | | 0.01 *** | 0.02 ** |
| IMF | t | MAE | [0.40] | | | | | | | 0.01 *** | 0.03 ** |
| IMF | t+1 | RMSE | [1.31] | | | | | | | | |
| IMF | t+1 | MAE | [1.13] | | | | | | | | |
| OECD | t | RMSE | [0.42] | | | | 0.28 | 0.03 ** | | 0.00 *** | 0.00 *** |
| OECD | t | MAE | [0.28] | 0.38 | | | 0.43 | 0.02 ** | | 0.00 *** | 0.00 *** |
| OECD | t+1 | RMSE | [1.14] | | | | | 0.01 ** | | 0.46 | |
| OECD | t+1 | MAE | [0.93] | | 0.50 | | | 0.00 *** | | 0.42 | |
| NAIVE | t | RMSE | [1.13] | | | | | | | | |
| NAIVE | t | MAE | [0.91] | | | | | | | | |
| NAIVE | t+1 | RMSE | [1.17] | | | | | 0.33 | | | |
| NAIVE | t+1 | MAE | [0.98] | | | | | 0.32 | | | |
| ARMA | t | RMSE | [0.66] | | | | | | | 0.01 ** | |
| ARMA | t | MAE | [0.57] | | | | | | | 0.04 ** | |
| ARMA | t+1 | RMSE | [1.05] | | | | 0.02 ** | 0.04 ** | 0.10 | 0.32 | |
| ARMA | t+1 | MAE | [0.81] | 0.29 | 0.23 0.08 * | 0.38 0.17 | 0.04 ** | 0.01 *** | 0.04 ** | 0.26 | |
| Inflation | | | | OeNB | WIFO | IHS | European Commission | IMF | OECD | NAIVE | ARMA |
| OeNB | t | RMSE | [0.14] | | 0.09 * | 0.32 | 0.00 *** | 0.00 *** | 0.04 ** | 0.01 *** | 0.10 |
| OeNB | t | MAE | [0.10] | | 0.14 | | 0.00 *** | 0.00 *** | 0.01 *** | 0.00 *** | 0.07 * |
| OeNB | t+1 | RMSE | [0.54] | | | 0.17 | 0.18 | | 0.35 | 0.02 ** | 0.13 |
| OeNB | t+1 | MAE | [0.46] | | | 0.32 | 0.38 | | 0.44 | 0.01 ** | 0.09 * |
| WIFO | t | RMSE | [0.21] | | | | 0.07 * | 0.00 *** | 0.04 ** | 0.02 ** | 0.45 |
| WIFO | t | MAE | [0.14] | | | | 0.08 * | 0.00 *** | 0.02 ** | 0.00 *** | 0.41 |
| WIFO | t+1 | RMSE | [0.53] | 0.43 | | 0.07 * | 0.18 | | 0.30 | 0.00 *** | 0.13 |
| WIFO | t+1 | MAE | [0.45] | 0.38 | | 0.17 | 0.28 | | 0.37 | 0.00 *** | 0.11 |
| IHS | t | RMSE | [0.16] | | 0.21 | | 0.00 *** | 0.00 *** | 0.04 ** | 0.01 ** | 0.19 |
| IHS | t | MAE | [0.09] | 0.35 | 0.15 | | 0.00 *** | 0.00 *** | 0.01 *** | 0.00 *** | 0.06 * |
| IHS | t+1 | RMSE | [0.59] | | | | | | 0.01 *** | 0.01 ** | 0.28 |
| IHS | t+1 | MAE | [0.49] | | | | | | 0.01 ** | 0.01 ** | 0.22 |
| European Commission | t | RMSE | [0.34] | | | | | 0.06 * | 0.13 | 0.03 ** | |
| European Commission | t | MAE | [0.25] | | | | | 0.02 ** | 0.18 | 0.01 *** | |
| European Commission | t+1 | RMSE | [0.59] | | | 0.47 | | | | 0.03 ** | 0.28 |
| European Commission | t+1 | MAE | [0.48] | | | 0.38 | | | | 0.02 ** | 0.19 |
| IMF | t | RMSE | [0.47] | | | | | | 0.37 | 0.11 | |
| IMF | t | MAE | [0.42] | | | | | | | 0.15 | |
| IMF | t+1 | RMSE | [0.46] | 0.26 | 0.28 | 0.19 | 0.20 | | 0.09 * | 0.01 *** | 0.01 *** |
| IMF | t+1 | MAE | [0.41] | 0.35 | 0.40 | 0.30 | 0.32 | | 0.28 | 0.00 *** | 0.01 ** |
| OECD | t | RMSE | [0.51] | | | | | 0.20 | | 0.23 | |
| OECD | t | MAE | [0.33] | | | | | | | 0.08 * | |
| OECD | t+1 | RMSE | [0.58] | | | 0.47 | 0.47 | | | 0.01 *** | 0.25 |
| OECD | t+1 | MAE | [0.48] | | | 0.43 | 0.48 | | | 0.00 *** | 0.18 |
| NAIVE | t | RMSE | [0.64] | | | | | | | | |
| NAIVE | t | MAE | [0.53] | | | | | | | | |
| NAIVE | t+1 | RMSE | [0.93] | | | | | | | | |
| NAIVE | t+1 | MAE | [0.78] | | | | | | | | |
| ARMA | t | RMSE | [0.22] | | | | 0.05 ** | 0.00 *** | 0.06 * | 0.02 ** | |
| ARMA | t | MAE | [0.16] | | | | 0.06 * | 0.00 *** | 0.05 * | 0.00 *** | |
| ARMA | t+1 | RMSE | [0.68] | | | | | | | 0.08 * | |
| ARMA | t+1 | MAE | [0.62] | | | | | | | 0.12 | |

Table A-2

**Significance of the Differences in Predictive Accuracy of the Spring and Fall Forecasts for Austria
from Fall 1998 to Fall 2006 (Comparison with First Data Release) – continued**

| Unemployment rate | | | | OeNB | WIFO | IHS | European Commission | IMF | OECD | NAIVE | ARMA |
|---------------------|-----|------|--------|----------|--------|----------|---------------------|----------|--------|----------|----------|
| OeNB | t | RMSE | [0.33] | | | 0.50 | 0.12 | | 0.31 | 0.12 | |
| OeNB | t | MAE | [0.24] | | | | 0.01 *** | | 0.25 | 0.16 | |
| OeNB | t+1 | RMSE | [0.51] | | | | 0.19 | 0.03 ** | 0.12 | 0.05 ** | 0.30 |
| OeNB | t+1 | MAE | [0.45] | | | | 0.49 | 0.05 ** | 0.22 | 0.14 | 0.36 |
| WIFO | t | RMSE | [0.33] | 0.47 | | 0.46 | 0.12 | | 0.24 | 0.11 | |
| WIFO | t | MAE | [0.23] | 0.48 | | | 0.01 *** | | 0.22 | 0.17 | |
| WIFO | t+1 | RMSE | [0.47] | 0.01 *** | | 0.00 *** | 0.09 * | 0.00 *** | 0.08 * | 0.01 *** | 0.12 |
| WIFO | t+1 | MAE | [0.39] | 0.01 *** | | 0.00 *** | 0.20 | 0.01 *** | 0.09 * | 0.02 ** | 0.15 |
| IHS | t | RMSE | [0.33] | | | | 0.13 | | 0.30 | 0.12 | |
| IHS | t | MAE | [0.23] | | 0.48 | | 0.01 *** | | 0.21 | 0.17 | |
| IHS | t+1 | RMSE | [0.50] | | | | 0.16 | 0.04 ** | 0.11 | 0.03 ** | 0.27 |
| IHS | t+1 | MAE | [0.45] | | | | 0.47 | 0.10 * | 0.21 | 0.09 * | 0.35 |
| European Commission | t | RMSE | [0.41] | | | | | | | 0.32 | |
| European Commission | t | MAE | [0.34] | | | | | | | 0.49 | |
| European Commission | t+1 | RMSE | [0.61] | | | | | 0.43 | 0.38 | | |
| European Commission | t+1 | MAE | [0.46] | | | | | 0.17 | 0.32 | 0.29 | 0.42 |
| IMF | t | RMSE | [0.31] | 0.18 | 0.22 | 0.19 | 0.05 * | | 0.14 | 0.09 * | |
| IMF | t | MAE | [0.23] | 0.37 | 0.39 | 0.38 | 0.00 *** | | 0.10 | 0.14 | |
| IMF | t+1 | RMSE | [0.62] | | | | | | 0.37 | | |
| IMF | t+1 | MAE | [0.54] | | | | | | 0.49 | | |
| OECD | t | RMSE | [0.35] | | | | 0.23 | | | 0.16 | |
| OECD | t | MAE | [0.27] | | | | 0.08 * | | | 0.25 | |
| OECD | t+1 | RMSE | [0.67] | | | | | | | | |
| OECD | t+1 | MAE | [0.54] | | | | | | | | |
| NAIVE | t | RMSE | [0.46] | | | | | | | | |
| NAIVE | t | MAE | [0.35] | | | | | | | | |
| NAIVE | t+1 | RMSE | [0.59] | | | | 0.45 | 0.36 | 0.28 | | |
| NAIVE | t+1 | MAE | [0.52] | | | | | 0.40 | 0.43 | | |
| ARMA | t | RMSE | [0.22] | 0.05 * | 0.05 * | 0.05 ** | 0.03 ** | 0.08 * | 0.05 * | 0.01 ** | |
| ARMA | t | MAE | [0.17] | 0.12 | 0.14 | 0.13 | 0.00 *** | 0.15 | 0.07 * | 0.03 ** | |
| ARMA | t+1 | RMSE | [0.54] | | | | 0.31 | 0.15 | 0.18 | 0.19 | |
| ARMA | t+1 | MAE | [0.48] | | | | | 0.24 | 0.33 | 0.29 | |
| Budget balance | | | | OeNB | WIFO | IHS | European Commission | IMF | OECD | NAIVE | ARMA |
| OeNB | t | RMSE | [0.50] | | | | | 0.45 | | 0.02 ** | 0.00 *** |
| OeNB | t | MAE | [0.39] | | | | | 0.36 | | 0.02 ** | 0.00 *** |
| OeNB | t+1 | RMSE | [0.95] | | | | 0.49 | | | 0.35 | 0.01 *** |
| OeNB | t+1 | MAE | [0.75] | | | | 0.46 | | | 0.33 | 0.00 *** |
| WIFO | t | RMSE | [0.41] | 0.01 ** | | | 0.07 * | 0.13 | 0.06 * | 0.00 *** | 0.00 *** |
| WIFO | t | MAE | [0.31] | 0.00 *** | | | 0.03 ** | 0.10 * | 0.17 | 0.00 *** | 0.00 *** |
| WIFO | t+1 | RMSE | [0.84] | 0.16 | | | 0.16 | 0.49 | 0.19 | 0.14 | 0.01 *** |
| WIFO | t+1 | MAE | [0.68] | 0.12 | | | 0.13 | | 0.18 | 0.20 | 0.00 *** |
| IHS | t | RMSE | [0.40] | 0.06 * | 0.44 | | 0.10 * | 0.08 * | 0.09 * | 0.00 *** | 0.00 *** |
| IHS | t | MAE | [0.29] | 0.01 ** | 0.34 | | 0.04 ** | 0.07 * | 0.08 * | 0.00 *** | 0.00 *** |
| IHS | t+1 | RMSE | [0.81] | 0.16 | 0.22 | | 0.11 | 0.33 | 0.16 | 0.12 | 0.01 *** |
| IHS | t+1 | MAE | [0.66] | 0.18 | 0.39 | | 0.13 | 0.46 | 0.24 | 0.18 | 0.00 *** |
| European Commission | t | RMSE | [0.49] | 0.42 | | | | 0.42 | | 0.02 ** | 0.00 *** |
| European Commission | t | MAE | [0.38] | 0.39 | | | | 0.31 | | 0.02 ** | 0.00 *** |
| European Commission | t+1 | RMSE | [0.95] | | | | | | | 0.37 | 0.01 *** |
| European Commission | t+1 | MAE | [0.76] | | | | | | | 0.34 | 0.00 *** |
| IMF | t | RMSE | [0.51] | | | | | | | 0.03 ** | 0.00 *** |
| IMF | t | MAE | [0.42] | | | | | | | 0.04 ** | 0.00 *** |
| IMF | t+1 | RMSE | [0.84] | 0.25 | | | 0.14 | | 0.27 | 0.23 | 0.01 *** |
| IMF | t+1 | MAE | [0.67] | 0.26 | 0.47 | | 0.14 | | 0.33 | 0.25 | 0.00 *** |
| OECD | t | RMSE | [0.46] | 0.18 | | | 0.26 | 0.30 | | 0.01 ** | 0.00 *** |
| OECD | t | MAE | [0.35] | 0.17 | | | 0.25 | 0.21 | | 0.01 ** | 0.00 *** |
| OECD | t+1 | RMSE | [0.93] | 0.28 | | | 0.32 | | | 0.33 | 0.01 *** |
| OECD | t+1 | MAE | [0.73] | 0.29 | | | 0.35 | | | 0.31 | 0.00 *** |
| NAIVE | t | RMSE | [0.73] | | | | | | | | 0.04 ** |
| NAIVE | t | MAE | [0.65] | | | | | | | | 0.06 * |
| NAIVE | t+1 | RMSE | [1.03] | | | | | | | | 0.03 ** |
| NAIVE | t+1 | MAE | [0.84] | | | | | | | | 0.02 ** |
| ARMA | t | RMSE | [1.15] | | | | | | | | |
| ARMA | t | MAE | [0.98] | | | | | | | | |
| ARMA | t+1 | RMSE | [2.09] | | | | | | | | |
| ARMA | t+1 | MAE | [1.79] | | | | | | | | |

**Significance of the Differences in Predictive Accuracy of the Spring and Fall Forecasts for Austria
from Fall 1998 to Fall 2006 (Comparison with First Data Release) – continued**

| Private consumption | | | | OeNB | WIFO | IHS | European Commission | IMF | OECD | NAIVE | ARMA |
|---------------------|-----|------|--------|----------|----------|----------|---------------------|-----|----------|----------|----------|
| OeNB | t | RMSE | [0.28] | | | 0.37 | 0.10 | | 0.19 | 0.02 ** | 0.00 *** |
| OeNB | t | MAE | [0.24] | | | | 0.18 | | | 0.01 *** | 0.00 *** |
| OeNB | t+1 | RMSE | [0.54] | | 0.01 *** | 0.01 *** | 0.04 ** | | 0.00 *** | 0.02 ** | 0.03 ** |
| OeNB | t+1 | MAE | [0.43] | | 0.07 * | 0.01 *** | 0.01 ** | | 0.00 *** | 0.07 * | 0.03 ** |
| WIFO | t | RMSE | [0.22] | 0.02 ** | | 0.03 ** | 0.01 *** | | 0.01 *** | 0.02 ** | 0.00 *** |
| WIFO | t | MAE | [0.14] | 0.00 *** | | 0.00 *** | 0.00 *** | | 0.00 *** | 0.00 *** | 0.00 *** |
| WIFO | t+1 | RMSE | [0.69] | | | 0.14 | 0.37 | | 0.01 ** | 0.07 * | 0.05 ** |
| WIFO | t+1 | MAE | [0.54] | | | 0.06 * | 0.18 | | 0.00 *** | 0.16 | 0.05 * |
| IHS | t | RMSE | [0.29] | | | | 0.15 | | 0.27 | 0.02 ** | 0.00 *** |
| IHS | t | MAE | [0.24] | | | | 0.22 | | | 0.01 *** | 0.00 *** |
| IHS | t+1 | RMSE | [0.74] | | | | | | 0.10 | 0.11 | 0.08 * |
| IHS | t+1 | MAE | [0.63] | | | | | | 0.16 | 0.27 | 0.15 |
| European Commission | t | RMSE | [0.33] | | | | | | | 0.03 ** | 0.00 *** |
| European Commission | t | MAE | [0.27] | | | | | | | 0.01 ** | 0.00 *** |
| European Commission | t+1 | RMSE | [0.71] | | | 0.36 | | | 0.01 ** | 0.11 | 0.04 ** |
| European Commission | t+1 | MAE | [0.58] | | | 0.23 | | | 0.00 *** | 0.22 | 0.06 * |
| IMF | t | RMSE | | | | | | | | | |
| IMF | t | MAE | | | | | | | | | |
| IMF | t+1 | RMSE | | | | | | | | | |
| IMF | t+1 | MAE | | | | | | | | | |
| OECD | t | RMSE | [0.31] | | | | 0.20 | | | 0.03 ** | 0.00 *** |
| OECD | t | MAE | [0.23] | 0.42 | | 0.44 | 0.13 | | | 0.01 ** | 0.00 *** |
| OECD | t+1 | RMSE | [0.81] | | | | | | | 0.20 | 0.07 * |
| OECD | t+1 | MAE | [0.69] | | | | | | | 0.37 | 0.18 |
| NAIVE | t | RMSE | [0.65] | | | | | | | | 0.38 |
| NAIVE | t | MAE | [0.52] | | | | | | | | 0.26 |
| NAIVE | t+1 | RMSE | [0.99] | | | | | | | | 0.31 |
| NAIVE | t+1 | MAE | [0.77] | | | | | | | | 0.38 |
| ARMA | t | RMSE | [0.69] | | | | | | | | |
| ARMA | t | MAE | [0.60] | | | | | | | | |
| ARMA | t+1 | RMSE | [1.15] | | | | | | | | |
| ARMA | t+1 | MAE | [0.86] | | | | | | | | |
| Investment | | | | OeNB | WIFO | IHS | European Commission | IMF | OECD | NAIVE | ARMA |
| OeNB | t | RMSE | [2.18] | | | | 0.20 | | | 0.04 ** | 0.22 |
| OeNB | t | MAE | [1.65] | | | | 0.13 | | | 0.03 ** | 0.15 |
| OeNB | t+1 | RMSE | [3.42] | | | | 0.34 | | | 0.04 ** | |
| OeNB | t+1 | MAE | [2.65] | | | | | | | 0.05 * | |
| WIFO | t | RMSE | [1.68] | 0.02 ** | | 0.06 * | 0.01 *** | | 0.02 ** | 0.02 ** | 0.03 ** |
| WIFO | t | MAE | [1.24] | 0.02 ** | | 0.02 ** | 0.00 *** | | 0.01 ** | 0.01 *** | 0.01 *** |
| WIFO | t+1 | RMSE | [3.10] | 0.03 ** | | 0.16 | 0.08 * | | 0.08 * | 0.02 ** | |
| WIFO | t+1 | MAE | [2.37] | 0.13 | | | 0.26 | | 0.18 | 0.03 ** | |
| IHS | t | RMSE | [2.07] | | | | 0.03 ** | | 0.44 | 0.04 ** | 0.19 |
| IHS | t | MAE | [1.57] | | | | 0.02 ** | | 0.36 | 0.02 ** | 0.11 |
| IHS | t+1 | RMSE | [3.25] | | | | 0.09 * | | 0.17 | 0.04 ** | |
| IHS | t+1 | MAE | [2.33] | | 0.42 | | 0.15 | | 0.11 | 0.04 ** | 0.00 *** |
| European Commission | t | RMSE | [2.33] | | | | | | | 0.05 ** | 0.33 |
| European Commission | t | MAE | [1.94] | | | | | | | 0.05 * | 0.37 |
| European Commission | t+1 | RMSE | [3.48] | | | | | | | 0.05 ** | |
| European Commission | t+1 | MAE | [2.51] | 0.18 | | | | | 0.29 | 0.05 * | 0.28 |
| IMF | t | RMSE | | | | | | | | | |
| IMF | t | MAE | | | | | | | | | |
| IMF | t+1 | RMSE | | | | | | | | | |
| IMF | t+1 | MAE | | | | | | | | | |
| OECD | t | RMSE | [2.10] | 0.14 | | | 0.08 * | | | 0.04 ** | 0.16 |
| OECD | t | MAE | [1.62] | 0.39 | | | 0.08 * | | | 0.03 ** | 0.11 |
| OECD | t+1 | RMSE | [3.39] | | | | 0.22 | | | 0.03 ** | |
| OECD | t+1 | MAE | [2.57] | 0.20 | | | | | | 0.04 ** | 0.37 |
| NAIVE | t | RMSE | [4.08] | | | | | | | | |
| NAIVE | t | MAE | [3.16] | | | | | | | | |
| NAIVE | t+1 | RMSE | [5.19] | | | | | | | | |
| NAIVE | t+1 | MAE | [4.41] | | | | | | | | |
| ARMA | t | RMSE | [2.54] | | | | | | | 0.07 * | |
| ARMA | t | MAE | [2.05] | | | | | | | 0.07 * | |
| ARMA | t+1 | RMSE | [3.34] | | | | 0.12 | | 0.25 | 0.05 ** | |
| ARMA | t+1 | MAE | [2.61] | 0.40 | | | | | | 0.06 * | |

**Significance of the Differences in Predictive Accuracy of the Spring and Fall Forecasts for Austria
from Fall 1998 to Fall 2006 (Comparison with First Data Release) – continued**

| Exports | | | | OeNB | WIFO | IHS | European Commission | IMF | OECD | NAIVE | ARMA |
|---------------------|-----|------|--------|---------|---------|---------|---------------------|-----|----------|----------|---------|
| OeNB | t | RMSE | [2.02] | | | | 0.28 | | | 0.00 *** | 0.17 |
| OeNB | t | MAE | [1.59] | | | | 0.41 | | | 0.00 *** | 0.14 |
| OeNB | t+1 | RMSE | [3.15] | | 0.02 ** | 0.10 | 0.27 | | 0.01 ** | 0.11 | |
| OeNB | t+1 | MAE | [2.75] | | 0.10 | 0.13 | 0.17 | | 0.04 ** | 0.25 | |
| WIFO | t | RMSE | [1.62] | 0.04 ** | | | 0.07 * | | 0.25 | 0.00 *** | 0.06 * |
| WIFO | t | MAE | [1.25] | 0.07 * | | | 0.15 | | 0.21 | 0.00 *** | 0.04 ** |
| WIFO | t+1 | RMSE | [3.58] | | | | | | 0.28 | 0.27 | |
| WIFO | t+1 | MAE | [3.05] | | | 0.48 | 0.45 | | 0.28 | 0.39 | |
| IHS | t | RMSE | [1.56] | 0.12 | 0.42 | | 0.06 * | | 0.25 | 0.00 *** | 0.04 ** |
| IHS | t | MAE | [1.24] | 0.14 | 0.48 | | 0.15 | | 0.26 | 0.00 *** | 0.04 ** |
| IHS | t+1 | RMSE | [3.51] | | 0.38 | | | | 0.29 | 0.22 | |
| IHS | t+1 | MAE | [3.06] | | | | 0.46 | | 0.32 | 0.39 | |
| European Commission | t | RMSE | [2.25] | | | | | | | 0.00 *** | 0.32 |
| European Commission | t | MAE | [1.68] | | | | | | | 0.00 *** | 0.23 |
| European Commission | t+1 | RMSE | [3.37] | | 0.30 | 0.39 | | | 0.06 * | 0.21 | |
| European Commission | t+1 | MAE | [3.11] | | | | | | 0.29 | 0.41 | |
| IMF | t | RMSE | | | | | | | | | |
| IMF | t | MAE | | | | | | | | | |
| IMF | t+1 | RMSE | | | | | | | | | |
| IMF | t+1 | MAE | | | | | | | | | |
| OECD | t | RMSE | [1.79] | 0.18 | | | 0.10 | | | 0.00 *** | 0.04 ** |
| OECD | t | MAE | [1.45] | 0.30 | | | 0.23 | | | 0.00 *** | 0.03 ** |
| OECD | t+1 | RMSE | [3.72] | | | | | | | 0.31 | |
| OECD | t+1 | MAE | [3.25] | | | | | | | 0.47 | |
| NAIVE | t | RMSE | [4.63] | | | | | | | | |
| NAIVE | t | MAE | [4.24] | | | | | | | | |
| NAIVE | t+1 | RMSE | [4.11] | | | | | | | | |
| NAIVE | t+1 | MAE | [3.31] | | | | | | | | |
| ARMA | t | RMSE | [2.51] | | | | | | | 0.00 *** | |
| ARMA | t | MAE | [2.06] | | | | | | | 0.00 *** | |
| ARMA | t+1 | RMSE | [2.43] | 0.09 * | 0.04 ** | 0.03 ** | 0.07 * | | 0.02 ** | 0.02 ** | |
| ARMA | t+1 | MAE | [2.06] | 0.11 | 0.07 * | 0.06 * | 0.03 ** | | 0.03 ** | 0.05 * | |
| Imports | | | | OeNB | WIFO | IHS | European Commission | IMF | OECD | NAIVE | ARMA |
| OeNB | t | RMSE | [1.98] | | | | 0.42 | | 0.39 | 0.00 *** | 0.18 |
| OeNB | t | MAE | [1.65] | | | | 0.45 | | | 0.00 *** | 0.17 |
| OeNB | t+1 | RMSE | [3.01] | | 0.41 | 0.39 | 0.12 | | 0.00 *** | 0.02 ** | |
| OeNB | t+1 | MAE | [2.52] | | 0.12 | 0.23 | 0.07 * | | 0.00 *** | 0.13 | |
| WIFO | t | RMSE | [1.59] | 0.05 ** | | | 0.13 | | 0.05 ** | 0.00 *** | 0.06 * |
| WIFO | t | MAE | [1.26] | 0.05 ** | | 0.49 | 0.11 | | 0.06 * | 0.00 *** | 0.04 ** |
| WIFO | t+1 | RMSE | [3.07] | | | 0.43 | 0.15 | | 0.02 ** | 0.00 *** | |
| WIFO | t+1 | MAE | [2.87] | | | | 0.35 | | 0.10 | | |
| IHS | t | RMSE | [1.49] | 0.02 ** | 0.32 | | 0.04 ** | | 0.01 ** | 0.00 *** | 0.03 ** |
| IHS | t | MAE | [1.26] | 0.04 ** | | | 0.06 * | | 0.06 * | 0.00 *** | 0.03 ** |
| IHS | t+1 | RMSE | [3.13] | | | | 0.29 | | 0.06 * | 0.00 *** | |
| IHS | t+1 | MAE | [2.82] | | 0.44 | | 0.36 | | 0.13 | | |
| European Commission | t | RMSE | [2.04] | | | | | | | 0.00 *** | 0.25 |
| European Commission | t | MAE | [1.69] | | | | | | | 0.00 *** | 0.21 |
| European Commission | t+1 | RMSE | [3.40] | | | | | | 0.10 | 0.07 * | |
| European Commission | t+1 | MAE | [3.02] | | | | | | 0.13 | | |
| IMF | t | RMSE | | | | | | | | | |
| IMF | t | MAE | | | | | | | | | |
| IMF | t+1 | RMSE | | | | | | | | | |
| IMF | t+1 | MAE | | | | | | | | | |
| OECD | t | RMSE | [2.04] | 0.49 | | | 0.49 | | | 0.00 *** | 0.23 |
| OECD | t | MAE | [1.65] | | | | 0.44 | | | 0.00 *** | 0.18 |
| OECD | t+1 | RMSE | [3.81] | | | | | | | 0.13 | |
| OECD | t+1 | MAE | [3.36] | | | | | | | | |
| NAIVE | t | RMSE | [4.32] | | | | | | | | |
| NAIVE | t | MAE | [4.11] | | | | | | | | |
| NAIVE | t+1 | RMSE | [4.31] | | | | | | | | |
| NAIVE | t+1 | MAE | [2.89] | | | | 0.36 | | 0.01 *** | | |
| ARMA | t | RMSE | [2.37] | | | | | | | 0.00 *** | |
| ARMA | t | MAE | [2.05] | | | | | | | 0.00 *** | |
| ARMA | t+1 | RMSE | [2.65] | 0.28 | 0.23 | 0.24 | 0.05 ** | | 0.05 ** | 0.03 ** | |
| ARMA | t+1 | MAE | [1.92] | 0.16 | 0.07 * | 0.10 * | 0.02 ** | | 0.03 ** | 0.07 * | |

Source: Authors' calculations.

Note: The values indicate the error probability of the Diebold-Mariano test when the null hypothesis of equal predictive accuracy is rejected.