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THE QUALITY OF A CONSENSUS FORECAST FOR ECONOMIC GROWTH IN BELGIUM, 1981-2001[1]

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ABSTRACT
This article evaluates the quality of an average or consensus forecast for economic growth in Belgium. A quarterly series of current and one-year-ahead growth forecasts is constructed as the average of forecasts published by Belgian institutions. In similar foreign studies a fixed number of forecasts is considered since a forecaster is only included if he published forecasts in every quarter of the sample; we do not take this restrictive view but calculated the average of all forecasts made available in any quarter.
The consensus growth forecasts will be evaluated graphically, statistically and econometrically.
The conclusion is that the Belgian consensus forecast is rather good, although some efficiency tests are not passed.

RESUME
Cet article évalue la qualité prédictive de la moyenne des prévisions (le 'consensus') de croissance pour l'économie belge. Des séries trimestrielles de prévisions pour l'année en cours et l'année prochaine sont construites comme la moyenne des prévisions des institutions belges. Des exercices semblables à l'étranger considèrent un nombre fixe d'institutions: une institution est incluse seulement si elle a publié des prévisions chaque trimestre de la période considérée. Nous ne suivons pas cette démarche restrictive car peut d'institutions belges pourrait être retenues. Par contre, nous calculons la moyenne de toutes les prévisions publiées par des institutions belges au cours d'un trimestre. La prévision moyenne est évaluée d'un point de vue graphique, statistique et économétrique. La conclusion indique que la qualité de la prévision moyenne est très acceptable ; certain test d'efficience sont néanmoins rejetés.

JEL CLASSIFICATION : E270, E370

KEYWORDS : prevision, conjuncture, consensus

[1] We acknowledge comments by S. Gutierrez, F. Van Leeuw and two anonymous referees. They are, of course, not responsible for remaining errors.

1. INTRODUCTION

The conviction of many users of macro-economic forecasts is that the average of the available forecasts is an unbeatable forecast. Such a consensus forecast summarizes all the available forecasts. Furthermore, users benefit from the fact that they do not need to make a choice among the available forecasts. For Belgium, no research has been done on the quality of a consensus forecast since the traditional calculation of a consensus forecast is not feasible. The reason is that this approach considers only forecasters that published forecasts in every quarter of the sample period: the number of forecasters is thus fixed. In Belgium, no institution published growth forecasts in every quarter since 1980. As an alternative consensus, we calculate the average of all forecasts published in every quarter since the beginning of 1980. This average is our 'Belgian consensus'. The term 'Belgian' not only refers to the fact that the Belgian growth is forecasted, but also to the fact that we only use forecasts published by Belgian institutions. Explicitly, we do not include in our Belgian consensus forecasts by the European Commission, international organisations or international financial institutions[1].

We start with a short explanation of the construction of the Belgian consensus forecasts. In a third paragraph, we evaluate these growth forecasts. We make use of graphical, statistical and econometric techniques. We end with concluding remarks.

2. DATA

2.1. DATA CONSTRUCTION

The Belgian consensus growth forecast[2] is the average of the forecasts published in every quarter[3] by Belgian forecasters. When computing this consensus forecast, we

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[1] We refer to Gutierrez and Vuchelen (2001) and Vuchelen and Gutierrez (2001) for a comparison of the Belgian consensus forecast with international growth forecasts for the Belgian economy.

[2] Until the beginning of the 1990's, growth referred to GDP (Gross Domestic Product) as well as to the GNP (Gross National Product). We make no distinction between these two forecasts and do not adjust the forecasts because forecasters who predicted both growth rates nearly never forecasted different rates.

[3] Three other average growth forecasts are available for the Belgian economy. First, there is the monthly publication in The Economist. This publication reports the average growth forecast of about 15 mainly foreign financial institutions. See Gutierrez and Vuchelen (2001) for a comparison of the performance of the forecasts published by The Economist and our data (for the 1990's). Second, there is the average forecast calculated by the Federal Planning Office and published in the Quarterly Newsletter. The problem here is that the publication date of the different forecasts is not considered so the average relates to quite different publication periods. Finally, there is the

tried to include as many forecasts as possible. Recall that only forecasts constructed by Belgian institutions are considered[4]. The sources are:

- Publications by the most important financial institutions: the Kredietbank-KBC, the Générale de Banque-Fortis, the Banque Bruxelles Lambert and Paribas-Artesia. These institutions publish forecasts for the Belgian economy on a very regular basis, at least three times a year but not always since 1980.
- Publications by universities: Dulbéa (Free University of Brussels (ULB)) and IRES (Catholic University of Louvain).
- In order to maximize the number of forecasts, we used some publications that used to or do publish surveys of the available forecasts. We refer to the Social-economic Newsletter of the Conseil Central de l'Economie, the Business Cycle Note published by the research department of the Ministry of Finance, Economic Forecasts and the Quarterly Newsletter of the Planning Office. These publications provided information about less regularly published forecasts or about publications that are less accessible. This way, we were able to include the forecasts by the Planning Office, the Ministry of Economic Affairs, the Crédit Communal-Dexia and Petercam.

Due to the low number of institutions that publish one-year-ahead forecasts in the first quarter, we exclude these forecasts[5].

Our sample of forecasts for the Belgian growth starts in 1980 and ends in the first quarter of 2002. In every quarter two consensus forecasts are calculated. In the first quarter, the first consensus forecast relates to the growth in the previous year (indicated with the subscript (t-1)); the second consensus forecasts concerns the current growth (indicated with the subscript (t)). In the second, third and fourth quarter, the consensus forecasts relate to current and one-year-ahead growth (indicated with the subscript (t+1)). Therefore, growth in any year is forecasted in eight consecutive quarters, being the three last quarters of the previous year, the four quarters of the current year and the first quarter of the next year. The year

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consensus forecast published in Belgian Prime News (available on the web page of the National Bank). The growth number is the average of the forecasts made by the National Bank, the Ministry of Finance and six primary dealers. This average is not exhaustive and the individual predictions are not published.

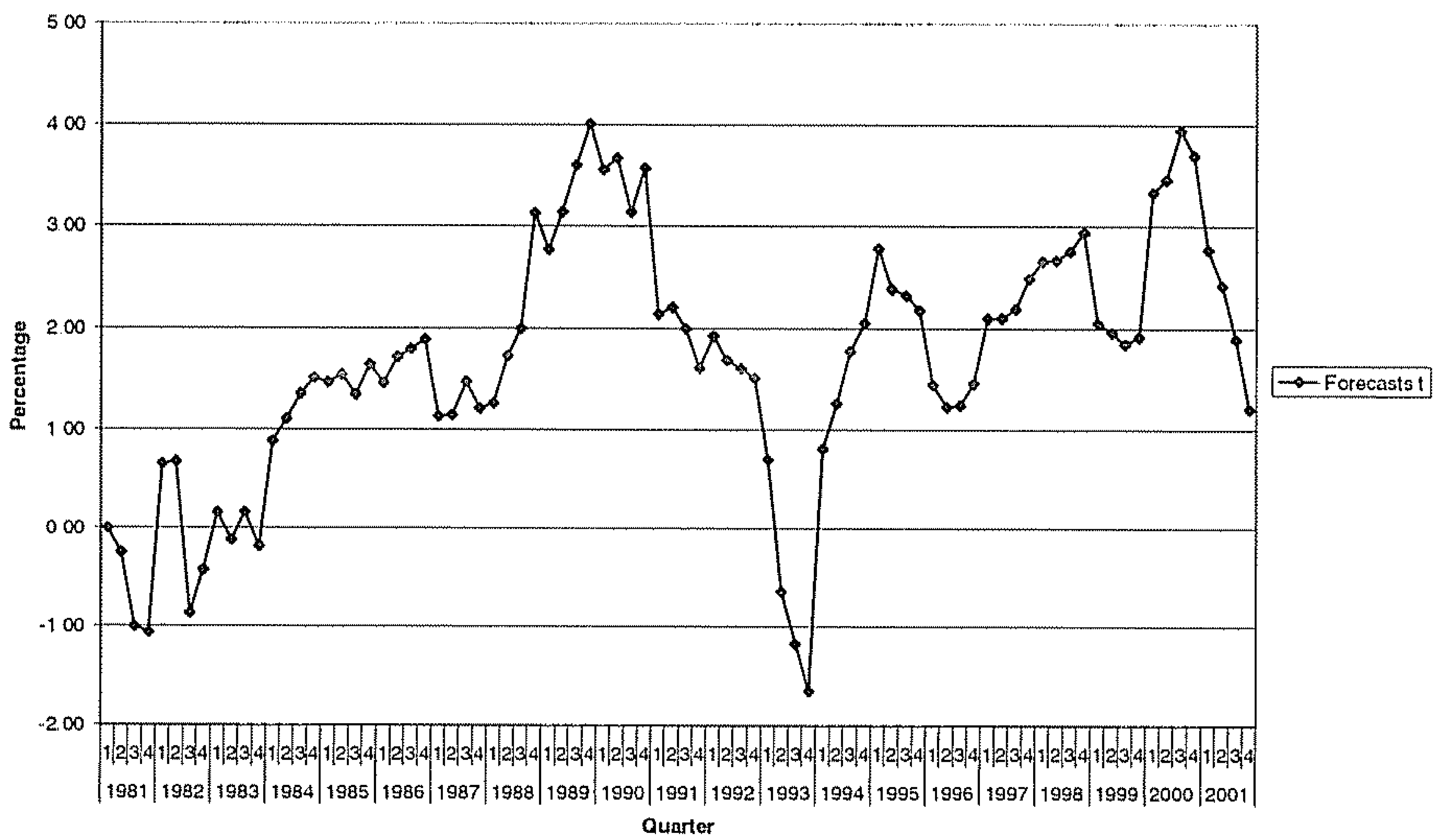
[4] This is based on previous research, see Gutierrez and Vuchelen (2001), that indicates that forecasts of the Belgian institutions are qualitatively better than those of foreign institutions. Note that all the forecasters, except the universities, are involved in economic activities.

[5] In general, the number of forecasts varies between 5 and 10. This is not enough to test for properties of the distribution of forecasts across forecasters. A consensus indeed implies that some agreement exists between forecasters. This can be tested using characteristics of the distribution. See, for example, Gregory, Smith and Yetman (2001).

1981 is the first year for which these eight forecasts are available. In total, we have thus a sample of 8 forecasts for each year of the period 1981 and 2001, or 168 forecasts.

Figure 1 shows the four consensus forecasts for the current year. Note that the forecast horizon declines as we move from the first to the fourth quarter. Interesting is that forecasts are not substantially modified during the year: the four current year forecasts are, usually, quite close. Exceptions are 1988, 1993, 1994 and 2001 when growth accelerated or decelerated, compared to growth in the previous year, by more than 2 percent. This illustrates the 'conservatism' of forecasters: they do not modify their forecasts unless required by evidence, i.e., data on the economic situation in the first months.

FIGURE 1. Consensus forecasts for the current year (1981 : 1 – 2001 : 4)



We also observe that forecasters do not tend to publish extreme forecasts: negative growth has only been forecasted in the early 1980's and in 1993; growth rates exceeding 3 percent in the late 1980's and in 2000.

2.2. ACTUAL GROWTH RATES

Choosing actual growth rates or realizations to evaluate forecasts is not straightforward. We use as actual growth rates the data published in the annual report of the National Bank. This report is published every year in February at about the same moment. The actual growth rates are thus homogenous in information content. In addition, business cycle analysts use these numbers as a first indication of the quality of their past forecasts. We do acknowledge, however, that the National Bank data are published very soon after the end of the year so they are rather preliminary estimates instead of actual growth rates.

The alternative to the actual growth rates published by the National Bank would be the data of the national accounts. However, these are available with an important and varying time lag so their information content is not homogenous.

A comparison between the initial growth estimates by the National Bank and the growth rates as published in the national accounts, reveals that the average estimation error is quite small (-0.3 percent) and not statistically different from zero (standard deviation of 0.60 percent). No systematic pattern is present in the estimation errors: the first autocorrelation coefficient equals -0.5 (t-value is -0.25). Individual estimation errors are, except for 1981 (-1.3 percent), smaller than 0.8 percent in absolute value. We feel that the benefits of using a forecasting benchmark that is homogenous in information content outweighs the drawbacks related to the initial nature of the actual growth estimation.

Some statistical characteristics of the actual growth rates, of the forecasts and of the forecast errors are reported in the next two tables. Table 1 gives information on the actual growth rates and on the eight consensus forecasts. Table 2 relates to the forecast errors.

TABLE 1. Actuals and forecasts, in percent, 1980:2 - 2002:1

	Actuals	Forecasts							
		t+1			t				t-1
		II	III	IV	I	II	III	IV	I
Minimum	-1.30	1.00	0.80	0.44	0.00	-0.64	-1.18	-1.65	-1.40
Maximum	4.20	2.97	3.10	3.29	3.56	3.68	3.95	4.01	4.51
Distribution, in percent									
≤ 0,5	9	0	0	10	10	10	5	10	5
> 0,5	5	0	19	9	19	10	5	0	5
> 1	38	43	28	29	28	43	52	52	47
> 2	29	57	48	43	33	23	24	19	24
> 3	19	0	5	9	10	14	14	19	19
Total	100	100	100	100	100	100	100	100	100
Positive	86	100	100	100	100	86	86	81	86
Negative	14	0	0	0	0	14	14	19	14
Total	100	100	100	100	100	100	100	100	100

Actual growth fluctuated over the past two decades between –1.3 and 4.2 percent (see the first column). Most of the time, growth was positive; growth was only negative in 1981, 1982 and in 1993. The first column of the forecasts reports the statistics for the forecast with the longest time horizon. We note the rather small difference between the minimum and maximum forecasted growth rates (nearly 2 percent), where this difference equals 5.5 percent for actual growth. In addition, the initial forecasts (second quarter column *t+1*) exceed one percent, but never 3 percent. Again, an indication of the 'conservatism' of forecasters. This dispersion of forecasts rises as the forecasting horizon declines. One obvious conclusion is thus that the initial forecasts do not have, in general, much in common with the actual growth rates. Users should especially be aware of the fact that extreme forecasts will never be made. This is a preliminary indication of the important errors that business cycle forecasters make when predicting over a longer time horizon. As the time horizon shortens, the characteristics of the forecast series tend towards these of the actual growth rates. We do note that forecasters already predict growth rates exceeding 3 percent in the third quarter of the previous year whereas negative rates are only predicted in the second quarter of the current year. Phrased differently, forecasters start relatively early to predict high growth rates but are very late in predicting negative rates.

Finally, the statistical characteristics of forecasts/estimates for the growth in the past year, last column, compare very well with the characteristics of the actual growth rates. However, note that the actuals are published in the middle of that quarter so probably some forecasters simply used these data.

TABLE 2. Forecast errors, in percent, 1980:2 – 2002:1

	t+1			t				t-1
	II	III	IV	I	II	III	IV	I
Minimum	**-3.60**	**-3.37**	**-2.67**	**-2.00**	**-1.42**	**-0.90**	**-0.72**	**-0.65**
Maximum	**2.70**	**2.35**	**2.79**	**2.83**	**2.37**	**2.10**	**0.97**	**0.66**
Distribution, in percent								
≤ 0,5	24	28	29	29	33	52	76	90
> 0,5	19	19	33	33	43	43	24	10
> 1	33	24	24	29	19	0	0	0
> 2	14	24	14	9	5	5	0	0
> 3	10	5	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100
Positive	48	52	52	57	62	62	62	57
Negative	52	48	48	43	38	38	38	43
Total	100	100	100	100	100	100	100	100

In table 2, we report the statistical characteristics of the forecast errors. These errors are calculated as the difference between the actuals and the forecasts. First, we observe that the size of the forecast errors increases with the time horizon. For the longest time horizon (the first forecasts), we observe that 10 percent of the forecasts errors exceed 3 percent. As the time horizon shortens (as we move from the left to the right in table 2), the errors decrease and the large errors disappear. For instance, forecasts made in the fourth quarter of the previous year never imply an error that exceeds 3 percent. All errors are below 1 percent as of the fourth quarter of the current year.

Interesting to note is that, except for the first one-year-ahead forecasts, the errors are more frequently positive. This indicates that the forecasts are, on average, smaller than the actual growth rates. In general, forecasters are thus, compared to the actual growth rates, pessimistic.

2.3. CORRELATION BETWEEN FORECASTS

As explained, two growth forecasts are calculated in every quarter. In the first quarter, these relate to the past and the current year; in the other quarters, the forecasts concern the current and the one-year-ahead growth. An interesting question relates to the relationship between these two forecasts. If forecasters revise the current year growth forecast and the one-year-ahead forecast in a similar way, this would be an indication that they forecast from a business cycle perspective. However, if revisions are unrelated, they do not forecast from a business cycle perspective.

In order to test for a relationship between forecasts, we calculate forecast revisions. These are defined as the difference between, for example, the forecasts published in the third quarter of 1988 for the growth in 1988 and in 1989 and the second quarter forecasts. Note, however, that for the current year forecast (the 1988 growth in our example) the third quarter revision is the fifth revision whereas it is the first revision of the one-year-ahead forecast (the 1989 growth in our example).

We use a regression analysis to test for correlations between forecast revisions. Any forecast $F_{t+i,t(j)}$ (i=1, 0 and -1; j = 1, 2, 3 and 4 but j = 2,3 and 4 if i = 1; j = 1, 2, 3, 4 if i = 0 and j = 1 if i = -1) is defined by reference to the forecasted growth, the first subscript, and by the publication date, the second subscript (quarter in brackets). Forecasts in every quarter are uniquely defined: past and current year growth forecasts in the first quarter, current and one–year-ahead growth forecasts in the three other quarters. Similarly, revisions are uniquely defined; the symbol is $R_{t+i,t(j)}$ where subscripts have the same interpretation as for forecasts.

In the first regression, the first revision of the forecast for the one-year-ahead growth is related to the fifth revision of current year growth forecast; these data are published in the third quarter of the current year. A second regression relates the forecast revisions of the fourth quarter and in a third regression, the revisions concern the forecasts published in the first quarter of the next year[6]. We thus estimated the following regression:

$$R_{t+i,t(j)} = \alpha + \beta R_{t+p,t(j)} + \varepsilon_{t(j)} \qquad t = 1981,\ldots,2001 \qquad (1)$$

Where i = 1 and p = 0 when j = 3 and 4; i = 0 and p = -1 when j = 1.

[6] No regression can be estimated for the forecasts published in the second quarter since the first forecast for the one-year-ahead growth is published in that quarter so no revision can be calculated.

The estimation results are reported in table 3 :

TABLE 3. Relation between growth revisions (t-values in parenthesis)

Revision (a)	$\hat{\alpha}$	$\hat{\beta}$
1	-0.09 (-1.17)	0.64 (4.27)
2	-0.16 (-1.56)	0.55 (2.01)
3	-0.10 (-2.07)	0.97 (4.85)

Note (a): The first revision indicates that the dependent variable is the first revision of the one-year-ahead forecast published in the third quarter of year t; the independent variable is the fifth revision in the current year growth forecast published in the same quarter.

These results clearly indicate that the growth forecast for two consecutive years are revised simultaneously. The revision in the one-year-ahead growth forecast is, initially, approximately one half to two-thirds of the revision in the current year growth forecast. The last regression shows that the revisions published in the first quarter of each year are about equal. It concerns the third revision of the current year growth and the seventh and last revision of the previous year growth. Note that this revision of the current year forecast concerns a first estimation of actual growth. Since this growth is published by the National Bank in February, probably some forecasters use this figure as their forecast for last year's growth.

The conclusion seems thus that forecasters predict from a business cycle perspective: a more (less) favourable current situation is transposed to next year's growth. Therefore, forecasters consider news or new information to affect growth over the next few years. This can only be rationalized by stressing that such news alters the view forecasters have on the exogenous determinants of growth. For example, forecasters can adjust their previous long-term forecasts for government expenditures if current expenditures are revised; similarly, an unexpected increase in interest rates can modify the previously predicted time profile of the business cycle, etc.

3. EVALUATIONS OF THE CONSENSUS GROWTH FORECASTS

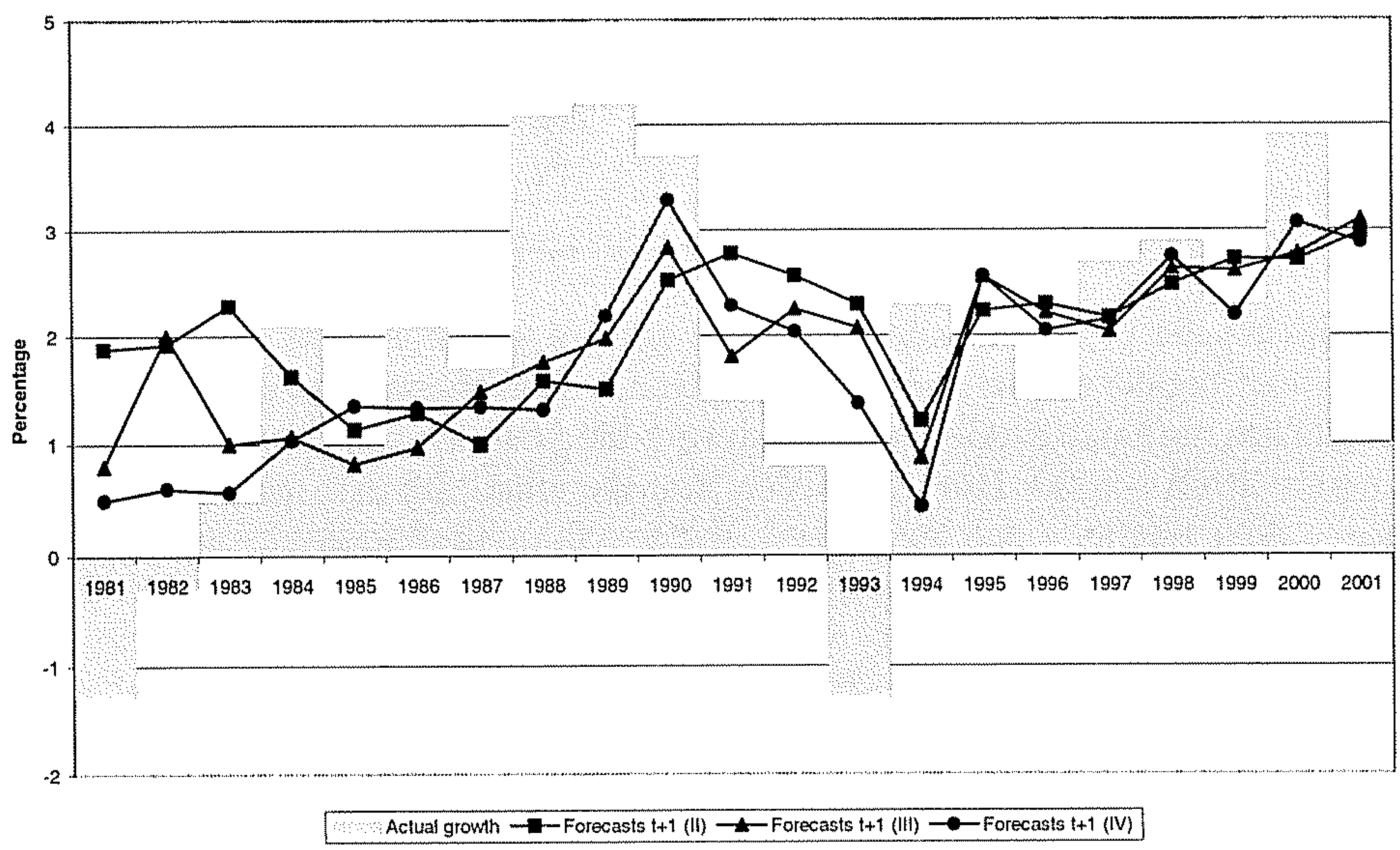
3.1. INTRODUCTION

In the next paragraphs, we will evaluate the consensus growth forecasts for the Belgian economy. We start with a graphical 'evaluation'. Then we proceed to a statistical appraisal using the traditional forecast evaluation statistics. Finally, we will perform some rationality tests. Note that we do not use a 'naïve' forecast (such as a constant growth or the same change in growth as in the past) as benchmark, because such a forecasting technique is not considered a viable alternative by macroeconomic forecasters.

3.2. GRAPHICAL EVALUATION

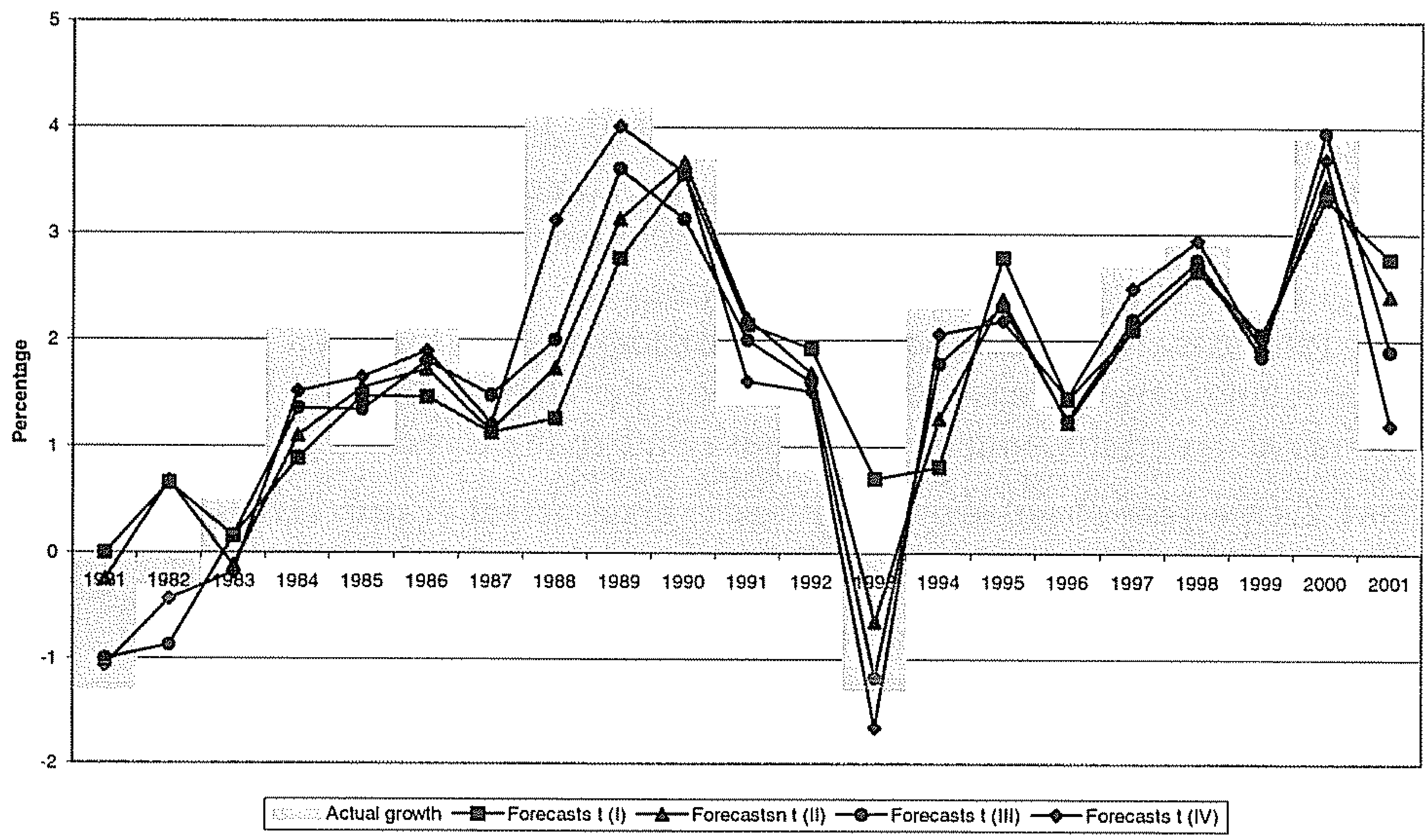
In figures 2, 3 and 4 the one-year-ahead forecasts (t+1), the current year forecasts (t) and the first estimation of last year's growth (t-1) are compared with the actual growth rates. The actuals are indicated by the bars. We remind the reader that we have three consensus forecasts for the next year (t+1), four forecasts for the current year (t) and one estimation for the past year (t-1). In the three figures, we combine the forecast to stress the publication time; the forecasting horizon differs between lines but is constant on each line. The lines connect thus forecasts published in the same quarter. For example, the line 'Forecasts t+1 (IV)' represent all the one-year-ahead forecasts made in the fourth quarter of the previous year. To avoid misunderstandings, forecasts are centred on the actuals that had to be forecasted: the points above, for example, 1985, thus relate to the forecasts published in 1984.

FIGURE 2. One-year-ahead growth forecasts versus actual growth (1981-2001)



We start in figure 2 with the three one-year-ahead forecasts. We observe first that the forecasts are much less volatile compared to the observed growth. Low actuals have been overpredicted whereas high actuals have been underpredicted. Important forecast errors are thus made when the observed values for economic growth were 'extreme'. In practice, this means negative growth rates or rates exceeding 3 percent. In addition, forecasters lag behind important changes in the growth rate. This is obvious for the increase in growth that started in 1988 and the decline that started in 1990. Forecasts published in the fourth quarter of the previous year are better than the forecasts published in the second and third quarter. This illustrates that the quality of the forecasts improves as the time horizon shortens. The best forecasts were those for 1985, 1995, 1998 and 1999; recall that it concerns here one-year-ahead forecasts.

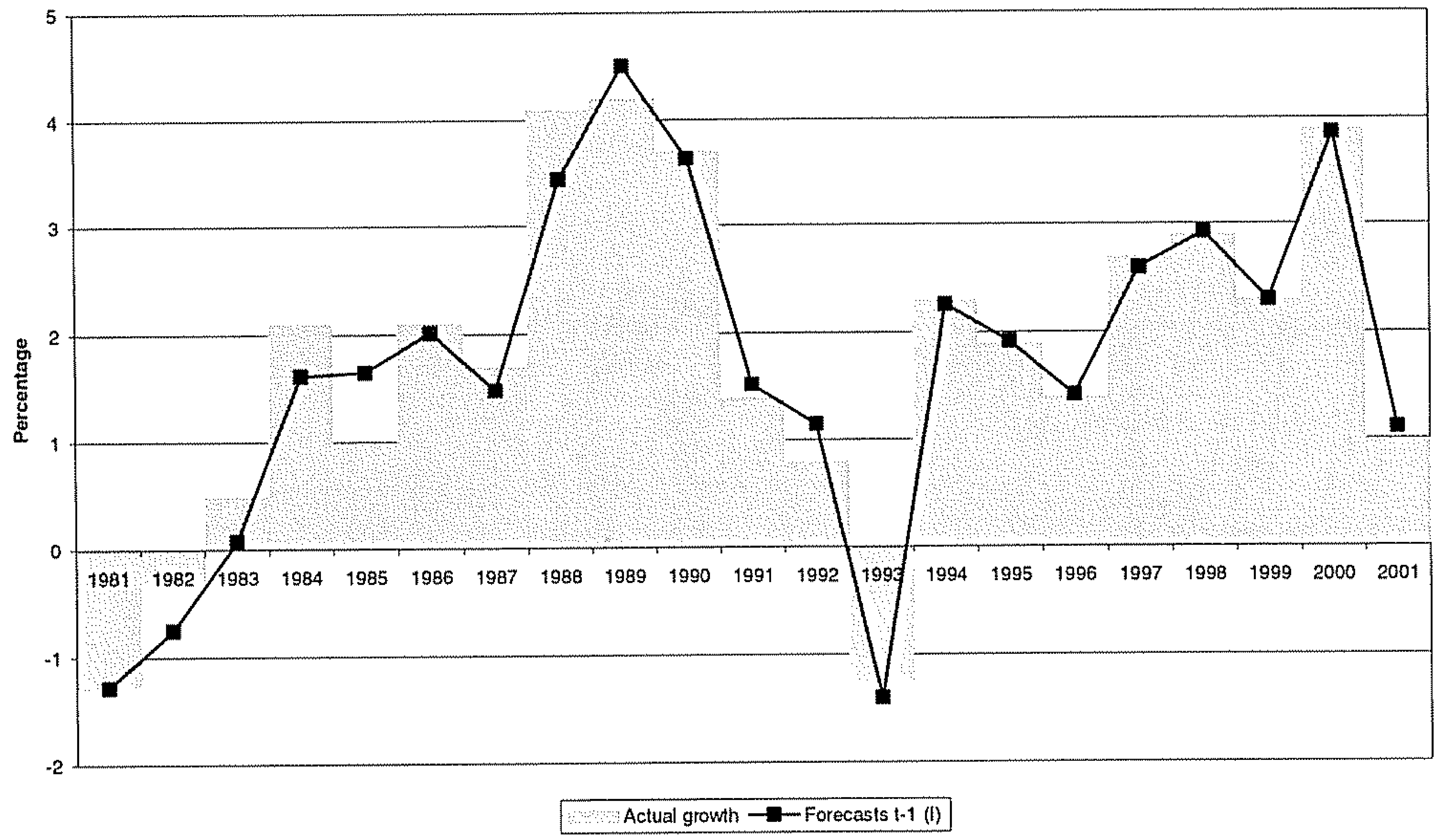
FIGURE 3. Growth forecasts for the current year versus actual growth (1981-2001)



We replicate the previous exercise for the current year forecasts. This is figure 3. The parallel course of the four lines is striking. That means that most of the time, forecasts are only marginally adjusted during the year. This is especially clear over the period 1996 - 2000. Note, however, that the small adjustments in forecasts do improve their quality since, in general, the fourth quarter forecasts are better than those published in the previous quarters. Apparent from figure 3 is also that the forecasts made over the period 1996-2000 are, compared to previous forecasts, more accurate. In addition, we observe that forecast errors for 'extreme' growth rates are smaller compared to the previous figure. This illustrates that 'extreme' growth rates are much better predicted as the forecasting horizon shortens.

Finally, figure 4 compares forecasts for growth in the previous year with the actual growth. Recall that the data are not really forecasts, but first estimations by forecasters of the growth in the past year; also remember that we only have data for the first quarter. Forecast errors are minimal: the forecasts are very close to the actual growth rates, especially in the 1990's. At least, forecasters do predict the past quite well.

FIGURE 4. Growth forecasts for the previous year versus actual growth (1981-2001)



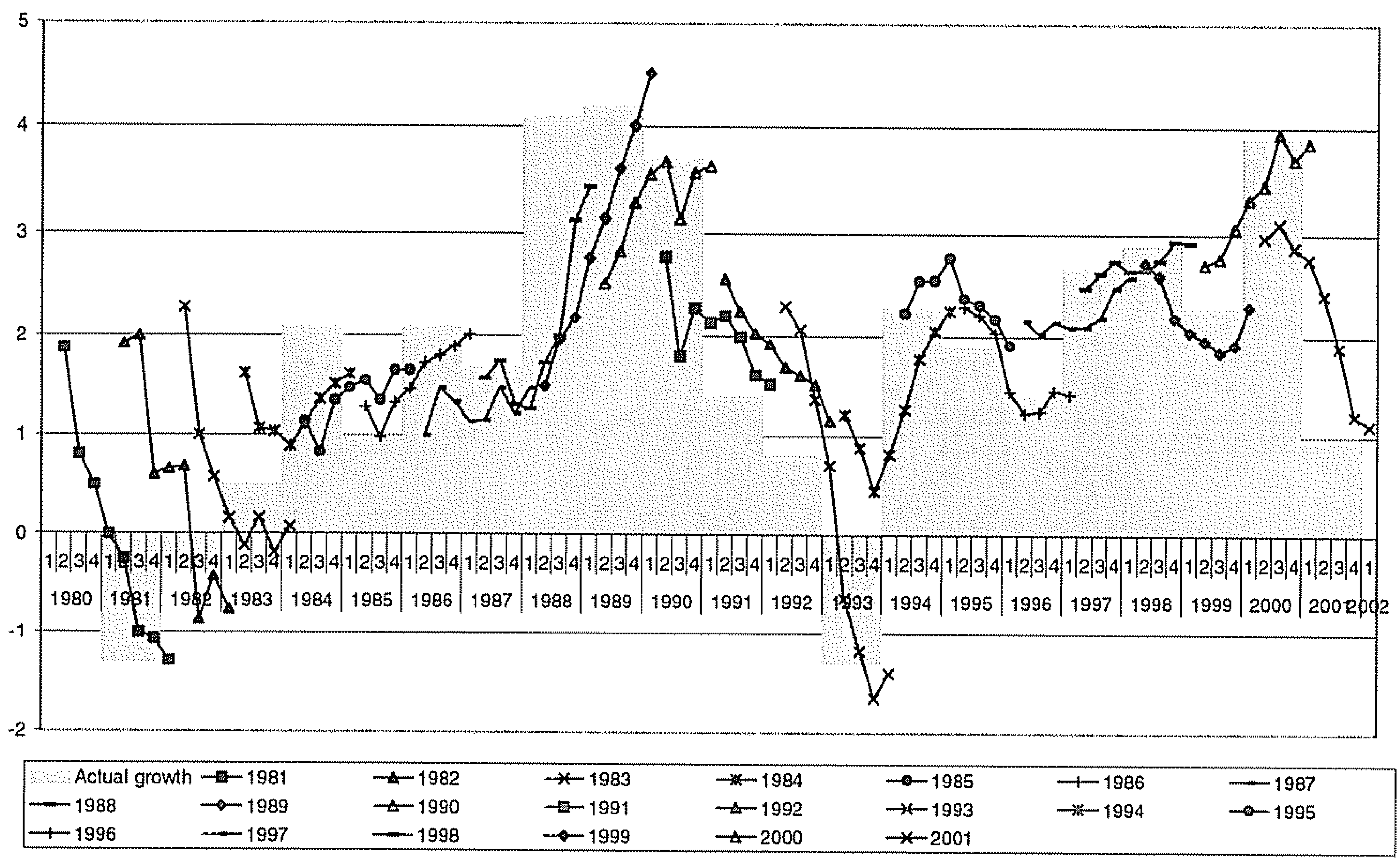
In figure 5, we re-arrange the forecasts to stress the growth rate that is forecasted. The lines in this figure connect the eight forecasts that are made for the growth in each year. For example, the first line in figure 5 represents the eight forecasts for growth in 1981. Three of them were published in 1980, four in 1981 and one in 1982. The bars still represent the actual growth rates.

As already observed, the quality of the forecasts improves as the forecast horizon shortens: the forecast errors of initial forecasts are frequently very large but decline as more information about the growth to be forecasted, becomes available.

This figure allows an evaluation of an important aspect of forecasts, i.e., how well are turning points predicted? Forecasts published in the second, third and fourth quarter imply a time profile for economic growth in the current and the coming year. We can thus compare the forecasted growth deceleration or acceleration with the observed change in the growth rate. An analysis of figure 5 reveals that forecasters do predict the change in the growth rate correctly in about two thirds of the years. Note that it concerns here completely ex ante forecasts with an horizon of more than one year.

One important conclusion from the previous analysis is that the quality of the forecasts is rather heterogeneous: initial forecast errors are frequently quite large whereas final forecasts are quite good. Any evaluation of forecasts should thus be based on a homogenous series of forecasts, i.e., forecasts with the same time horizon.

FIGURE 5. Growth forecasts according to the date of publication and actual growth (1981-2001)



3.3. STATISTICAL EVALUATION

In this paragraph, traditional forecast evaluation statistics are calculated. These statistics are based on the forecast error, defined as the difference between the actual growth rate and the forecasted growth rate. We consider the following statistics: mean error (ME), the mean absolute error (MAE), the mean percentage error (MPE; evaluation of errors in relation to the actuals), the root mean squared error (RMSE; measures the distribution of the forecasts around the actuals). The mean squared error is decomposed into three components MC, SC and RC. Accurate forecasts imply a value for RC close to one and values close to zero for MC and SC. We also calculate the Theil-inequality coefficient (U) and the Granger-proportion (G). This last statistic is the ratio of the mean absolute error and the root of the mean squared error. This value is typically below 0.8 for acceptable forecasts. Granger (1996) argues that forecast errors are usually drawn from a distribution with a relative low variance, but now and then from a distribution with a high variance. Occasionally, forecast errors are thus large. The Granger-proportion decreases when the frequency of large forecasting errors increases.

The evaluation statistics are explained in detail in the appendix.

Table 4 reports the evaluation statistics for all 168 forecasts. We note that the mean error for the consensus growth forecasts is quite small, indicating that the average forecast fits the actual growth rates quite well. This is an important conclusion but recall that the result holds for all forecasts combined. Compensations between positive and negative errors, underpredictions of growth in expansions and overpredictions of growth in recessions, do occur. This is confirmed by the mean absolute error, the mean of the forecast errors taken in absolute value. This statistics equals 0.80 percent. Other statistics show that the forecasts are, in general, quite acceptable : RC equals one, MC and SC are zero. The Theil U-coefficient is low and, as required for acceptable forecasts, the Granger-proportion is well below 0.8.

TABLE 4. Global evaluation of the growth forecasts

ME	MAE	MPE	RMSE	MSE %			U	G
				MC	SC	RC		
0.01	0.80	16.55	1.10	0.00	0.00	1.00	0.22	0.73

In the next tables, we decompose the global evaluation into different partial evaluations to obtain a more detailed view on the forecast errors. We start in table 5 with an evaluation of the one-year-ahead forecasts (t+1). These are 'true' or ex ante forecasts. Recall that such forecasts are published in the last three quarters of the previous year. The striking observation is that the evaluation statistics are much worse than the global statistics (reported in table 4) indicating the general 'poor' quality of the forecasts. Since forecasts do improve as the time horizon shortens, the best evaluation statistics are obtained for the forecasts published in the fourth quarter. However, still important errors, see the MAE-statistics, are made. Also note that the Granger statistics exceeds 0.8 indicating that the number of large forecast errors is relatively small.

TABLE 5. Statistics for the one-year-ahead growth forecasts (period t+1)

	ME	MAE	MPE	RMSE	MSE%			U	G
					MC	SC	RC		
II	-0.29	1.40	30.71	1.70	0.03	0.15	0.82	0.53	0.82
III	-0.12	1.21	45.39	1.49	0.01	0.03	0.96	0.40	0.81
IV	-0.01	1.05	22.69	1.32	0.00	0.00	1.00	0.32	0.80
Total	-0.14	1.22	32.93	1.51	0.01	0.04	0.95	0.42	0.81

Table 6 reports the statistics for the current year growth forecasts (period t). We see immediately that the statistics are much better than those for the one-year-ahead forecasts (reported in table 5). Again, this illustrates the improvement in the forecasts as the time horizon shortens. This is confirmed by the decline in the statistics as we move from the first to the fourth quarter but do note that still systematic errors are made (see mean error).

TABLE 6. Statistics for the growth forecasts for the current year (period t)

	ME	MAE	MPE	RMSE	MSE%			U	G
					MC	SC	RC		
I	0.05	0.93	24.83	1.15	0.00	0.00	1.00	0.24	0.81
II	0.09	0.74	23.05	0.90	0.01	0.03	0.96	0.15	0.83
III	0.17	0.51	-7.73	0.66	0.07	0.01	0.92	0.08	0.77
IV	0.11	0.34	0.55	0.42	0.07	0.00	0.93	0.03	0.82
Total	0.11	0.63	10.17	0.83	0.02	0.01	0.98	0.13	0.76

In table 7, we report the evaluation statistics for the forecasts/predictions for the growth in the past year (*t-1*). We recall that the only forecast is published in the first quarter. Since this forecast is an ex post forecast, the quality is very good. Noteworthy is the low value of the Granger statistic. This would indicate the presence of several large errors but figure 4 illustrates that the forecasts/predictions are quite correct. One is thus tempted to conclude that the Granger statistic has to be interpreted with caution when the two components of the statistics (MAE and RMSE) are relatively small.

TABLE 7. Statistics for the growth forecasts for the past year (period t-1)

ME	MAE	MPE	RMSE	MSE %			U	G
				MC	SC	RC		
0.05	0.20	-7.07	0.29	0.03	0.02	0.95	0.02	0.70

In order to obtain a more general view on the change in the quality of the forecasts as the forecast horizon declines, we calculated a percentage decomposition of the global ME-, MAE- and MPE-statistics, as reported in table 4, into the eight time horizons, each corresponding to a publication quarter; each horizon thus contains 21 forecasts. The results are reported in table 8. As expected, the largest contribution has to be allocated to the ex ante forecasts. Again, as the time horizon shortens, forecast errors decrease. The best forecasts are those made in the last three quarters. Note that the initial forecasts systematically overpredict next year's growth whereas current year's growth is systematically underpredicted (see sign in mean error column).

In table 9, we take yet another look by calculating the evaluation statistics for every year separately. Recall that the growth in each year is predicted in eight consecutive quarters. This approach allows us to check whether forecasts ameliorate over the years. A straightforward conclusion is not possible. We do note that forecasts are in general bad when growth is exceptionally small (1981, 1982, 1992, 1993 and 2001) or large (1988, 1989 and 2000; the exception is 1990 but this is possibly explained by the fact that it was the third year of high growth).

TABLE 8. Percentage distribution of the evaluation statistics of the growth forecasts

Period	Quarter	ME	MAE	MPE
t+1	II	-495	22	23
	III	-205	19	34
	IV	-14	16	17
t	I	82	15	19
	II	159	12	17
	III	296	8	-6
	IV	191	5	0
t-1	I	86	3	-5
Total		100	100	100

TABLE 9. Statistical measures of the growth forecasts according to the predicted year

	ME	MAE	MPE	RMSE	U	G
1981	-1.25	1.25	95.95	1.61	1.53	0.78
1982	-0.77	1.06	258.30	1.30	18.66	0.82
1983	0.01	0.59	1.14	0.77	2.35	0.78
1984	0.82	0.82	39.28	0.87	0.17	0.95
1985	-0.37	0.42	-37.29	0.46	0.21	0.91
1986	0.54	0.54	25.69	0.63	0.09	0.85
1987	0.42	0.42	24.48	0.45	0.07	0.92
1988	2.07	2.07	50.59	2.21	0.29	0.94
1989	1.24	1.32	29.49	1.58	0.14	0.83
1990	0.42	0.42	11.39	0.58	0.02	0.73
1991	-0.64	0.64	-45.98	0.75	0.28	086
1992	-1.04	1.04	-130.45	1.12	1.98	0.93
1993	-1.50	1.61	115.11	2.12	2.66	0.76
1994	0.96	0.96	41.82	1.13	0.24	0.85
1995	-0.47	0.47	-24.59	0.53	0.08	0.88
1996	-0.27	0.35	-19.40	0.49	0.12	0.71
1997	0.47	0.47	17.46	0.51	0.04	0.93
1998	0.17	0.19	5.98	0.22	0.01	0.84
1999	0.10	0.28	4.23	0.32	0.02	0.89
2000	0.54	0.55	13.90	0.70	0.03	0.79
2001	-1.30	1.30	-129.50	1.49	2.23	0.87
Total	0.01	0.80	16.55	1.10	0.22	0.73

3.4. ECONOMETRIC EVALUATION

The econometric evaluations test forecasts for rationality. Different tests, depending on the definition of rationality, exist. Forecasts are considered to satisfy the condition of weak rationality when they do not systematically differ from the actuals. In other words, when the forecasts are unbiased. Forecasts are said to be strongly rational when they are efficient, i.e., when they contain all the available information. This can be tested by analysing whether forecast errors or forecast revisions are correlated with the information that was available when the forecasts were prepared. In the next paragraphs, we test both forms of rationality.

3.4.1. Unbiasedness or weak rationality

Unbiasedness or weak rationality is tested by estimating regression (2) for the 8 forecast horizons:

$$A_t = \alpha + \beta F_{t+i,t(j)} + \varepsilon_{t(j)} \quad \text{where } j = 2,3,4 \text{ if } i = 1 \quad (2)$$

$$j = 1,2,3,4 \text{ if } i = 0$$

$$j = 1 \text{ if } i = -1$$

The first subscript of the forecasts F refers to the forecasted growth rate, the second subscription to the publication year, the quarter is indicated between brackets. The forecasts are unbiased and therefore weak rational if :

1) The null hypothesis $\alpha = 0$ and $\beta = 1$ is accepted
2) The error term $\varepsilon_{t(j)}$ is white noise.

Regression model (2) is estimated for each forecast horizon, 8 in total, so each sample consists of 21 observations. The F-values for the null hypothesis are reported in table 10.

The critical F-value for the 5 percent significance level is about 3.52, which means that we can accept the first hypothesis of unbiasedness for all eight regressions.

TABLE 10. Test of unbiasedness

Period	Quarter	F-value
t+1	II	1.27
	III	1.15
	IV	0.01
t	I	0.00
	II	0.06
	III	0.09
	IV	0.20
t-1	I	0.44

The second hypothesis concerns the white noise property of the error term. This is tested by means of the Durbin-Watson d-statistic. If the residuals are not autocorrelated, the error terms can be considered white noise.

Table 11 reports the d-statistic for the eight forecast horizons. We observe that these statistics tend towards two as the time horizon shortens; autocorrelation thus decreases. The residuals of the first and second regression are positively autocorrelated. Since both regressions concern ex ante forecasts with the longest time horizon, the autocorrelation may be explained by lack of information about the growth in the next year. The other six regressions do not show signs of autocorrelation indicating that the error terms are white noise.

TABLE 11. Durbin-Watson d-statistic for the white noise test

Period	Quarter	d-statistic	Result
t+1	II	0.97	positive autocorrelation
	III	1.25	positive autocorrelation
	IV	1.50	no autocorrelation
t	I	1.50	no autocorrelation
	II	1.38	no autocorrelation
	III	1.57	no autocorrelation
	IV	1.79	no autocorrelation
t-1	I	2.15	no autocorrelation

Other, more general, tests about autocorrelation produce similar results[7] so that we may conclude that, in general, the consensus forecasts are unbiased and thus weakly rational, except the two forecasts with the longest time horizon.

3.4.2. Efficiency tests for strong rationality

Strong rationality can be tested in different ways. The difficulty consists in determining which information was available at the time the forecasts were made. The easiest assumption is that only historical values of the series to be forecasted, were available. Rationality tests then analyse the correlations between the forecast errors or the forecast revisions and lagged values of the forecasts or of the actuals.

- Tests on the forecast revisions

Rationality implies that the forecast revisions are not autocorrelated or that they are not correlated with other variables. We conduct three tests. First, we test for autocorrelation in the revisions. Thereafter, we look for correlations between the revisions and finally, we conduct a global test on the correlations.

We start by testing for autocorrelation in the forecast revisions. By way of illustration, we test whether the second revision of the forecast for 1990 is correlated with the second revision of the forecast for 1989. The regression, estimated for each of the 7 revisions, is :

$$R_{t+i,t(j)} = \alpha + \beta R_{t+i-1,t(j)} + \varepsilon_{t(j)} \qquad (3)$$

[7] These test are the Q-statistic and the Ljung-Box-statistic, but the reliability of these tests is small due to the small number of observations.

The F-values for the hypothesis that both regression coefficients are zero, are reported in table 12. Obviously, no relationship exists between forecast revisions in consecutive years. We add that the residuals do not indicate any presence of autocorrelation.

TABLE 12. Efficiency test for the revisions of the growth in consecutive years

Revision	F- values
1	0.65
2	1.66
3	0.59
4	0.59
5	0.52
6	0.50
7	0.81

A second test checks correlations between revisions. We test whether revisions are correlated with previous revisions. This implies 21 combinations or regressions:

$$R_{t+i,t(j)} = \alpha + \beta R_{t+i,t(j-p)} + \varepsilon_{t(j)} \qquad 0<p<j \qquad (4)$$

The F-statistics for α and $\beta = 0$ are reported in table 13. The critical F-value equals 3.52 so, except for three cases, we accept that most revisions are not correlated.

TABLE 13. Efficiency test on the forecast revisions (F-values)

Revision (a)	**Revision (a)**					
	1	2	3	4	5	6
7	0.34	5.39	0.47	0.22	0.14	0.27
6	0.05	6.19	1.57	0.02	0.99	-
5	1.85	0.71	2.58	0.04	-	-
4	7.69	1.09	0.23	-	-	-
3	1.41	2.80	-	-	-	-
2	0.01	-	-	-	-	-

Note (a): For example, the case (revision 2, revision 1) refers to the regression that explains the revision in the fourth quarter of the one-year-ahead forecast by the preceding revision.

Finally, we test whether consecutive revisions of the same growth forecast are correlated. This requires the estimation of 21 regressions, t = 1981,…,2001, with a sample of six observations. The regression model is:

$$R_{t+i,t(j)} = \gamma R_{t+i,t(j-1)} + \varepsilon_{t(j)} \qquad (5)$$

$R_{t+i,t(j)}$ is the revision of the growth rate for (t + i) published in $t_{(j)}$.

The necessary condition for efficiency or rationality is that the regression coefficient γ is not statistically different from zero. If forecasts only adjust gradually, the γ-coefficient will be positive. Obviously, regression (5) suffers from a small sample size. The cross section-time series methodology can solve this problem. This methodology was developed by Clements (1997) who extended previous research by Nordhaus (1987). Before entering into details, we emphasise that we did estimate the 21 regressions. Of the 21 coefficients, only three differ significantly from zero: those for the forecast revisions of 1989, 1992 and 1993. Growth was quite high in 1989 (4.2 percent) whereas low in the two other years (0.8 percent in 1992 and –1.3 percent in 1993). This does not seem to indicate any relationship with the growth level. Fifteen of the coefficients were positive and six negative; note that the three significant coefficients had a positive sign. These results support the view of Nordhaus (1987) who argued that forecasters adjust their forecasts gradually.

Clements (1997) uses three different estimation methods. In a first method, the data are compiled in one global regression; the sample is thus 126. The estimated value for the γ-coefficient is 0.297 with a t-value of 3.12. The coefficient differs significantly from zero. In a second estimation procedure, Clements uses the method of generalized least squares. This requires the knowledge of the variance-covariance matrix of the errors; use is made of the residuals of the previous estimations. This procedure leads to a regression coefficient for γ of 0.538 with a t-value of 8.23. A last estimation method incorporates correlations between revisions. Such correlations could result from the availability of new important information at about the same time every year and so affect the forecasts made at that time. An example is the release of consumer prices at about the same time every month. The results do not deviate substantially from the previous ones: the γ-coefficient equals 0.473 with a t-value of 8.10. It might be a coincidence, but Clements (1997, page 233) found comparable results for the British growth forecasts for 1993 and 1994.

To sum up, the forecasts made for the Belgian economic growth for the period 1981-2001 do not fulfil the requirements of strong efficiency. The revisions are positively correlated indicating a slow adjustment to new information. The results seem sufficiently reliable.

Several acceptable explanations can be formulated for these conclusions. Forecasters can be reluctant to adjust their forecasts in a drastic way, because this could affect their credibility or because they might fear that a radical change will have to be reversed in the future. Furthermore, they also might be reluctant to deviate substantially from the forecasts made by their colleagues at other institutions.

- Tests on the forecast errors

The purpose of the two tests we perform here is to check whether the forecast errors contain information that was available at the time the forecasts were made. In a first test, the available information is defined as past observed growth rates; in a second test, the information set contains previous forecast errors.

The first test requires the estimation of the following regression:

$$A_t - F_{t+i,t(j)} = \alpha + \sum_{k=1}^{N} \beta_k A_{t-k} + \varepsilon_{t(j)} \qquad (6)$$

Where N represents the number of lagged observed growth rates. Efficiency requires that no coefficient of the regression is significant. We estimate eight regressions, one for each forecast horizon. The choice of the number of lags (N) is somewhat arbitrary. We systematically increased N to four, but obtained only a significant coefficient, at the 5 percent level, for N = 1 and for the forecast (t - 1). This is the last regression in table 14.

It is difficult to rationalize this result. One explanation could be that the independent variable is not really a forecast, but an ex post prediction of the growth in the past year. Note that this forecast is very good (see table 8) and that the estimated regression coefficient is small, so that the violation of the efficiency test does not seem dramatic.

TABLE 14. Efficiency test for the forecasts: estimation results of equation [6](a)

Period	Quarter	$\hat{\alpha}$	$\hat{\beta}$
t+1	II	-0.59 (-1.06)	0.25 (1.08)
	III	-0.27 (-0.51)	0.14 (0.66)
	IV	0.17 (0.36)	-0.04 (-0.22)
t	I	0.26 (0.65)	-0.08 (-0.46)
	II	0.31 (1.00)	-0.08 (-0.64)
	III	0.40 (1.79)**	-0.11 (-1.16)
	IV	0.28 (1.97)**	-0.08 (-1.29)
t-1	I	0.23 (2.44)*	-0.09 (-2.33)*

Note (a): t-values in parenthesis; * significant at the 5% level and ** significant at the 10% level.

A second efficiency test checks whether consecutive forecast errors are correlated. If they are, forecasts cannot be considered efficient. This test requires the estimation of the regression :

$$A_t - F_{t+i,t(j)} = \alpha + \beta\,(A_{t-1} - F_{t+i,t-1(j)}) + \varepsilon_{t(j)} \qquad (7)$$

Again, we estimate regressions for each forecast horizon. The results are reproduced in table 15.

TABLE 15. Efficiency test for the forecasts: estimation results of equation (7)(a)

Period	Quarter	$\hat{\alpha}$	$\hat{\beta}$
t+1	II	-0.06 (-0.19)	0.39 (1.90)**
	III	-0.01 (-0.04)	0.25 (1.09)
	IV	0.07 (0.23)	0.16 (0.67)
t	I	0.09 (0.33)	0.18 (0.75)
	II	0.11 (0.52)	0.26 (1.09)
	III	0.16 (0.98)	0.17 (0.68)
	IV	0.12 (1.19)	0.09 (0.37)
t-1	I	0.06 (0.81)	-0.06 (-0.24)

Note (a) : t-values in parenthesis ; ** significant at the 10% level.

Only one coefficient is significant, at the 10% level, that is the slope in the first regression. This implies that the forecast with the longest time horizon can be improved by taking the forecast error of last year into account.

4. CONCLUSION

In this article, we presented and evaluated a consensus forecast for the Belgian economic growth for the period 1981-2001. This consensus is the average of all the growth forecasts published by Belgian forecasters in a specific quarter. The number of forecasts we consider is not fixed, but the conducted tests clearly show that the consensus growth meets most characteristics of forecasts. The statistical quality is very good, and the forecasts pass the weak rationality tests. Some forecasts, especially those with the longest time horizon and the ex post prediction, fail to pass the strong rationality tests. We conclude therefore that a simple average of the growth forecasts published in any quarter, provides an acceptable current and one-year-ahead forecast of the Belgian growth.

APPENDIX

The statistics used to evaluate the forecasts are defined in this appendix.

- The mean error:

$$ME = \sum_{t=1981}^{2001} \sum_{i=-1,0,1} (A_t - F_{t+i,t(j)}) / n \qquad \text{where } j=2,3,4 \text{ if } i=1$$

j=1,2,3,4 if i=0

j=1 if i=-1

The number of forecasts considered is *n*. The mean error allows us to analyse whether the forecasts systematically underestimate or overestimate the realizations. In other words, whether the average growth was predicted correctly.

- The mean absolute error:

$$MAE = \sum_{t=1981}^{2001} \sum_{i=-1,0,1} |(A_t - F_{t+i,t(j)})| / n \qquad \text{where } j=2,3,4 \text{ if } i=1$$

j=1,2,3,4 if i=0

j=1 if i=-1

This statistics avoids that negative and positive forecast errors compensate each other.

- The mean percentage error:

$$MPE = \sum_{t=1981}^{2001} \sum_{i=-1,0,1} [\, (A_t - F_{t+i,t(j)}) / A_t * 100 \,] / n \quad \text{where } j=2,3,4 \text{ if } i=1$$

j=1,2,3,4 if i+0

j=1 if i=-1

This statistic relates the error to the value of the observed growth.

- The root mean squared error:

$$RMSE = \sqrt{MSE}$$

$$RMSE = \sqrt{\sum_{t=1981}^{2001} \sum_{i=-1,0,1} (A_t - F_{t+1,t(j)})^2 / n} \qquad \text{where } j=2,3,4 \text{ if } i=1$$

j=1,2,3,4 if i=0

j=1 if i=-1

This measure has two advantages. First, positive and negative forecast errors do not cancel each other out and large forecast errors are penalised.

- The decomposition of the mean squared error:

The MSE can be decomposed into three components that sum to one:

$$MC = (AG - FG)^2 / MSE$$

$$SC = (S_f - r\,S_a)^2 / MSE$$

$$RC = (1 - r^2)\,S_a^2 / MSE$$

$$MC + SC + RC = 1$$

Where AG and FG are respectively the mean of the actual growth rates and of the forecasts ; S_a and S_f are respectively the standard deviations of the actual growth rates and the forecasts and where r is the correlation coefficient between actual growth and the forecasts.

MC represents the proportion in the MSE due to the bias in the forecasts; SC measures that proportion of the forecast error that is explained by the fact that actual growth and forecasts do not evolve together; RC is the proportion of the forecast error that cannot be explained by MC and SC, it is the residual part. When forecasts are accurate, RC will be close to one and MC and SC will be small.

- The Theil-inequality coefficient :

$$U = MSE / [\, \sum A^2 / n \,]$$

The advantage of this measure is that it takes the value zero for perfect forecasts.

- The Granger-proportion :

$$G = MAE / RMSE$$

Granger[8] states that the proportion between the mean absolute error and the root of the mean squared error is usually below 0.8 for acceptable forecasts. The reason is that the forecast errors are usually sampled from a distribution with a relatively low variance, but sometimes from a distribution with a high variance. This last distribution leads to important forecast errors. The Granger-proportion decreases when there are more forecast errors taken from distributions with high variances.

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[8] See Granger (1996).

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