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Are We More Accurate? Revisiting the European Commission's Macroeconomic Forecasts

Andras Chabin, Sébastien Lamproye and Milan Výškrabka

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Abstract

In this paper, we present the results of the comprehensive assessment of the accuracy of European Economic Forecasts. High-quality macroeconomic forecasts are a prerequisite for economic surveillance of the European Commission. We evaluate forecasts for three key variables – GDP growth, consumer price inflation and the general government budget balance – on two forecast horizons – current year and one-year-ahead – over the period 2000-2017. Pointing to some improvement in the accuracy recently, the forecasts continue to show a satisfactory track record which does not differ much from the forecast track records of other international institutions. The Commission's forecasts present largely an unbiased outlook for near term economic developments, accurately foresee an acceleration and deceleration in the underlying variables and mostly contain information beyond a naïve forecast. There is room for improvement, however. The forecasts appear to be prone to repeating errors, which to some extent seems to be related to an overly conservative assessment of the business cycle dynamics and to a lesser extent to errors in technical assumptions.

JEL Classification: C1, E60, E66.

Keywords: macroeconomic forecasts, forecast errors, accuracy, statistical properties, GDP, inflation, government budget balance, European Commission.

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Contact: Milan Výškrabka, European Commission, Directorate-General for Economic and Financial Affairs, milan.vyskrabka@ec.europa.eu. Andras Chabin and Sébastien Lamproye prepared the paper while working at the European Commission, Directorate-General for Economic and Financial Affairs.

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1. INTRODUCTION

The European Economic Forecasts are an integral part of the European Commission's Treaty-based economic surveillance framework.[1] In particular, the forecasts, prepared by the staff of the European Commission, form a basis for fiscal surveillance, the surveillance of macroeconomic imbalances and the formulation of economic policy recommendations to the euro area and the Member States.[2] However, the importance of macroeconomic forecasting goes well beyond its role in the Commission's surveillance. Policy institutions, including the European Commission, employ macroeconomic forecasts also to communicate their views on economic prospects, shape the basis for policy considerations and steer expectations. In this broader application, the narrative and the assessment of risks are also key attributes of the forecast. Qualitative consistency is thus equally important and the forecast process puts strong emphasis not only on quantitative accuracy but also on overall consistency across variables and Member States.

In this paper, we focus on the quantitative accuracy of forecasts instead. We evaluate point estimates of three prominent variables in the Commission's economic surveillance, i.e. GDP growth, inflation and the general government budget balance. Each spring and autumn, an evaluation of Member States fiscal plans based on the Commission's macroeconomic forecasts widely informs the overall assessment of compliance with the EU fiscal rules. For this reason, quality forecasts are a necessary ingredient of the Commission's surveillance framework. A macroeconomic forecast is inherently an imprecise description of actual future economic developments. The role of a forecaster is to accurately assess the current state of the economy and take all available information into account when producing a forecast.

To increase the transparency and credibility of its forecasts, the Commission regularly evaluates the forecast performance. Fioramanti et al. (2016) extensively discussed the results of the last such exercise. They find that "*the European Commission's forecasts continue to display a reasonable track record, similar to that of the other international institutions*" over the entire forecast history until 2014.[3] Using a battery of statistical tests, the forecasts were found unbiased for most EU Member States, and adequately anticipated pick-ups and slow-downs. They also were more accurate than simple naïve forecasts. Moreover, the forecast errors were mostly random. The results mostly confirmed the findings of previous Commission's assessments of its forecast performance (Keereman (1999), Melander, Sismanidis and Grenouilleau (2007), González Cabanillas and Terzi (2012)). Based on a similar set of tests, forecasters at other international institutions, such as the European Central Bank, the International Monetary Fund and the OECD, also regularly carry out the assessment of the accuracy of their forecasts. Kontogeorgos and Lambrias (2019) concluded that (Broad) Macroeconomic Projection Exercises of the ECB reliably informed policymakers about future economic developments in the euro area. Yet, they also found room for improvement. Pain et al. (2014) compared the performance of OECD forecasts during and after the financial crisis. They found that projections mostly overestimated GDP growth, failed to anticipate the magnitude of the impact of the crisis and the subsequent lukewarm recovery. Similarly, Eicher et al. (2018) found that IMF forecasts for countries in times of crisis carried informational value. Bias and inefficiency were present in projections of some variables for some countries.

In this iteration of the Commission's evaluation, we extend the database by adding three years of forecasts, 2015-2017. During this period, the European economy experienced a sustained expansion

[1] Hereinafter referred to as the Commission's forecasts or simply the forecasts.

[2] This analysis evaluates Commission's forecasts until 2017, hence the UK is included and is also part of the EU aggregates calculated throughout the paper. As of 1 February 2020, the UK is no longer a Member State of the EU. During the transition period, the UK remains subject to economic and fiscal surveillance.

[3] Starting in 1969 for some Member States.

with most Member States' growth accelerating. The upswing of the business cycle did not go hand in hand with rising inflationary pressures, however. By contrast, the environment of low interest rates and swift growth helped most Member States reduce (increase) their budget deficits (surplus). Compared to earlier years, when the 2008-2009 financial crisis and the sovereign debt crisis severely challenged the performance of forecasts, the newly added period to the sample was characterised by much less volatile developments.

The first aim of this paper is to assess the relative performance of recent forecasts compared to findings in the previous evaluation exercise. To this end, we calculate basic statistics widely used to characterise forecast accuracy, namely the average error, the mean average error and the root mean square error. To explore some sources of inaccuracies, we estimate the contribution of errors in external assumptions. The second aim is to test the quality of the forecasts formally. Quality forecasts are required to be unbiased, efficiently use the information available and not repeat past errors. The third aim is to compare the Commission's forecasts with those of the OECD, IMF, the ECB and Consensus Economics.

The paper is organised as follows: section 2 introduces the data and the summary statistics used in the analysis. Section 3 explores the quantitative accuracy of the forecasts and discusses the performance of the newly added forecasts to the sample. Section 4 presents the qualitative characteristics of the forecasts based on the results of several formal statistical tests. Section 5 investigates the role of several factors that are likely to drive forecast inaccuracies. Section 6 compares the accuracy of the Commission's forecasts with forecasts of other major international institutions and private forecasters. Finally, we conclude.

2. DATA DESCRIPTION AND SUMMARY STATISTICS

2.1. DEFINITIONS AND REFERENCE PERIODS

Three prominent forecast variables are considered in this paper: real GDP growth, inflation (price deflator of private consumption) and the general government balance to GDP ratio. These variables are essential to economic analysis and policy debate. This paper deals with the current year forecast error and the year-ahead forecast error. The forecast error for a given country *i* is defined as follows:

$$e_{i,t,t} = y_{i,t,t} - y_{i,t} \quad \textit{for the current year}$$

$$e_{i,t+1,t} = y_{i,t+1,t} - y_{i,t+1} \quad \textit{for the year-ahead}$$

where $y_{i,t,t}$ and $y_{i,t+1,t}$ are the forecasts made for country *i* at time *t*, for periods *t* and *t+1* respectively; $y_{i,t}$ and $y_{i,t+1}$ are the realisations of the variable in question for country *i* for period *t* and *t+1*, respectively. Hence, positive errors indicate an overestimation, whereas negative errors indicate an underestimation of the actual outturns.

Data have been processed in a similar manner as in previous evaluations of the Commission forecasts' accuracy.[4] The current year forecasts ($y_{i,t,t}$) and current year realisations ($y_{i,t}$) are extracted from the Commission's spring forecast publications, which are published in May. The current year forecast for period *t* is taken from the spring forecast in period *t*, while the realisation for period *t* is taken from the spring forecast in period *t+1*. The year-ahead forecasts ($y_{i,t+1,t}$) and realisations ($y_{i,t+1}$) are taken from the Commission's autumn forecasts, which are published in November. The year-ahead forecasts for

[4] Keereman (1999), Melander, Sismanidis and Grenouilleau (2007), González Cabanillas and Terzi (2012), Fioramanti et al. (2016)

period t are taken from the autumn forecast in *t-1*, while the realisation of the forecast for period *t* is taken from the autumn forecast *t+1*.

The forecast errors are calculated for all EU Member States except for Croatia, the UK and for the euro area and European Union (EU) aggregates.[5] For the EU and the euro area, the aggregates reflect the changing composition over time. We focus mainly on the forecast performance in recent history, starting in 2000 and ending in 2017. This period is referred to as the baseline sample. For the sake of continuity, we include the results of the previous study in the next section. Wherever appropriate, we complement the empirical analysis with statistical tests run on the entire available sample, starting in 1969 for some Member States, in order to verify empirical findings based on the relatively short baseline sample.

Table 2.1.: **Number of observations in reference periods**

	GDP		Inflation		General Government Balance	
	'69-'17	'00-'17	'69-'17	'00-'17	'69-'17	'00-'17
Belgium	49	18	49	18	47	18
Germany	49	18	49	18	49	18
Estonia	14	14	14	14	14	14
Ireland	45	18	45	18	44	18
Greece	37	18	37	18	36	18
Spain	32	18	32	18	32	18
France	49	18	49	18	49	18
Italy	49	18	49	18	49	18
Cyprus	14	14	14	14	14	14
Latvia	14	14	14	14	14	14
Lithuania	14	14	14	14	14	14
Luxembourg	49	18	49	18	44	18
Malta	14	14	14	14	14	14
Netherlands	49	18	49	18	49	18
Austria	23	18	23	18	23	18
Portugal	32	18	32	18	32	18
Slovenia	14	14	14	14	14	14
Slovakia	14	14	14	14	14	14
Finland	23	18	23	18	23	18
Euro area	20	18	20	18	20	18
Bulgaria	11	11	11	11	11	11
Czech Republic	14	14	14	14	14	14
Denmark	45	18	45	18	41	18
Hungary	14	14	14	14	14	14
Poland	14	14	14	14	14	14
Romania	11	11	11	11	11	11
Sweden	23	18	23	18	23	18
United Kingdom	45	18	45	18	45	18
EU	49	18	49	18	49	18

Source: EC, Eurostat, own calculations.

[5] Croatia is left out due to an insufficient number of observations.

2.2. SUMMARY STATISTICS

To measure the European Commission's forecasting performance, several summary statistics are computed in this study. They are described in the paragraphs below.

2.2.1. Mean error

The mean error (ME) is the average forecast error for each country *i* over a given period *T*. It is a basic indicator of accuracy. This indicator indicates possible bias in the forecast as positive and negative errors can offset each other. Formally,

$$ME_i = \frac{1}{T}\sum_{t=1}^{T} e_{i,t,t}$$

$$ME_i = \frac{1}{T}\sum_{t=1}^{T} e_{i,t+1,t}$$

for the current year and the year-ahead forecast, respectively.

2.2.2. Mean absolute error

The mean absolute error (MAE) is the average of the absolute value of the forecast errors for each country *i* over a given period *T*. Negative errors cannot cancel out positive ones, therefore MAE does not limit the size of the error. The MAE, however, does not provide information on the direction of the error (underestimation or overestimation). Also, in the calculation of the MAE, all the errors are equally weighted in the average whatever their size. Formally,

$$MAE_i = \frac{1}{T}\sum_{t=1}^{T} \left|e_{i,t,t}\right|$$

$$MAE_i = \frac{1}{T}\sum_{t=1}^{T} \left|e_{i,t+1,t}\right|$$

for the current year and the year-ahead forecast, respectively.

2.2.3. Root mean squared error

The root mean squared error (RMSE) is the square root of the average of the squared forecast errors for each country *i* over a given period *T*. Since the errors are squared, large errors have a relatively higher weight. Therefore, the RMSE is preferred when large errors are considered particularly harmful. It is an estimate of the standard deviation of the error series. Also, the RMSE is not independent of the number of observations and does not provide information on the direction of the errors. Formally,

$$RMSE_i = \sqrt{\frac{1}{T}\sum_{t=1}^{T} e_{i,t,t}^2}$$

$$RMSE_i = \sqrt{\frac{1}{T}\sum_{t=1}^{T} e_{i,t+1,t}^2}$$

for the current year and the year-ahead forecast, respectively.

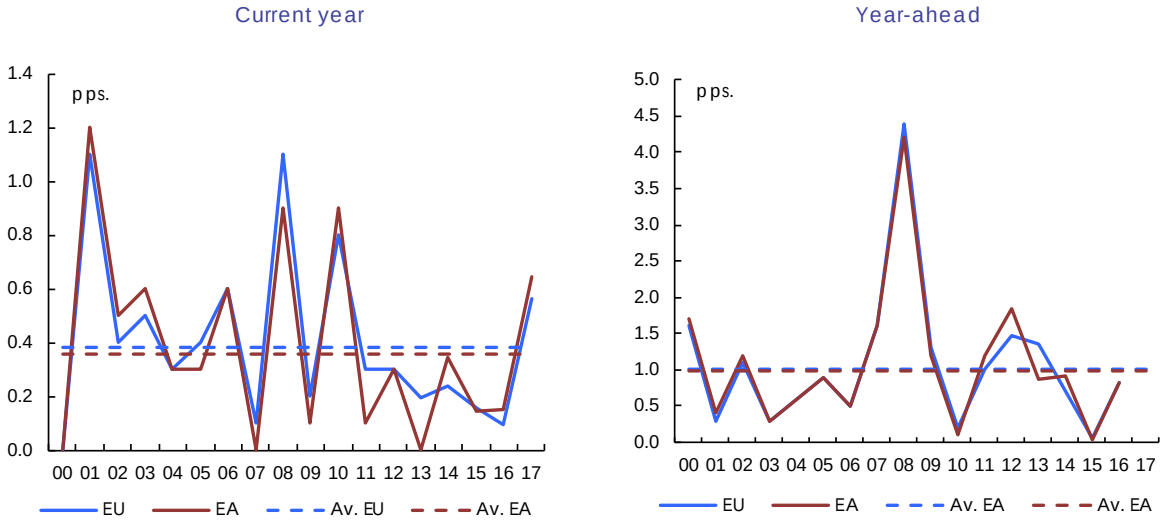
3. FORECASTING PERFORMANCE IN RECENT YEARS

In this section, we discuss the performance of recent macroeconomic forecasts by comparing errors over the period 2000-20017 (baseline sample) to the reference period 2000-2014. This section also subjects the forecasts to standard metrics of forecast errors that provide. We discuss the ME, MAE and RMSE for real GDP growth, inflation and general government balance in percentage of GDP. Detailed summary statistics are provided in Annex.

3.1. GROSS DOMESTIC PRODUCT

The current year forecasts of GDP growth performed reasonably well in the years 2015-2017. Adding these years to the reference sample 2000-2014 slightly improves the overall forecast accuracy. As measured by both the MAE and the RMSE, the forecast error for real GDP growth for the current year declined somewhat for both the EU and euro area aggregates (Table A.1 in Annex). Graph 3.1 shows that the forecasts undershot the economic expansion in 2015-2017 after having overestimated the expansion in the preceding years. Hence the average error (ME) decreased more significantly compared to the other two measures of accuracy. Further back, forecast errors for the current year were particularly high in the years 2001 (bursting of the dotcom bubble), 2008 (the financial crisis) and 2010 (sovereign debt crisis); all dominated by major shocks. The forecast also did not accurately anticipate the strength of growth in 2017. The current year forecast errors for both the EU and the euro area for the crisis and post-crisis period (2008-2017) are slightly lower compared to those for the pre-crisis period (2000 to 2007). Compared to historical standards, the current year growth forecasts fared particularly well in the period between 2011 and 2016.

Graph 3.1.: **Gross domestic product, absolute error**



Source: EC, Eurostat, own calculations.

For the year-ahead forecasts, errors are markedly larger than for the current year forecasts as much less information is available at the time of forecasting. Similarly to the current year forecasts, the overall accuracy improved for both the EU and euro area aggregates in 2015-2017. The MAE and RMSE fell slightly while the ME decreased more significantly. The year-ahead forecast for 2009 projected some slowdown in economic activity in both the EU and the euro area, but failed to anticipate the contraction. The forecast error for 2009 is by far the largest error in the sample period. By contrast, for the current year forecasts, the forecast error for 2009 was small, as the economy was already formally in recession and forecasters had more information at the time of forecasting. For year-ahead forecasts, the accuracy deteriorated in the crisis and post-crisis period compared to the pre-crisis period for both the EU and euro area aggregates as volatility of GDP growth increased in this period and the forecasts struggled to anticipate factors driving the economy.

At the Member State level, the current year forecasts for the years 2015-2017 reduced the overall error in 18 Member States when measured by the ME and 19 Member States when measured by the RMSE. The average reduction in the ME reached about 9% while the RMSE decreased by about 6% on average. Current year forecasts for GDP growth in Latvia, Slovakia, Hungary, the UK and Belgium improved by more than 10%, as measured by the ME. On the other hand, the forecast accuracy worsened in 8 Member States when measured by the ME and in 5 Member States when measured by the RMSE. The average increase in the absolute error was about 10%. More country forecasts recorded an increase in the average error. The increase is either negligible or the error is quantitatively small in most cases, however.

For the year-ahead forecast, the results show an improvement in the forecast accuracy in 23 Member States when measured by the ME and 25 Member States when measured by the RMSE. The average decrease in both the mean absolute error and the root mean square error is about 9%. The accuracy of the forecasts for Estonia, Latvia, Lithuania and Slovakia improved more than the accuracy for other countries. The accuracy of the forecasts for Ireland, Greece, Malta and Bulgaria decreased when the forecasts for Ireland recorded a significant decline in overall performance.[6] Similarly, four country forecasts recorded an increase in the mean error – Ireland, Malta, Slovakia and Poland – when Ireland clearly stands out while deterioration for Slovakia and Poland are not substantial.

Unlike for the euro area and the EU, some deterioration in the forecast accuracy can be seen for most EU Member States for both the current year and year-ahead forecasts in the post-crisis period compared to the pre-crisis period. The deterioration is, in general, much more pronounced for the year-ahead forecasts. For the current year forecasts, the largest increase in the MAE in the crisis (and post-crisis) period compared to the pre-crisis period can be seen for Cyprus, Greece and Ireland; three countries that were under an Adjustment Programme. There are however some exceptions where the forecast accuracy improved for the current year (e.g. France, the Netherlands, Belgium and Slovakia, Czech Republic and Poland). For the year-ahead forecasts, the same Programme countries reported the largest increases in the MAE. Poland, Slovakia and Belgium stand out as the countries for which the forecast error decreased in the post-crisis period compared to the pre-crisis period.

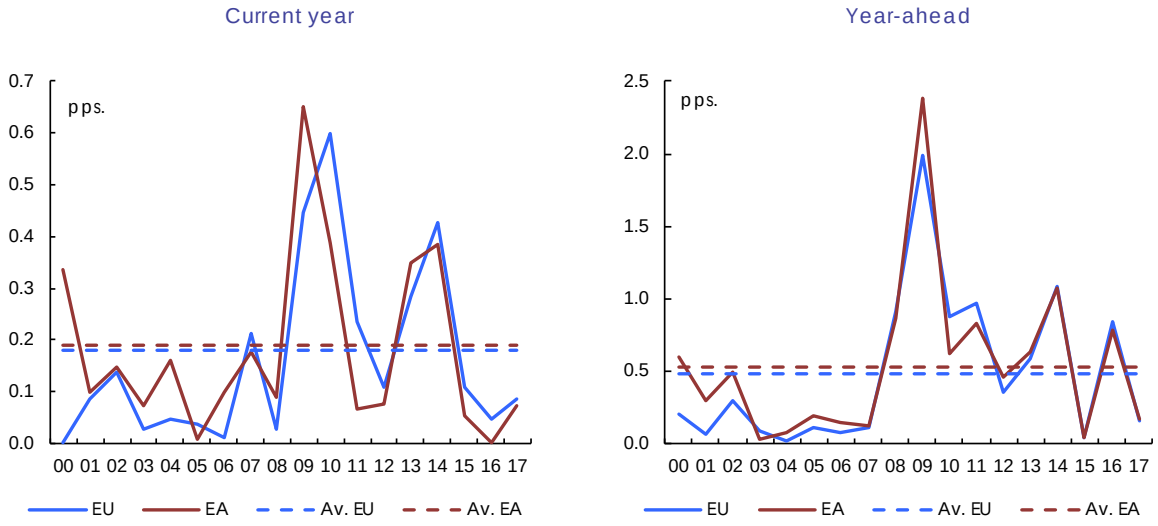
3.2. INFLATION

Errors in the forecasts of inflation measured as the annual rate of change in the price deflator of private consumption are lower than those in GDP growth as the latter is somewhat more volatile. The addition of three years to the sample marginally reduces the MAE and RMSE for both the EU and the euro area. The current year forecasts of inflation for the years 2014-2017 missed the outturns for the euro area and the EU by a narrow margin when in all instances the forecasts overshot actual inflation. Forecast performance in these three years ended a period of substantially larger errors between 2009 and 2014 (see Graph 3.2). In this period, a sharp drop in inflation in 2009 was followed by an equally fast rebound the next year with a gradual slowdown afterwards. The forecasts did not fully envisage the erratic behaviour at the beginning of the period, neither did they recognise the changing trend in the second half of the period. The average error over the whole studied sample is, however, very close to zero.

The accuracy of the one year-ahead forecasts slightly improved as well. Both the MAE and the RMSE decreased in both the euro area and the EU by adding three new observations. The magnitude of errors does not differ significantly from the magnitude of errors in a few previous years. Similarly to the current year forecasts, most year-ahead forecasts overestimated the actual outturns since 2013. Despite a series of positive errors, the average error over the whole sample remains very close to zero.

[6] The Irish economy is a good example of a challenge that forecasters may face. One-off accounting operations of large multinational corporations, such as those in 2015, can substantially impact overall economic growth with detrimental consequences for the accuracy of any forecast.

Graph 3.2.: **Inflation, absolute error**



Source: EC, Eurostat, own calculations.

In general, the accuracy of inflation forecasts deteriorated after the crisis as evidenced at the aggregate (see Graph 3.2) and Member States levels. The magnitude of both current year and one year-ahead forecast errors is substantially larger after 2009. Unlike in the case of the GDP forecasts, the crisis marked the beginning of a prolonged period of reduced accuracy of inflation forecasts. On average, the errors are close to zero in both the pre-crises and post-crisis period, however.

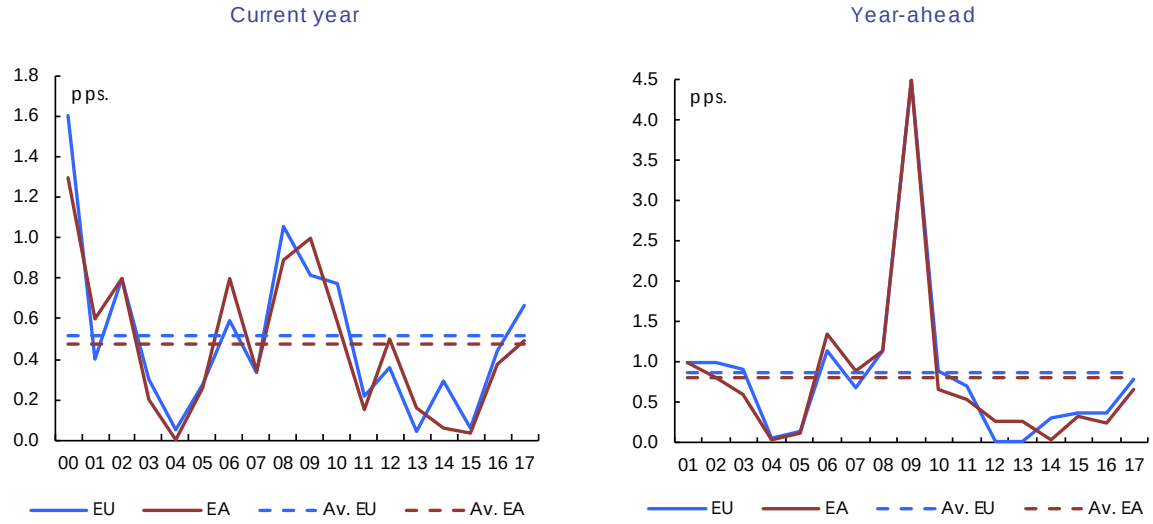
At the Member State level, improving forecast records for the current year are also evident for Member States, as the MAE and the RMSE of the current-year forecasts of all Member States decreased as a result of the addition of the 2015-2017 period. With respect to the year-ahead forecasts, the accuracy increased for all Member States except Luxembourg and Denmark with these two countries recording only marginal deterioration in both the MAE and the RMSE.

3.3. GENERAL GOVERNMENT BALANCE

Turning to the general government balance-to-GDP ratio, errors in current-year forecasts were larger around the turn of the century than during the 2008-2009 crisis, as was also the case of the current-year GDP forecast errors. The addition of three years of data leads to a small improvement in the forecasting performance in terms of both the MAE (see Table A.3 in Appendix) and RMSE. In all three years, the Commission's current year forecasts underestimated the pace of fiscal consolidation in both the EU and the euro area. Similarly to the GDP growth forecasts for this period, errors are larger towards the end of the sample as the business cycle culminated. In terms of the average error, the current year forecasts of the general government balance-to-GDP ratio performed well, see Graph 3.3.

With the exception of the year 2009, the pattern of the one-year-ahead forecast errors closely resembles the pattern of the current year forecast errors. Especially due to the year 2009, the accuracy statistics of the year-ahead forecasts are worse than those of the current year forecasts. Three newly added observations to the sample are negative, their magnitude is smaller compared to the past errors, which improve overall forecast performance when measured by any performance statistics. Gains in the accuracy are larger when measured by the average error (ME) as the negative errors in 2015-2017 compensate for the overall positive error accumulated in the period before.

Graph 3.3.: **General government balance, absolute error**



Source: EC, Eurostat, own calculations.

At the Member State level, the accuracy of the current year forecasts improved for 17 Member States when measured by the ME and for 21 Member States when measured by the RMSE. The average improvement in the forecast accuracy is about 10%. On the other hand, the addition of three new observations led to some deterioration in the forecast accuracy in 9 Member States when measured by the MAE and in 5 Member States when measured by the RMSE. The average rate of deterioration is about 7%. In terms of the mean error, the forecast accuracy improved in only 14 Member States while it deteriorated in 11 Member States. In all but two Member States, the current year forecast errors in the period 2014-2017 were negative.

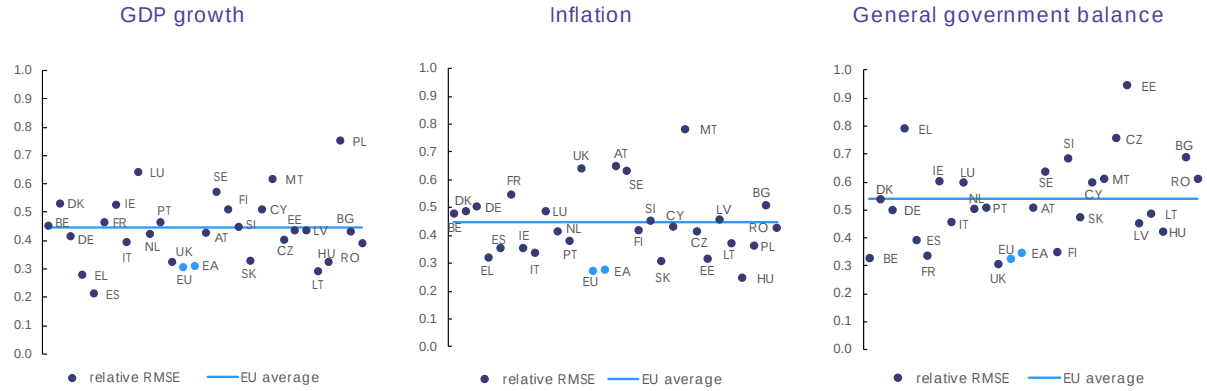
The accuracy of the one year-ahead forecasts improved for a majority of the Member States. Only 5 Member States recorded some deterioration in the forecast accuracy; the forecasts for Malta stands out in this group with the largest rise in the ME. All other Member States recorded an improvement in the forecast accuracy. The average gain in improvement reached 10% when measured by the MAE and 8% when measured by the RMSE.

3.4. VOLATILITY ADJUSTED FORECAST ERRORS

In general, forecasts for some countries are more accurate than for others irrespective of the variable in question and the forecast horizon as we document in Tables A.1-A.3. There is a number of factors out of forecasters' control, which may substantially affect the ex post evaluation of forecast performance. Namely, the stability of the economy, changes in accounting standards and data quality with frequent and large revisions are typical factors that make forecasting for some countries more challenging than for others. Naturally, forecasts of more volatile variables are likely to be less accurate in terms of either the MAE or the RMSE. In this section, we explore to what extent the RMSEs are related to the volatility of the underlying data. By normalising the RMSEs by the corresponding standard errors, one can isolate the impact of one determinant of forecast errors, see Graph 3.4.

Taking into account the volatility of the underlying data, current year forecasts of GDP growth are more accurate on average than forecasts of the other two variables although only slightly so with respect to the forecasts of inflation. Similarly, the dispersion of relative RMSEs is lowest for GDP growth forecast and largest for the general government balance. In the previous sections, forecasts for the euro area and the EU came out among the most accurate. Unsurprisingly, forecasts for the two areas continue to dominate in terms of relative performance. The fact that forecasts for the two blocks are the result of aggregation of individual forecasts of Member States contributes to higher accuracy as errors of the opposite sign offset one another in aggregation.

Graph 3.4.: **Volatility adjusted forecast errors, 2000-2017, RMSE, current-year**



Note: RMSE for each Member State is normalised by the respective standard deviation of the data.
Source: EC, Eurostat, own calculations.

RMSEs are closely related to the standard deviation of the underlying data series. Of course, the volatility in the underlying data is only one of many factors affecting the forecast accuracy, and relative performance of forecasts differ across Member States due to a number of factors as briefly outlined in Introduction.

4. PROPERTIES OF THE FORECAST ERRORS

This section focuses on the statistical properties of the forecast errors, as presented in the preceding chapter. As we argue above, a proper assessment of the state of the economy and the use of all relevant information should lead to errors that are random and not large on average. Following the literature, these essential criteria translate into a series of statistical tests detecting the presence of bias, error persistence and informational efficiency, and also challenge the forecasts against a simple benchmark model.[7]

Generally, the tests are performed using linear regressions for each of the 27 Member States and for the EU and euro area aggregates where feasible. The feasibility depends mainly on the sample size (see Table 2.1). When the sample size is too small to perform a reliable regression analysis, non-parametric alternatives are used. In case non-parametric tests are not suitable or not available, panel regressions are used to get an overall picture across Member States. In the baseline scenario, the tests are performed on the period 2000-2017. In order to assess the power of statistical tests and stability of regression results, the analysis is complemented by tests run on the entire sample, starting in 1969 for some Member States. The results of the tests performed on the entire sample are reported in Appendix.

4.1. ARE THE PROJECTIONS BIASED?

Forecasts from public national or international institutions are often assumed to be too optimistic. Criticism was notably voiced against the Commission's forecast during the Great Recession of 2008-2009 and the subsequent period of a slower-than-expected recovery.[8] The issue at stake is the presence of bias. Unbiasedness requires the forecast errors to be close to zero on average over the sample. In other words, it prescribes that there is no systematic over- or under-estimation of a selected variable.

[7] For example Fioramanti et al. (2016), Bank of England (2015), Kontogeorgos and Lambrias (2019)

[8] https://www.euractiv.com/section/social-europe-jobs/news/commission-too-optimistic-in-economic-growth-forecasts-analyst-says/

In order to test whether the Commission's forecasts are biased, the projection errors are regressed on a constant as follows:

$$e_{i,t,t} = \alpha + \varepsilon_{i,t,t} \quad (1)$$

$$e_{i,t+1,t} = \alpha + \varepsilon_{i,t+1,t} \quad (2)$$

Where $e_{i,t,t}$ and $e_{i,t+1,t}$ stand for the current year and year-ahead forecast errors for country i at time t respectively, and ε for an independently and identically distributed error term. In the absence of bias, the constant term should not be statistically different from zero, i.e. $\alpha = 0$. Below, an estimate is considered statistically significant when the corresponding p-value is less than 0.05. The null hypothesis of the absence of a bias is then rejected at the 5% significance level.

4.1.1. Gross Domestic Product

Fioramanti et al. (2016) found, in line with the previous Commission's studies, that there was no evidence of bias in the Commission's projections for GDP growth for the EU and euro area aggregates, except for the year ahead forecasts with respect to the EU when tested on the entire sample. In the updated sample, from 2000 to 2017, the results still hold (Table 4.1). The single-series regressions for both areas indicate a positive but statistically not significant average error in the year-ahead forecasts. Taking into account all Member States data, the panel regression confirms a slight upward bias of the year ahead forecasts. This more powerful tool shows that the positive bias in the year-ahead forecasts is statistically significant at the 1% level.

At the Member State level, the forecast for Italy remains the only country forecast to have a bias that is statistically significant at the 1% level, for both the current year and year-ahead forecasts. Compared to the previous Commission study, the existence of bias has been detected for more Member States when extending the observation sample to 2017. With regards to the current year, negative and statistically significant bias was found for the forecasts of Malta and Denmark. For the year ahead forecasts, positive bias was found for the forecasts for Belgium, France, Italy and Portugal.

As indicated by the single-country regression results for both areas and the panel regression, current year forecast average error for most Member States is not only quantitatively small, there is also no systematic qualitative pattern. The average error is positive for twelve countries and negative for fifteen countries. The results are markedly different for the year-ahead forecasts. In general, forecasts overestimated GDP growth one-year-ahead when forecasts for only four Member States recorded a negative average error. Member States whose economic growth was underestimated grew swiftly over the period of evaluation (Poland, Slovakia, Malta and Ireland). In general, forecasts underestimated one-year-ahead GDP growth in the pre-crisis years (2000-2007) while in post-crises years, the average error was positive in most countries. The financial crisis and later the sovereign debt crisis in Europe was a challenging period for forecasters when GDP growth persistently underperformed average growth rates. Performance of the forecasts in more recent years (2015-2017), however, helped to reduce the inaccuracy for most Member States.[9]

4.1.2. Inflation

Unlike the forecasts of GDP growth, Fioramanti et al. (2016) found the Commission's forecast of inflation for the euro area and the EU unbiased on both forecast horizons. In the updated sample, 2000-2017, the inflation forecasts for the two aggregates continue to display no bias.

In the 2000-2017 period, the panel regression shows no bias for both current year and year-ahead inflation forecasts. This also holds for the aggregated euro area and EU variables. However, among Member States, in addition to the bias for Spain (which is now only significant at the 10% level) and

[9] see Section 3.1

Malta, forecasts for Belgium, France and Austria also came out with a large and statistically significant bias for the current year forecast.

In the pre-crisis period (2000-2007), the year-ahead inflation was on average underestimated across for the EU and the euro area (-0.1 pps. and -0.23 pps., respectively), while in the 2008-2017 period, inflation projections were somewhat biased upwards at both horizons. These findings are supported by the panel regressions as well, with coefficient estimates of -0.27 and -0.25 in the pre-crisis period for the current year and year-ahead projections, respectively, and 0.11 and 0.22 in the post-crisis sample for the two horizons. All of the panel regression estimates are significant at the 5% significance level.

Table 4.1.: **Tests for forecast bias, 2000-2017**

	GDP		Inflation		General Government	
	current year	year ahead	current year	year ahead	current year	year ahead
Belgium	0.05	0.31**	-0.25***	-0.25***	-0.03	0.00
Germany	-0.10	0.23	0.03	0.13**	-0.50*	-0.39
Estonia	-0.06	0.73	-0.23	-0.07	-0.70	-0.94
Ireland	-0.71	-1.34	0.11	0.38	1.25	1.35
Greece	0.33	1.21	-0.17*	-0.14	1.73**	2.34***
Spain	-0.14	0.28	-0.21*	-0.25	0.63	0.93
France	0.18*	0.50***	0.18***	0.03	0.09	0.19
Italy	0.41***	0.99***	0.02	-0.04	0.15**	0.29**
Cyprus	-0.58	0.80	0.40	0.46	0.04	-0.38
Latvia	-0.35	0.48	-1.28	-1.48*	-0.55	-0.72
Lithuania	0.05	0.48	-0.26	-0.37	-0.28	-0.50
Luxembourg	-0.04	0.29	-0.12	0.06	-0.98***	-1.64***
Malta	-0.79**	-0.65	0.37**	0.38***	-0.42	-0.70
Netherlands	0.19	0.50	0.10	0.25	-0.30	-0.10
Austria	0.01	0.35*	-0.19***	0.04	-0.43***	-0.39***
Portugal	0.11	0.58**	-0.13	0.08	0.27***	0.98***
Slovenia	-0.14	0.50	0.06	0.54	0.43	0.49
Slovakia	-0.47	-0.13	0.12	0.36	0.05	0.19
Finland	0.26	0.67	0.01	-0.03	-0.36*	-0.32
Euro Area	0.09	0.38	0.02	0.01	-0.01	0.13
Bulgaria	-0.05	0.59	0.06	0.41	-0.07	0.70
Czech Republic	-0.35	0.13	0.16	0.30	-0.86***	-0.99*
Denmark	0.46**	0.76*	0.11	0.09	-0.85***	-0.92**
Hungary	0.09	0.46	0.06	0.15	-0.16	-0.59
Poland	-0.41*	-0.26	0.04	0.18	0.48	0.50
Romania	-0.16	0.82	0.31*	-0.06	0.16	0.36
Sweden	-0.02	0.18	-0.11	0.26**	-0.72***	-0.79***
United Kingdom	0.19*	0.39	-0.01	-0.06	-0.14	0.19
EU	0.10	0.34	0.02	0.03	-0.06	0.11
Overall	-0.04	0.36***	-0.03	0.04	-0.07	-0.01

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
Reported values are the estimated average errors, α, from equations (1) and (2).
Source: EC, Eurostat, own calculations.

4.1.3. General government balance

In the case of the general government balance, only the budgetary measures known in sufficient detail or approved by the national parliaments are taken into account. This may have had a particular impact on forecast errors and bias, notably for year-ahead forecasts, which are mostly based on a no-policy-

change assumption. The government budget balance projections for the EU and euro area aggregates appear as unbiased for both the current year and the year-ahead forecasts.

For the 2000-2017 period, the panel regression shows no bias for general government balance forecasts. At the Member State level, forecasts for Greece, Italy and Portugal exhibit positive, while forecast for Luxembourg, Austria, Denmark and Sweden exhibit negative biases for both horizons. Depending on the country and the year, a negative average error for the government balance can either mean that the surplus was underestimated or that the deficit was overestimated. For Greece, Italy and Portugal, the positive bias for that period appear to refer to an underestimation of the deficit.

4.2. ARE THE PROJECTION ERRORS PERSISTENT?

If forecasters repeat the same mistakes (or compensate past mistakes by subsequent errors of the opposite sign), forecast errors will be positively (negatively) autocorrelated. In this study, we employ the Ljung-Box test for testing serial correlation in errors up to two lags.[10] An estimate is considered statistically significant when the corresponding p-value is below 0.05. The null hypothesis of absence of autocorrelation in forecast errors is then rejected at the 5% level.

4.2.1. Gross Domestic Product

Between 2000 and 2017, there is no evidence of serial correlation in GDP growth forecast errors for the EU and the euro area either for the current year or year-ahead forecasts. At the Member State level, forecasts for twelve countries show statistically significant persistence in errors at the first lag of current-year forecasts. Positive serial correlation is a typical pattern when only three of these twelve countries have a negative autocorrelation coefficient. Forecasters typically tend to smooth forecasts and do not adequately capture upswings and downswings of the business cycles, as shown below. Adding another lag, the number of countries with significantly persistent errors drops to eight. For three of these countries (Bulgaria, Hungary and Poland), the sample is shorter as they entered the EU in and after 2004 hence the test may not be powerful enough, and the results should be interpreted with caution. In order to assess the robustness of the results, the test was run on the entire sample. The results (see Table A.5 in Appendix) reveal that serial correlation in errors is a systematic feature of the current-year forecasts for Greece, Spain, Italy, Austria and Sweden.

For one-year-ahead forecasts, there is no evidence of serial correlation in errors for the euro area and the EU in the sample period starting in 2000. At the Member States level, the number of countries with statistically significant autocorrelated one-year-ahead forecast errors is lower than in the case of current year forecasts. The test identifies serial correlation at both lag lengths (one lag and two lags) only in forecasts for Spain. Furthermore, there is also some evidence of error persistence in forecasts for Greece Sweden and Estonia, and to a lesser extent for Slovakia, Bulgaria, Poland and Romania.

4.2.2. Inflation

For inflation, no error persistence was identified either for the euro area or for the EU in the current year forecasts. At the Member States level, errors in the forecasts for Germany, Bulgaria and Poland are found to be serially correlated at both lag lengths (one lag and two lags). For additional nine countries, errors are found to be autocorrelated at either the first lag or first two lags. Unlike in the case of GDP growth forecasts, positive autocorrelation does not dominate in inflation forecast errors when thirteen countries have positively correlated errors (irrespective of the magnitude of autocorrelation) and fourteen countries have a negative autocorrelation coefficient at the first lag. At two lags, negative serial correlation is prevalent (22 countries). The post-2000 period was

[10] See Box 4.1 in Fioramanti et al. (2016) for details.

characterised by increased error persistence as the strength of serial correlation falls below the level of statistical significance at the longer sample period.

For one-year-ahead forecasts of inflation, there is no evidence of serial correlation in errors for the euro area and the EU in the period 2000-2017. At the Member States level, forecast errors for Malta and Slovakia are found to be serially correlated at both lag lengths (one lag and two lags). Furthermore, errors for Belgium, Ireland, Slovenia and Romania are found to be serially correlated when considering two lags. Like in the case of current-year forecast, negative serial correlation dominates in the country sample with 19 countries having negative autocorrelation coefficients.

Table 4.2.: **Tests for error persistence, current-year, 2000-2017**

	GDP		Inflation		General Government Balance	
	lag 1	lag 2	lag 1	lag 2	lag 1	lag 2
Belgium	-0.47***	-0.14*	-0.24	-0.13	-0.01	-0.18
Germany	0.26**	-0.17	-0.3**	-0.33***	0.27	0.2*
Estonia	0.26	-0.37	-0.20	-0.37	0.2**	-0.43*
Ireland	-0.17	0.27	0.34	-0.30	0.19*	0.12
Greece	0.73***	-0.29	-0.16	-0.24	0.02	-0.23
Spain	0.44**	-0.39	-0.07	-0.03	0.34*	-0.38***
France	-0.38***	-0.03	0.01	-0.5***	0.11	-0.24
Italy	-0.44**	-0.45	0.16	-0.04	-0.45***	-0.67**
Cyprus	0.21	-0.09	0.42**	-0.29	-0.13	-0.20
Latvia	0.29**	-0.40	0.61***	0.08	-0.3*	-0.36***
Lithuania	0.08	-0.40	0.01	0.31**	0.32	0.04
Luxembourg	0.18***	-0.47**	0.08	0.01	-0.25***	-0.34
Malta	0.11	-0.19	-0.51**	-0.11	0.42	-0.12
Netherlands	0.18	0.27**	0.12	-0.36*	0.15	-0.01
Austria	0.19**	0.17**	-0.23*	-0.17	0.05	0.26
Portugal	-0.01	0.14	0.13	-0.32***	-0.32	-0.42*
Slovenia	0.25	-0.07	-0.10	-0.20	-0.02	0.01
Slovakia	0.11	-0.28	-0.15	-0.23	0.41**	-0.33
Finland	-0.14	-0.28	-0.08	0.33	-0.02	-0.32
Euro Area	-0.05	-0.14	-0.20	-0.20	0.41*	-0.57**
Bulgaria	0.11**	0.38**	-0.33**	-0.16***	0.49	-0.36
Czech Republic	0.13	0.02	0.27	-0.15	-0.25	-0.08
Denmark	0.12	-0.4**	0.61***	-0.27*	-0.03	-0.43**
Hungary	0.59**	-0.8***	-0.01	-0.4***	-0.03	-0.25**
Poland	-0.14**	-0.17**	0.56***	-0.32***	-0.13*	-0.01
Romania	0.28	0.15	-0.65***	-0.14	-0.32***	0.00
Sweden	-0.20	-0.28**	-0.20	0.09	-0.04	-0.25
United Kingdom	0.11	-0.30	0.23	-0.06	0.31**	-0.28
EU	-0.17	-0.20	0.05	-0.21*	0.23	-0.54**

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
The table reports the Ljung-Box test statistics.
Source: EC, Eurostat, own calculations.

4.2.3. General government balance

Current-year forecasts errors of the general government balance show persistence for both the euro area and the EU at two lags while serial correlation at the first lag is only mildly statistically significant (at the 10% level) for the euro area. As regards Member States, only forecasts for Italy show a serial correlation in errors at both lag lengths. Forecasts for additional nine countries show a serial correlation in errors at either one lag or two lags. The errors for Estonia, Spain and Latvia are found to be serially correlated at one lag length and mildly statistically significant at the other lag

length. Furthermore, forecasts for Luxembourg, Slovakia, Denmark, Hungary, Romania and the UK show some autocorrelation at one lag length only.

For one-year-ahead forecasts of the general government balance, errors for the euro area are found to be statistically significant at two lags while there is less evidence of persistence in errors for the EU. Forecasts for eleven Member States are found to show persistence in errors. When cross-checked with the results on the longer sample period, errors for Ireland, Austria and Sweden continue to be serially correlated.

Table 4.3.: **Tests for persistence, year-ahead, 2000-2017**

	GDP		Inflation		General Government Balance	
	lag 1	lag 2	lag 1	lag 2	lag 1	lag 2
Belgium	-0.48	-0.49*	-0.27	-0.46**	-0.23*	-0.28*
Germany	-0.33	-0.39*	-0.51*	-0.28	0.13	-0.28*
Estonia	0.40***	-0.42***	-0.35	-0.48**	0.16	-0.52***
Ireland	0.14	0.01	0.00	-0.38***	0.59***	0.06
Greece	0.43*	0.65**	-0.33	-0.13	-0.20	-0.34
Spain	0.56***	-0.51**	-0.05	-0.13	0.40**	-0.35
France	-0.25	-0.30	-0.20	-0.26	-0.06	-0.19
Italy	-0.10	-0.43*	-0.06	-0.20	-0.33	-0.70***
Cyprus	0.16	-0.22*	-0.17	0.05	0.02	-0.23
Latvia	0.33	-0.40	0.08	0.10	0.38***	-0.51*
Lithuania	-0.10*	-0.40*	0.01	-0.10**	0.15	-0.23**
Luxembourg	0.36*	-0.35	0.03	-0.01	-0.33*	-0.44*
Malta	0.19	-0.05	-1.04***	-0.4***	0.69*	-0.07
Netherlands	-0.11	-0.09	-0.14	-0.09	0.07	0.03
Austria	-0.21	-0.34*	-0.27	-0.43	-0.36***	-0.24
Portugal	-0.31	-0.26	-0.15	-0.20	-0.09	-0.44*
Slovenia	0.14	-0.21	-0.26	-0.38***	-0.39*	-0.20
Slovakia	-0.15	-0.27***	-0.36***	-0.27**	0.29***	-0.33
Finland	-0.08	-0.31	-0.19	-0.22	-0.14	-0.38**
Euro area	-0.09	-0.31	-0.29	-0.25	0.07	-0.34**
Bulgaria	0.05	0.12***	0.05	-0.22	0.23	-0.21*
Czech Republic	0.04	-0.20	-0.03	0.06	0.09	-0.25
Denmark	0.19	-0.09	-0.15	0.51*	0.07	-0.21*
Hungary	-0.01	0.00	0.07	-0.05	-0.14	-0.26*
Poland	-0.44	-0.74***	0.19	-0.32	-0.19	-0.29*
Romania	0.29***	-0.01	-0.25	0.24***	-0.01	0.20**
Sweden	-0.14	-0.29**	-0.17	-0.07	0.06	-0.40**
United Kingdom	-0.10	-0.14	0.13	-0.09	0.06	-0.04
EU	-0.10	-0.27	-0.27	-0.21	0.02	-0.30*

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
The table reports the Ljung-Box test statistics.
Source: EC, Eurostat, own calculations.

4.3. ARE THE PROJECTIONS QUANTITATIVELY ACCURATE?

In this section, we test whether the EC's forecasts systematically beat naïve forecasts. In this work, the naïve forecast is defined as keeping the variable in question at the latest known actual value. For example, the current-year naïve forecast for GDP growth in year *t* would be the actual growth rate in period *t-1*. The literature assessing the performance of different forecast models typically finds it

difficult to beat a naïve forecast systematically, especially on longer forecast horizons.[11] The Diebold-Mariano test is used to statistically assess the difference between the two forecasts.[12] The null hypothesis of the naïve forecast being equally accurate than the Commission's forecast is tested against the alternative stating that the Commission's forecast is more accurate. An estimate is considered statistically significant when the corresponding p-value is below 0.05.

The test statistics for all three variables and both forecast horizon come out almost uniformly positive suggesting that Commission's forecasts for most Member States were more accurate than the naïve counterparts in quantitative terms. In many cases, the difference between the performances of the two forecast types is not sufficient to safely reject the null hypothesis, however.

4.3.1. Gross Domestic Product

The Commission's current year forecasts of GDP growth for the euro area and the EU are found to be significantly more accurate than the naïve forecasts. The current year forecasts for Germany, France, Bulgaria, Denmark, Poland, Sweden and the UK do not outperform the naïve forecasts, however. It turns out that the Commission's forecasts did not fare much better than the naïve forecasts for all these countries except Poland, especially in the post-crisis period. Prior to 2008, the forecasts for Germany and Sweden seem to be more accurate than the naïve forecasts.

The year-ahead Commission's forecasts could not systematically beat the naïve forecasts. The forecasts neither for the euro area nor for the EU significantly outperformed the naïve forecasts. It turns out that the forecasts failed to beat the naïve model, especially in the post-crisis period, which was characterised by a relatively steady GDP growth favouring the naïve type of forecast. The situation is similar at the Member States level. The year-ahead GDP growth forecasts for only seven countries are significantly more accurate than the naïve forecasts.

4.3.2. Inflation

The Commission's current-year forecasts of inflation for the euro area and the EU are statistically more accurate than the naïve forecasts. At the Member States level, the majority of countries show a significantly better forecasting power than that of the naïve forecast (only the test statistics for Belgium, Spain, France, Luxembourg and Portugal are not significant at the 5% level, although the Commission's forecast errors are smaller than the naïve forecast errors for these countries). Like in the case of GDP growth forecasts, forecasts for all Member States that have a longer forecast record significantly beat the naïve forecast.

By contrast, the picture for the year-ahead forecasts is quite different from the Commission's forecasts for 13 Member States not performing statistically better than the naïve forecasts. The same holds for both aggregates, the euro area and the EU. The one-year-ahead forecasts for seven countries cannot beat the naïve forecasts irrespective of the sample period. In absolute accuracy, the Commission's forecast continue dominating naïve forecasts, however.

4.3.3. General government balance

There is no statistical evidence that the euro area and EU aggregates current-year forecasts of the general government balance outperform the naïve forecasts in the baseline period. Similarly, the forecasts for nine Member States are not statistically better than the naïve forecasts even though Member States' budgets are generally known and incorporated into the forecast. Forecasts for Member States except the Netherlands with a longer forecasts record appear to perform better than the naïve forecast, however.

[11] See for example Faust and Wright (2013), Giannone et al. (2014) for more details.
[12] See Box 4.1 in Fioramanti et al. (2016) for details.

Year-ahead forecasts for the euro area, the EU and 14 Member States could not beat the naïve forecast in the baseline sample. This finding is rather robust as the forecasts for only the euro area, the EU, Austria, Portugal and Finland are found be more accurate than the naïve forecasts in the entire sample.

Table 4.4.: **Diebold-Mariano test, 2000-2017**

	GDP		Inflation		General Government	
	current year	year ahead	current year	year ahead	current year	year ahead
Belgium	2.25**	1.01	1.09	0.84	1.30	1.29
Germany	1.67*	1.23	2.37**	1.77**	2.35**	2.19**
Estonia	2.40**	1.81**	1.77**	1.88**	0.40	0.37
Ireland	3.39***	1.31	1.75**	1.84**	1.86**	1.25
Greece	2.25**	2.13**	2.78***	1.84**	2.42**	2.56**
Spain	2.05**	1.35*	1.38*	0.48	1.85**	1.30
France	1.27	0.26	1.13	-0.04	1.57*	-2.78
Italy	2.06**	1.55*	2.02**	0.39	2.55**	2.42**
Cyprus	2.48**	2.23**	2.5**	1.94**	2.63***	2.97***
Latvia	2.36**	1.63*	2.21**	1.69*	-1.07	-1.24
Lithuania	1.98**	1.31	4.13***	2.79***	2.12**	0.81
Luxembourg	2.87***	2.12**	1.72*	-2.73	2.50**	2.40**
Malta	2.74***	1.99**	3.78***	1.48*	3.19***	2.58***
Netherlands	2.09**	-0.91	2.45**	-12.73	0.72	-9.55
Austria	1.95**	1.29	3.26***	1.08	1.51*	2.49**
Portugal	2.87***	0.45	1.66*	1.29	1.73*	1.99**
Slovenia	2.07**	1.54*	1.95**	1.66*	2.04**	1.39*
Slovakia	1.94**	1.40*	3.74***	3.50***	2.12**	2.26**
Finland	2.04**	1.37*	3.09***	3.20***	1.96**	1.92**
Euro area	1.98**	0.96	1.82**	0.89	1.72*	1.65*
Bulgaria	1.46*	-1.35	2.41**	2.41**	1.49*	-1.82
Czech Republic	2.16**	1.49*	1.85**	2.05**	2.4**	0.10
Denmark	0.44	-0.30	1.81**	1.04	2.07**	2.65***
Hungary	2.47**	1.75**	3.36***	3.56***	2.09**	1.64*
Poland	-3.32	-3.70	3.29***	6.39***	3.67***	3.01***
Romania	1.86**	1.89**	3.39***	2.58***	-5.60	-1.18
Sweden	1.61*	1.29	2.13**	2.71***	2.70***	3.28***
United Kingdom	1.70*	1.23	2.56**	-0.44	2.43**	1.73*
EU	1.91**	1.07	2.06**	1.26	1.05	1.63*

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
Table reports the Diebold-Mariano test statistics.
Source: EC, Eurostat, own calculations.

4.4. DO THE PROJECTIONS ENCOMPASS THE NAÏVE FORECAST?

Exploring further the information content of forecasts, we examine whether the Commission's forecasts add information on top of the naïve forecasts. For current year forecasts, in a panel regression of the outcome value of each of the three variables on their lagged values and their forecasts, we test whether the coefficient on the lagged value equals zero and the coefficient on the forecast value is statistically significant. The regression equation for the year-ahead forecasts includes the current year spring forecast on top of the two variables as described above.

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

$$y_{i,t+1} = \alpha + \beta y_{i,t-1} + \gamma y_{i,t,t} + \delta y_{i,t+1,t} + \varepsilon_{i,t+1} \quad (4)$$

That is, for the current year, the European Commission's forecasts encompass the naïve forecast if $\beta = 0$ and $\delta > 0$ and for the year ahead forecast if $\beta = 0$; $\gamma = 0$ and $\delta > 0$. We found mixed results for the three forecast variables. In general, the results are rather robust to the sample used when only the results for year-ahead inflation forecasts in the baseline sample are somewhat different from the results in the full sample.

4.4.1. Gross Domestic Product

For the current year, the Commission's GDP growth projections contain significantly more information than was contained in the naïve forecast across countries ($\delta \neq 0$). The panel regression yielded a significantly positive coefficient for the Commission's forecast, indicating a positive correlation between the projection and the outcome. However, the regression coefficient of the naïve forecast is also found to be statistically significant ($\beta \neq 0$). This indicates that the naïve forecast also contains additional information about the outcome that is not contained in the Commission's forecast. Overall, the Commission's current year forecasts add information on top of the naïve forecast in explaining the outcome, but the naïve forecast is also useful to predict the outcome variable. A similar conclusion applies for the year ahead projections. The Commission's autumn forecasts contain information that is not contained in the naïve forecast. However, the same significant result is found for the coefficient on the spring forecast, while the coefficient on the naïve forecast is also statistically significant.

4.4.2. Inflation

The Commission's current-year forecasts for inflation are found to contain significant information on top of information contained in the naïve forecast ($\beta = 0$ and $\delta > 0$). In fact, the slope coefficient on the forecast variable is quantitatively close to unity, the consequences of which we explore in the next section. A similar conclusion applies to year-ahead inflation projections. A significantly positive coefficient on the Commission's autumn forecast was found, while the naïve forecast did not help explain the outcome. However, the autumn forecasts do not encompass the information of the spring forecasts. This implies that the spring projection contains some information about the outcome which is not taken on board in the subsequent autumn projection. The results from the full sample suggest that the inflation forecast performance in terms of encompassing the naïve forecast worsened somewhat recently. In the full sample regression, the autumn one-year-ahead forecasts seem to encompass the spring current-year forecasts fully.

Table 4.5.: **Forecast encompassing tests**

		GDP		Inflation		General government balance	
		'69-'17	'00-'17	'69-'17	'00-'17	'69-'17	'00-'17
Current-year	**α = 0**	-0.02	-0.06	0.04	-0.16***	0.03	0.01
	β = 0	-0.13***	-0.18***	0.01	-0.02	0.04	0.05
	δ = 0	1.18***	1.23***	0.98***	1.1***	0.94***	0.95***
Year-ahead	**α = 0**	0.43***	0.44***	0.05	-0.06	-0.05	-0.2
	β = 0	-0.04*	-0.08**	0.04*	0.03	0.17***	0.18***
	γ = 0	1.32***	1.32***	0.99***	1.17***	1.06***	1.13***
	δ = 0	-0.37***	-0.34***	-0.05	-0.19***	-0.27***	-0.38***

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
The table reports the estimated coefficients from equations (3) and (4).
Source: EC, Eurostat, own calculations.

4.4.3. General government balance

The current year Commission's projections for the general government budget balance-to-GDP ratio encompass information in the naïve forecast. The coefficient on the actual past value is insignificant and quantitatively very close to zero, whereas the coefficient on the forecast is very close to unity. For the year-ahead forecasts, the coefficient on the year-ahead forecast is significantly positive. However, the coefficient for the naïve forecast is also statistically significantly different from zero, suggesting that the forecast does not encompass all information contained in the naïve forecast. Also, the coefficient of the spring forecast for the current year reaches statistical significance. This implies that the projections in autumn for the next year do not fully encompass the projections done in spring.

4.5. ARE THE PROJECTIONS DIRECTIONALLY ACCURATE?

The next section examines whether the Commission's forecasts correctly predicted pick-ups and slowdowns in the three examined variables. In a pooled dataset of all forecasts across Member States, the Pesaran-Timmermann test that examines the ability of a forecast to detect the correct sign of a change in the underlying series is employed.

4.5.1. Gross Domestic Product

Pick-ups and slowdowns of GDP growth were found to be predicted successfully by the Commission's forecasts. A deceleration in economic activity was accurately predicted in 86% while acceleration was foreseen in 71%. Overall directional accuracy of the current year forecasts thus reached 78%. However, as opposed to the findings of the preceding Commission's study, the directional accuracy for the current year forecasts decreased somewhat in the 2015-2017 period. As we argue above, the Commission's forecasts did not adequately envisage the business cycle upswing in this period and overall directional accuracy decreased slightly. The year-ahead forecasts were also reasonably directionally accurate, with predicting correctly 70% of slowdowns and 71% of pick-ups. Unlike in the case of the current year forecasts, the addition of three new observations did not change the overall directional accuracy of one-year-ahead forecasts, which stays at 71%. According to the Pesaran-Timmermann test, the ability of the Commission's forecasts to correctly detect the sign of a change is statistically significant on both horizons, the current-year and the year-ahead.

4.5.2. Inflation

The directional accuracy of inflation forecasts is slightly higher than the directional accuracy of GDP growth forecasts. Pick-ups in inflation were correctly identified in 85% of all cases, while the accuracy rate of identifying slow-downs is 82%. The overall accuracy rate reached 83% and did not change compared to the findings in Fioramanti et al. (2016). For the year-ahead forecasts, the overall directional accuracy is 76%, with 74% of pick-ups predicted correctly, and 78% of slow-downs predicted correctly. Like the current year forecasts, the addition of new observations did not change much the overall directional performance of one-year-ahead forecasts of inflation. According to the Pesaran-Timmermann test, the ability of the Commission's forecasts to detect the sign of a change in inflation correctly is statistically significant on both horizons, as in the case of GDP growth forecasts.

Table 4.6.: **Tests for directional accuracy, 2000-2017**

		GDP		Inflation		General government balance	
		projected decrease	projected increase	projected decrease	projected increase	projected decrease	projected increase
Current-year	actual decrease	175	29	190	43	149	33
	actual increase	68	167	31	175	83	174
	accuracy (%)	77.9***		83.1***		73.6***	
Year-ahead	actual decrease	150	64	164	47	120	54
	actual increase	60	150	56	159	107	149
	accuracy (%)	70.8***		75.8***		62.6***	

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
The table reports the Pesaran-Timmermann test statistics.
Source: EC, Eurostat, own calculations.

4.5.3. General government balance

The Commission's forecasts were also successful in predicting increases and decreases in the government budget balance-to-GDP ratio with the overall accuracy standing at 74% for the current year forecasts. Decreases in the government budget balance-to-GDP ratio were forecast with much higher accuracy (82%) than increases (68%). For the year-ahead forecasts, the directional accuracy is lower (63%) when decreases in the general government budget balance-to-GDP ratio were correctly predicted in 120 out of 174 cases (69%). On the other hand, positive changes were forecast with a lower accuracy (58%). Compared to the findings in Fioramanti et al. (2016), the overall directional accuracy of the Commission's forecasts did not change much on either forecast horizon. Like in the preceding case, the Pesaran-Timmermann test found that the ability of the Commission's forecasts to correctly detect the sign of a change is statistically significant on both horizons.

4.6. ARE THE PROJECTIONS EFFICIENT?

In this section, the efficiency analysis goes a step further than the encompassing test. The test investigates whether the forecasts are statistically indistinguishable from the outcome values. In such a case all information about the forecast variable was properly factored in the projection. There are various ways of testing this (see Holly and Weale (2000) for an overview). A test of weak efficiency based on a regression analysis with the outcome as a dependent variable and an intercept and the projection as predictors was used.

$$y_{i,t} = \alpha + \beta y_{i,t,t} + \varepsilon_{i,t} \qquad (5)$$

$$y_{i,t+1} = \alpha + \beta y_{i,t+1,t} + \varepsilon_{i,t+1} \qquad (6)$$

The Commission's forecast can be considered efficient if it jointly holds that the intercept is zero ($\alpha = 0$) and the slope coefficient is not different from unity ($\beta = 1$). Hence, the F statistic is examined. In case the hypothesis is rejected, the regression coefficients give an estimate of the scaling factors by which the forecasts could have been made more accurate. The nonzero intercept represents an additive factor while the slope coefficient is a multiplicative factor. Overall, the point estimates of the coefficients for all three variables do not differ much from each other, suggesting that the forecasts are about equally efficient in using information.

4.6.1. Gross Domestic Product

Neither the current year nor year-ahead GDP projections are found to be efficient in the interpretation of the test. Both, the intercept and the slope coefficient are statistically different from their target test values even though they are not quantitatively too far away from zero and unity, respectively, in the case of the current-year forecasts. On the other hand, in the year-ahead regression, the intercept is rather large while the slope coefficient is statistically different from unity only at the 5% level. The estimated coefficients suggest that the Commission forecasts may be too conservative. This is further analysed in Section 5.2., which discusses the cyclicality of forecast errors.

4.6.2. Inflation

Similarly to the growth forecasts, the current year inflation forecasts are found to be not efficient. Testing separately, both coefficients are significantly different from zero and unity, respectively. The results are different in the full sample, however. These findings indicate that the efficiency of the current year forecasts worsened somewhat recently. By contrast, the year-ahead forecasts are found to be efficient in the baseline sample. In any case, the inflation forecasts are reasonably good in terms of information content as neither the intercept nor the slope coefficient is quantitatively far off from zero and unity, respectively, on both forecast horizons.

4.6.3. General government balance

The forecasts of the government balance budget-to-GDP ratio on both forecast horizons are found to be efficient in the baseline sample. Although there is some evidence that the slope coefficients are only weakly different from unity, the joint hypothesis cannot be rejected. Like in the case of inflation forecasts, discrepancies between the one-year-ahead forecasts of the government budget balance-to-GDP ratio and the outturn data seem to be lower in the baseline sample than in the entire sample.

Table 4.7.: **Forecast efficiency tests**

		GDP		Inflation		General government balance	
		'69-'17	'00-'17	'69-'17	'00-'17	'69-'17	'00-'17
Current-year	**α = 0**	-0.11*	-0.17**	0.05	-0.19***	0.03	0.20*
	β = 1	1.09***	1.12***	0.99	1.11***	0.98	1.06*
	F(α=0, β=1)	10.89***	10.85***	0.72	11.54***	1.63	1.81
	F(Serial corr.)	5.62**	4.64**	3.74*	0.91	53.18***	44.86***
Year-ahead	**α = 0**	-0.53***	-0.78***	-0.18**	-0.13	-0.35***	-0.21
	β = 1	1.11**	1.18**	1.08***	1.04	0.88***	0.9**
	F(α=0, β=1)	6.95***	6.38***	11.23***	0.56	10.58***	2.31
	F(Serial corr.)	21.95***	16.24***	51.54***	21.36***	73.34***	36.05***

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
The table reports the estimated coefficients from equations (5) and (6) and F test statistics.
Source: EC, Eurostat, own calculations.

5. THE ROLE OF EXTERNAL FACTORS

To ensure internal consistency of the forecast, a set of agreed assumptions about a set of key exogenous variables is imposed on the country forecasts. The set includes the growth of the world economy and international trade, commodity prices, the exchange rate, the short and long interest rates and fiscal policy.

The assumptions for oil prices and the interest rates are based on expectations of market participants. The assumption of constant exchange rates over the forecast horizon for all currencies in the EU is generally deemed to be a good approximation given the statistical properties of exchange rates (i.e. to the extent exchange rates follow a random walk it is difficult to beat a simple forecast of constant exchange rates). For fiscal policy, only measures that are legislated or quasi-certain to be adopted are implemented in the forecasts 'no-policy-change' assumption.[13]

On the one hand, these assumptions ensure consistency of the forecasts and greatly improve the transparency of the forecast production. On the other hand, errors in these assumptions cause errors in the forecasts of endogenous variables. In this section, we investigate what role errors in these exogenous assumptions play in errors in the GDP growth forecasts.

We closely follow the methodology described in the previous assessment of the Commission's forecasts, Fioramanti et al. (2016). In a panel regression, we regress errors in GDP growth forecasts on unanticipated changes in the exogenous variables (errors in the assumptions). The assessment of the statistical significance of the estimated coefficients then reveals whether the errors in the exogenous variables systematically cause errors in the GDP growth forecasts.

5.1. THE ROLE OF EXTERNAL ASSUMPTIONS

Following Fioramanti (2016), we estimate a number of panel regressions. Our baseline specification includes errors in all external assumptions as introduced above and the data for all Member States. The second model explores a possible nonlinear effect of errors in the assumed path of fiscal policy. Uncertainty in the future course of economic developments is the only certainty in macroeconomic forecasting. Whether higher uncertainty leads to higher inaccuracies is the subject of interest in the third model. We use an index of uncertainty derived from the Commission's business and consumer surveys and investigate whether it helps to explain forecast errors.[14] In the fourth model, we limit the impact of the crisis year (2009) by introducing a dummy variable for this year. Otherwise, the model coincides with the baseline model. In the last two specifications, we add the uncertainty variable (the fifth model) and nonlinearity (the sixth model) to the model with the dummy variable. These estimations are based on a general panel regression equation

$$e_{i,t} = x'_{i,t}\beta + u_i + \varepsilon_{i,t} \qquad (7)$$

[13] https://ec.europa.eu/info/sites/info/files/economy-finance/ip101_en.pdf

[14] A number of studies operationalise uncertainty as dispersion in the guesses of economic actors or analysts about the future. The underlying assumption is that, in times of high uncertainty, ideas about the future (e.g. future levels of economic growth) should be more diverse than in times of low uncertainty, where most actors will agree on roughly the same outlook. The measure that we employ follows Bachmann et al. (2013) who propose an uncertainty measure (FDISP) derived from the dispersion of the responses of German industry managers to a question inquiring their production expectations over the next three months. Concretely, they calculate the cross-sectional standard deviation of the share of positive and negative responses to the expectation question at time t. The formula reads:

$$FDISP_t = \sqrt{Frac_t^+ + Frac_t^- - (Frac_t^+ - Frac_t^-)^2}$$

5.1.1. GDP growth forecasts

Fioramanti et al. (2016) found that errors in the external assumptions played a role in the accuracy of the Commission's growth forecasts, although the impact was rather limited especially in the case of the current-year forecasts. For the year-ahead forecasts, the errors in external assumptions seemed to play a more significant role. More importantly, errors in only some exogenous variables were found to help explain the growth forecast errors significantly. Errors in the long interest rates in particular and errors in oil prices and the structural balance to a lesser extent were informative.

In this analysis, we come to similar conclusions. First, the ability of errors in the external assumptions to explain errors in current-year growth forecasts is rather limited when they explain about 20% of their variation. The effect of the long-term interest rates is found to be significant across model specifications and is rather large. Oil prices also seem to be a systematic factor of GDP forecast errors. The effect of inaccuracies in foreign growth expectations is insignificant in the baseline. Even though the measure of uncertainty appears to be significant, it carries an unintuitive qualitative interpretation. The quantitative impact is, however, very low. Controlling for the crisis year (2009), the exchange rate is found to be a significant factor in forecast accuracy. By contrast, a different-than-assumed path of fiscal policy does not appear to systematically deviate growth forecasts, although there is some evidence that fiscal policy may have a nonlinear effect.

For the year-ahead forecasts (see Tables A.9 and A.10 in Annex), the errors in external assumptions are found to play a more prominent role than in the case of the current-year forecasts. However, oil prices become statistically insignificant. On the other hand, fiscal policy and foreign growth gain statistical significance across the model specifications. The interest rates are also unambiguously an important factor. Controlling for the crisis year (2009) substantially increases the share of data variability explained by the model. At the same time, the effect of some variables changes pointing to the sensitivity of the results to model specification. The impact of the effective exchange rate becomes stronger and turns significant in all three dummy variable models. The effect of foreign demand is positive, in line with intuition, but its size and significance are ambiguous. The same findings with a negative sign, however, hold for the effect of short-term interest rates. The effect of oil prices and long-term interest rates is reasonably stable.

Table 5.1.: **External assumptions, gross domestic product, current year, 2000-2017**

variables	Baseline	Non-linear	Uncertainty	Crisis dummy	Uncertainty and crisis dummy	Non-linear with uncertainty and crisis dummy
Structural balance	0.092	-0.058	0.067	-0.007	-0.088	-0.169**
Structural balance squared		-0.127***				-0.082***
Global (exl. EU) growth	0.223	0.298*	-0.053	0.691***	0.220	0.206
NEER	0.053	0.063	0.031	0.191**	0.183**	0.168**
Oil	-0.014***	-0.015***	-0.015***	-0.01**	-0.012***	-0.013***
Long-term int. rates	-0.572***	-0.573***	-0.588***	-0.562***	-0.59***	-0.59***
Short-term int. rates	-0.284	-0.324	-0.08	-0.539**	-0.126	-0.097
uncertainty			-0.095*		-0.218***	-0.22***
dummy (2009)				-1.885***	-2463***	-2.19***
constant	-0.368***	-0.222**	-0.269***	-0.185**	0.099	0.167
# observations	274	274	274	274	274	274
# countries	27	27	27	27	27	27
R2 within	0.14	0.20	0.15	0.24	0.29	0.32
R2 overall	0.11	0.17	0.12	0.21	0.28	0.30
F test	6.51	8.39	6.17	10.72	12.62	12.39

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.

Source: own calculations.

5.1.2. Inflation forecasts

The effect of inaccuracies in the external assumptions on the performance of current-year inflation forecast is even lower than in the case of the GDP growth forecasts. Oil prices are found to have a significant impact on the accuracy irrespective of the model specification. Yet, like in the case of GDP growth forecasts, the quantitative impact is modest. The interest rates are also found to be an important factor. When the baseline model is modified by adding the uncertainty index and/or the crisis dummy, foreign GDP growth turns significant.

The errors in external assumptions explain a much larger share of variation in the year-ahead inflation forecast errors (annex 3). This time, the coefficients on the interest rates are found to be insignificant. Oil prices, the effective exchange rate and fiscal policy are significant across model specifications. The measure of uncertainty seems to capture the effect of the crisis as the dummy variable turns insignificant when combined with the uncertainty index.

Table 5.2.: **External assumptions, inflation, current year, 2000-2017**

variables	Base	Non-linear	Uncertainty	Crisis dummy	Uncertainty and crisis dummy	Non-linear with uncertainty and crisis dummy
Structural balance	-0.029	0.005	-0.059	0.009	-0.029	-0.017
Structural balance squared		0.029				0.012
Global (exl. EU) growth	-0.044	-0.061	-0.354***	-0.226**	-0.396***	-0.393***
NEER	0.040	0.037	0.02	-0.022	-0.014	-0.010
Oil	0.009***	0.009***	0.007***	0.007***	0.006**	0.006***
Long-term int. rates	-0.17**	-0.17**	-0.189**	-0.164**	-0.183**	-0.183**
Short-term int. rates	-0.172	-0.164	0.043	-0.08	0.047	0.045
uncertainty			-0.104***		-0.080***	-0.081***
dummy (2009)				0.717***	0.444**	0.395*
constant	0.089*	0.056	0.197***	0.023	0.130**	0.121*
# observations	266	266	266	266	266	266
# countries	27	27	27	27	27	27
R2 within	0.10	0.11	0.15	0.15	0.17	0.17
R2 overall	0.09	0.11	0.14	0.12	0.15	0.15
F test	4.30	4.09	6.00	5.67	5.83	5.21

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.

Source: own calculations.

5.2. CYCLICALITY OF FORECAST ERRORS

In light of a rather low explanatory power of errors in the exogenous variables in explaining growth and inflation current year forecast errors, we further explore other candidates that can systematically impact on the forecast performance. Following the results of the efficiency test in section 4.6 and the fact that forecast errors for most Member States are persistent, one can conjecture that the forecasts do not adequately capture the dynamics of different business cycle phases.[15]

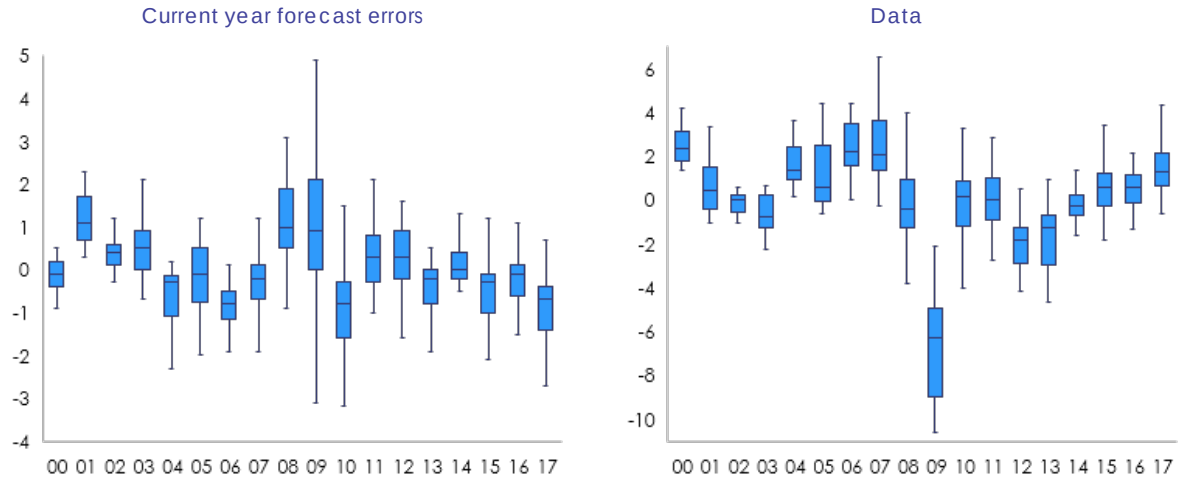
In general, the forecast errors were mostly positive when actual GDP growth was below its trend and vice versa. The left chart of Graph 5.1. shows basic cross-sectional characteristics of the current-year

[15] Kontogeorgos and Lambrias (2019) find a similar pattern in growth projections for the euro area of the European Central Bank.

GDP growth forecast errors over time. The bars represent the interval that contains a half of all forecast errors (between 25th and 75th percentiles) across Member States each year. Within each bar, the median value of the forecast error is depicted. The right chart presents the same characteristics of demeaned actual GDP growth rates. The demeaned growth rate is a simple measure of above and below-trend growth. It is evident that the errors tend to (inversely) co-move with actual growth rates. In this respect, the Commission's forecasts appear to be conservative. In the expansion phase of the business cycle, the forecasts tended to under-predict actual growth. By contrast, in the downturn phase, the forecasts tended to overestimate actual growth. We can easily identify a similar pattern in the year-ahead forecasts (see Graphs A.1 and A.2 in Appendix).

The inflation forecasts largely performed better than growth forecast as we document above. Both the ME and the RMSE are lower for most Member States, and even though statistical evidence for bias is about the same for both variables, quantitative estimates of bias are lower for inflation. Furthermore, inflation forecasts also fare somewhat better in other tests, such as directional accuracy. On the other hand, in terms of information content and error autocorrelation, forecasts of inflation and GDP growth are not very different. For this reason, we conduct the same analysis for inflation forecasts as for GDP growth forecasts.

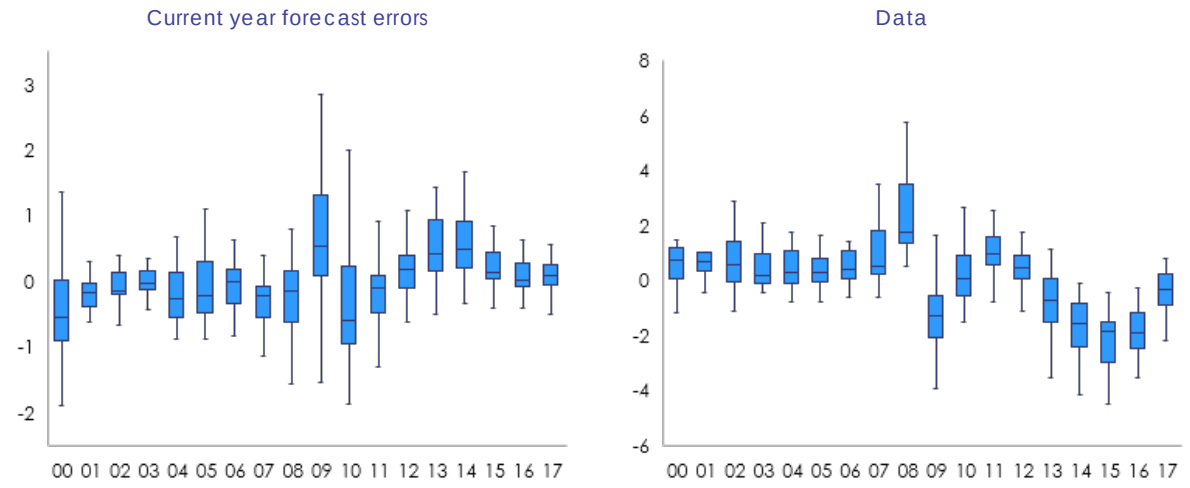
Graph 5.1.: **GDP growth, data and current year forecast errors, 2000-2017**



Note: The chart presents the median value (-) along with the interquartile range (bar), and minimum and maximum values.
Source: Source: EC, Eurostat, own calculations.

Visual inspection of the scatter plots does not provide as clear pattern as in the case of GDP growth forecasts. However, the cyclicality of forecast errors is also evident. Underestimation of actual inflation at the beginning of the last decade became even more pronounced between 2004 and 2008. With the sovereign debt crisis unfolding, inflation did not accelerate as expected and forecasts for most Member States largely overestimated price growth for several years in a row.

Graph 5.2.: **Inflation, data and current year forecast errors, 2000-2017**



Note: The chart presents the median value (-) along with the interquartile range (bar), and minimum and maximum values.
Source: EC, Eurostat, own calculations.

The model used to test the forecasts for efficiency in section 4.6 provides us with an estimation of the degree of smoothing. The test is based on a panel regression of a forecast on the actual data. The estimated constant represents the average bias while the slope coefficient is a scaling factor.

In the baseline model for GDP current year forecasts, the scaling factor is estimated at 1.12. On average, the Commission's forecasts smoothed GDP growth by about 12%. Treating the impact of the Great financial crisis as an outlier, the estimate of scaling factor shrinks to 1.06. The results are considerably robust as the estimate in the entire sample comes in at 1.09. Taking into account the uncertainty of the estimates, the coefficients are found to exceed unity significantly. The results do not change much for the year-ahead forecasts. The scale of smoothing increases somewhat but controlling for the effect of the crisis; the forecasts after 2000 do not seem to smooth out the business cycle dynamics systematically.

Despite inflation forecasts performing somewhat better than GDP growth forecasts, they also appear to be conservative. The scaling coefficient is statistically greater than unity in the baseline model and even after controlling for the effect of the crisis. By contrast, there is no evidence of systematic smoothing in the entire sample. For the year ahead forecasts, the quantitative estimate of the scaling factor is not very far from unity. However, due to repeated negative errors in the period of sluggish inflation after 2012, systematic misestimating of the inflation dynamics might have been higher recently as suggested by the model with the crisis dummy variable.

Table 5.3.: **Forecast efficiency tests**

		GDP			Inflation		
		'00-'17	'00-'17 with dummy	'69-'17	'00-'17	'00-'17 with dummy	'69-'17
Current-year	**α = 0**	-0.17**	0.01	-0.11*	-0.19***	-0.12**	0.05
	β = 1	1.12***	1.06	1.09***	1.11***	1.10***	0.99
Year-ahead	**α = 0**	-0.78***	0.21	-0.53***	-0.13	-0.25	-0.18**
	β = 1	1.18**	0.95	1.11**	1.04	1.18***	1.08***

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01
The table reports the estimated coefficients from equations (5) and (6).
Source: EC, Eurostat, own calculations

6. COMPARING GDP FORECAST ERRORS WITH THOSE OF OTHER INTERNATIONAL INSTITUTIONS

This chapter compares the accuracy of the Commission's GDP growth forecast with that of other international institutions. Forecasts from the OECD, IMF, Consensus Economics and the ECB (in this case only for the euro area aggregate) are compared with those of the Commission for the sample period 2000-2017, both for current and year-ahead forecasts.[16]

Forecasts and outturns for the other institutions have been collected and compiled in the same way as for the Commission. The current year and year-ahead forecasts from the OECD are taken respectively from the June and the December OECD Economic Outlook. The IMF forecasts come from the April and October World Economic Outlook. The Consensus forecast means refer to the April and October reports, which are close to the cut-off date of the Commission's spring and autumn forecasts. The forecasts from the ECB are taken from the March ECB Staff macroeconomic projections and the September projections. The outturn data is taken from the publications from the respective institutions in the same way as described in Section 2. The MAE statistic is computed and compared with that of the Commission's forecast for both horizons (see Graphs A.3 – A.5 for a long-sample comparison).

6.1. COMMISSION VERSUS OECD

In the baseline sample period, the OECD current-year forecasts come out in general slightly more accurate, but the difference in the MAE for the large majority of countries is likely to be below any meaningful statistical relevance. The Commission's current year forecast errors for Spain, Italy, Finland and the UK are visibly larger than the OECD forecast error. On the longer forecast horizon, the accuracy of forecasts for these countries is nearly identical. On the other hand, the Commission's year-ahead forecasts are more accurate than the OECD forecasts for Greece and Portugal while Commission's forecasts for Ireland Luxembourg, Austria and the euro area are somewhat less accurate. Looking at the long sample, the relative performance of forecasts of the two institutions is nearly identical for most Member States, especially on the one-year-ahead horizon. Current year OECD forecasts for Ireland, Italy, Luxembourg and Finland are clearly more accurate (in terms of MAE) than the Commission's forecasts. Commission's current-year forecasts are more accurate for the euro area, on the other hand.

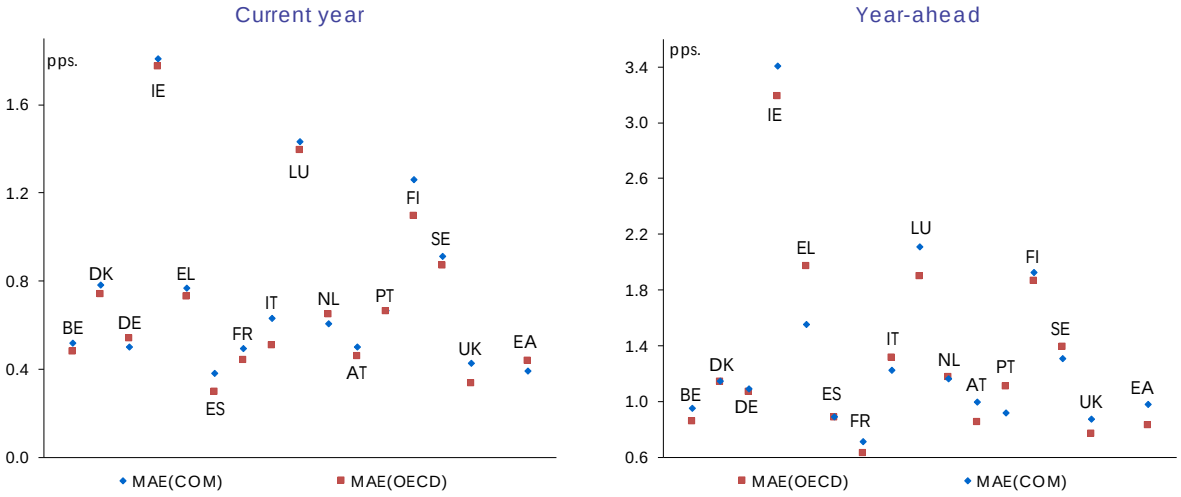
For the Member States that acceded in 2004 and 2007, the forecast errors of GDP growth are also larger for the Commission when compared to the OECD for both the current and the year-ahead, except for the Czech Republic, Hungary and Poland and only in case of the year-ahead forecasts.[17]

The difference in the timing of the respective publications could explain the differences in forecasting performance. OECD Economic Outlooks, which are published in June and December (a month later than the Commission's spring and autumn forecasts, respectively) include additional information, such as GDP growth rates (for the first and third quarters of the current year) and the first soft data (surveys) for the following quarter. This is likely to help to reduce the forecast error for the current year but should also allow for a better assessment of the carry-over effect to the year-ahead forecast.

[16] The results for the long sample period are presented in Appendix. For this sample, the observation period of the Commission's forecasts has been adapted in order to match the timeframe of the other forecasters.

[17] Slovenia, Estonia, Latvia and Lithuania are not analysed here due to too short sample of OECD forecasts for these Member States.

Graph 6.1.: **Mean absolute error, 2000-2017**

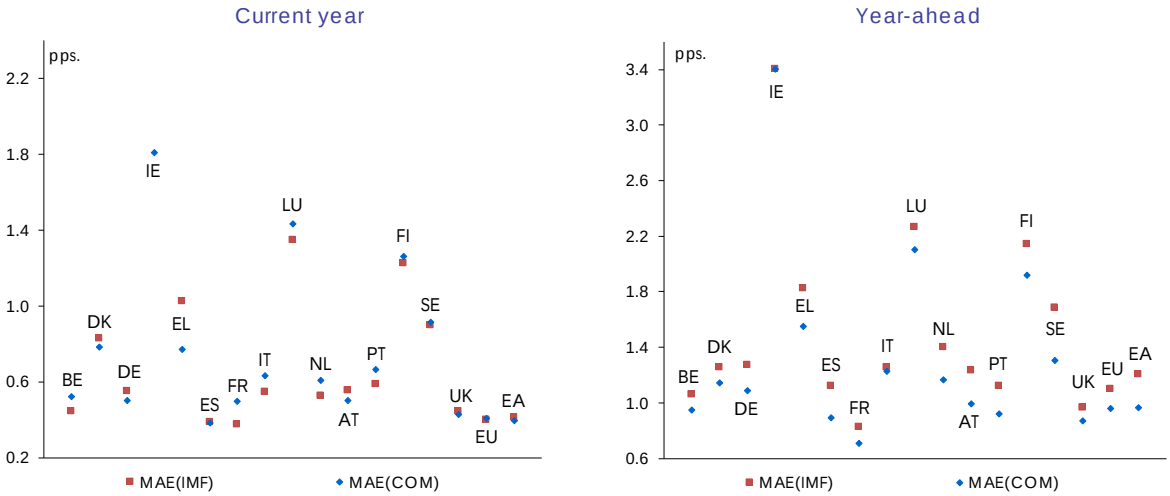


Source: OECD, EC, Eurostat, own calculations.

6.2. COMMISSION VERSUS IMF

Relative to the IMF, the Commission's forecast accuracy for the current-year comes out as very similar, with the difference in forecast errors for most countries below 0.1 pps. The Commission's current-year forecasts outperform the IMF's for Greece and Ireland in particular, while the IMF's slightly outperforms the Commission's for Belgium, France, Italy, Luxembourg and the Netherlands. For the EU and euro-area aggregates, the forecast accuracy is almost identical. Looking at the longer sample period, the differences in the forecast performance of the two institutions are broadly stable.

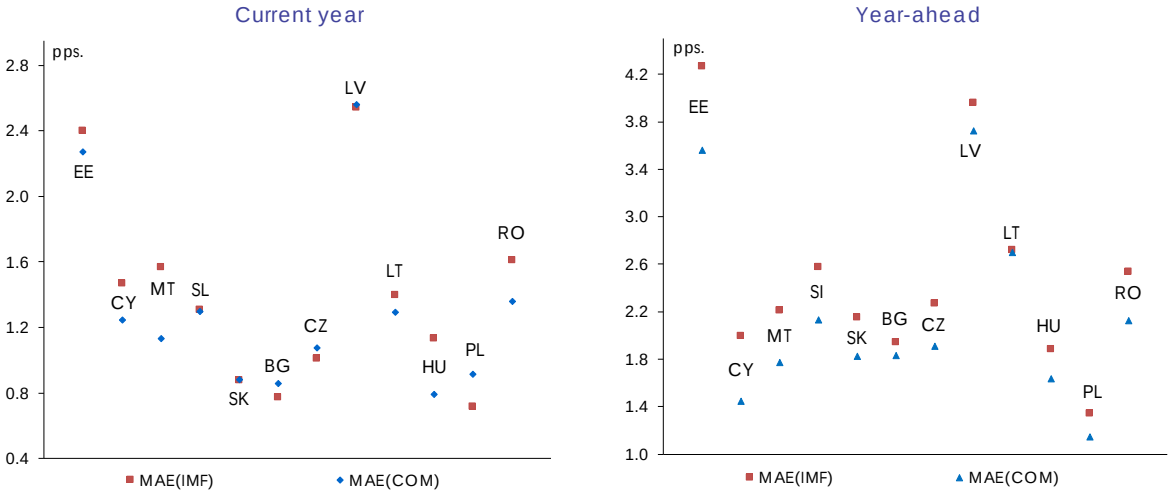
Graph 6.2.: **Mean absolute error, 2000-2017**



Source: IMF, EC, Eurostat, own calculations.

For the year-ahead forecasts, the Commission's forecasts systematically display smaller errors than the IMF's for a majority of Member States. It also holds for the EU and euro area aggregates. The accuracy of the forecasts of the IMF can match the accuracy of the Commission's forecasts only for Italy. Similarly to the current-year forecasts, these findings are robust across the two samples that we investigate here.

Graph 6.3.: **Mean absolute error, 2000-2017**



Source: IMF, EC, Eurostat, own calculations.

For the Member States that accessed the EU in and after 2004, the errors for the current year forecasts seem larger or broadly the same for the forecasts prepared by the IMF, except for Poland, Bulgaria and the Czech Republic (for the latter two the difference is negligible). For the year-ahead, the European Commission's forecasts also come out in general as more accurate than the IMF's. Also in this case, the timing factor can play a role and is in favour of the Commission, whose forecasts are published about a month later than the IMF's.

6.3. COMMISSION VERSUS CONSENSUS

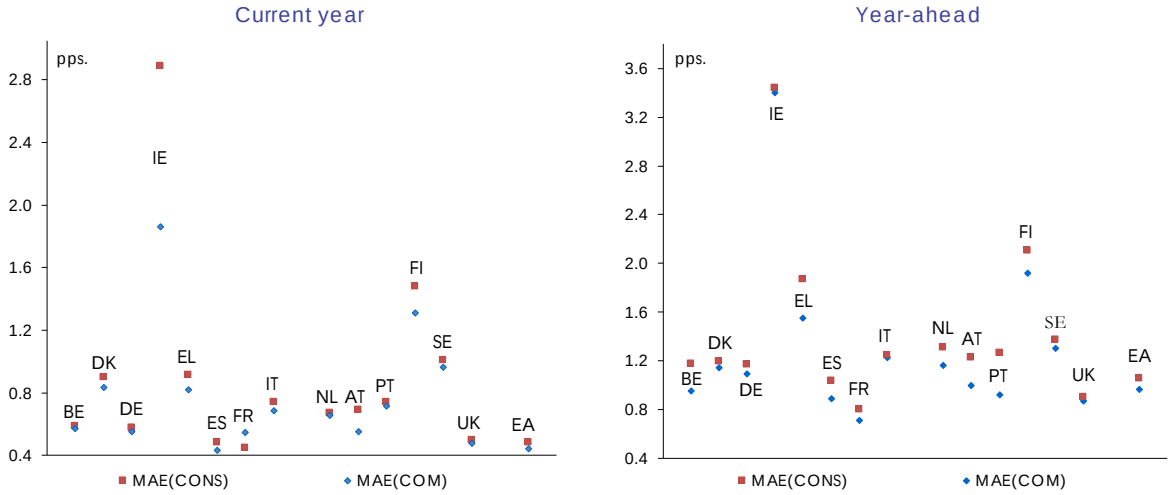
For the current year, the errors associated with the Commission's forecasts are smaller or comparable to those of Consensus for the majority of Member States.[18] The errors are smaller or markedly smaller for Ireland, Finland and Austria. On the other hand, the panel of Consensus forecasters predicted GDP growth in France somewhat more accurately than the Commission's forecasters. The accuracy of the Commission's current year forecasts in the baseline sample did not change much after 2000, compared to the Consensus forecasts.

For the year ahead, Consensus forecasts come out in general as less accurate. In some instances, the differences are noticeable (Belgium, Greece, Austria, Portugal and Finland). For the euro area, the Commission's forecasts were also slightly more accurate than the Consensus forecasts. These findings are reasonably robust as the results from the entire sample lead to very similar conclusions.

As regards the timing issue, the monthly Consensus reports coincide better with the Commission cut-off dates. Therefore, timing is unlikely to play a large role in explaining the differences in forecast accuracy. Also, private-sector forecasters are less bound by policy assumptions (absence of no-policy change assumption) than international institutions, but apparently, this does not lead to higher accuracy.

[18] Due to data availability, the comparison of forecast performance with Consensus excludes the Member States that entered the EU in and after 2004.

Graph 6.4.: **Mean absolute error, 2000-2017**



Source: Consensus Economics, EC, Eurostat, own calculations.

6.4. COMMISSION VERSUS ECB

The comparison with the ECB is limited to the forecast for the euro area since the ECB does not publish country forecasts in its March and September projections and to the period 2001-2017. For the current year forecasts, the forecast accuracy is found to be the same (MAE of 0.42 for both institutions). For the year ahead forecasts, the Commission's forecast error appears somewhat lower than the ECB's (0.97 against 1.10, respectively). The different cut-off dates may also play a role, in this case in favour of the Commission, since the forecasts of the EC are published about two months later than the ECB's Staff projections.

7. CONCLUSIONS

This work presents the results of the assessment of the Commission's European Economic Forecasts. In order to preserve consistency, we closely follow the methodology of the previous evaluation, Fioramanti et al. (2016). In the current analysis, we extend the sample period by adding three years of forecasts, from 2015 to 2017. The main goal is to assess the performance of the newly added forecasts, re-estimate statistical properties of the forecasts and compare their performance with that of other international institutions and a group of private forecasters.

We do so by comparing three basic statistics, namely the mean error (ME), the mean absolute error (MAE) and the root mean square error (RMSE). We investigate three key variables of the Commission's forecasts – GDP growth, inflation measured by the price deflator of private consumption and the general government budget balance-to-GDP ratio – on two forecast horizons – current year and one-year-ahead. The baseline sample, from 2000 to 2017, is short enough to assess the impact of the newly added data on the overall forecast performance and long enough to draw conclusions based on statistical tests. In order to evaluate the stability of the results, we cross-check the results from the baseline sample with the results from the entire sample that for some countries starts in 1969. Beyond the basic tests of the quality of forecasts, we analyse several factors for their systematic effect on forecast errors.

In general, the newly added forecasts helped to reduce inaccuracies in all three variables as measured by both the average and absolute errors. The Commission's forecasts are largely an unbiased description of the near term economic developments, accurately foresee an acceleration and

deceleration in the underlying variables and mostly contain information beyond a naïve forecast. There is room for improvement, however. The forecasts appear to be prone to repeating errors. Such persistence of errors seems to be related to an overly conservative assessment of business cycle dynamics.

For the aggregate euro area and EU forecasts, the accuracy slightly improved recently. The average error of the current year forecasts is statistically and quantitatively very close to zero for all three variables. There is also not much evidence that the forecasts suffer from repeating the same errors. In terms of information content, the forecasts systematically beat naïve forecasts. For the longer horizon, the average error of the inflation and budget balance forecasts remains small and statistically insignificant. For GDP growth forecasts, the average error increases, though the difference is not statistically significant. Similarly, errors are found to be not persistent. Compared to the performance of the naïve forecast, the Commission's forecasts fared somewhat better in the baseline sample.

Compared to the accuracy of GDP growth forecasts of other major international institutions and a group of private forecasters, the Commission's forecasts are competitive. The forecasts of the OECD seem to be somewhat more accurate. By contrast, the Commission's forecasts are not less accurate than the forecasts of the IMF and are mostly more accurate than the mean forecasts of private forecasters grouped in the Consensus Economics project. The differences are mostly minimal, and the timing of the forecast publication may explain part of them as the OECD publishes its forecast later than the Commission while the IMF releases its outlook earlier than the Commission.

Beyond the basic statistics and the tests of the quality of forecasts, this work also explores a few obstacles that objectively pose a challenge to achieve a more accurate assessment of economic prospects.

First, the higher volatility of the underlying data goes hand in hand with lower forecast accuracy. Any shock in a more volatile environment is likely to deviate the economy further away from a projected path than in a more stable environment. Since the Commission presents its forecasts as point estimates rather than interval estimates, more volatile data naturally pose a challenge for forecasters to pinpoint the future developments with low error. Taking into account the volatility of the underlying data, the relative performance of forecasts differs across Member States. However, we document that forecasts for less volatile economies do not necessarily outperform those for more volatile economies.

Second, as is typical among institutional forecasters, the Commission conditions its forecasts on a set of assumptions. On the one hand, this practice improves the transparency of the process. On the other hand, assumptions that prove to be incorrect ex post are likely to increase forecast errors. For this reason, we examine the impact of errors in the external assumptions on errors in the forecasts. Various specifications of the regression model unambiguously confirm that the errors in external assumptions indeed play a role. The overall impact seems to be limited, however, as the errors in external assumptions explain only a fraction of forecast errors. Evaluating the effect of individual assumptions is a challenging task as the magnitude, and sometimes even the sign of the impact is unintuitive. Nevertheless, controlling for the crisis year 2009 or adding a measure of uncertainty into the model does not change much the fact that some assumptions seem to help systematically explain part of the forecast errors.

Despite some objective obstacles that pose a challenge to forecast the economic outlook accurately, there is a room for improvement. In particular, the Commission's forecasts appear to be conservative. Although the forecasts correctly anticipate accelerations and decelerations of economic activity, they tend to smooth different phases of the business cycle too much. This introduces persistence in forecast errors.

Overall, this comprehensive assessment identifies both weak and strong characteristics of the Commission's macroeconomic forecasts. Pointing to some improvement in the accuracy in recent years, the forecasts continue to show a satisfactory track record which does not differ much from the forecast track records of other international institutions. Despite some identified imperfections, the forecasts appear to be a sound basis for the Commission's economic and fiscal surveillance.

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ANNEX

Table A.1: **Gross domestic product, error statistics, 2000-2017**

	current year						year-ahead					
	2000-2014			2000-2017			2000-2014			2000-2017		
	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE
Belgium	0.09	0.58	0.74	0.05	0.51	0.68	0.45	1.11	1.35	0.31	0.99	1.24
Germany	-0.07	0.53	0.84	-0.09	0.50	0.78	0.36	1.26	1.72	0.23	1.13	1.58
Estonia	0.01	2.52	2.98	-0.06	2.27	2.75	1.07	4.28	5.57	0.73	3.63	4.99
Ireland	-0.29	1.61	2.04	-0.71	1.81	2.30	0.23	2.33	3.12	-1.34	3.47	6.13
Greece	0.32	0.81	1.16	0.33	0.77	1.09	1.22	1.69	2.37	1.21	1.72	2.32
Spain	-0.08	0.37	0.46	-0.14	0.38	0.46	0.52	1.03	1.45	0.28	1.02	1.39
France	0.25	0.54	0.60	0.19	0.49	0.56	0.65	0.84	1.08	0.50	0.77	1.01
Italy	0.53	0.69	0.79	0.41	0.63	0.74	1.20	1.47	1.91	0.99	1.29	1.76
Cyprus	-0.31	1.17	1.58	-0.58	1.25	1.58	1.41	1.77	2.78	0.80	1.70	2.55
Latvia	-0.34	3.02	3.69	-0.34	2.56	3.30	0.68	4.45	6.33	0.48	3.70	5.64
Lithuania	0.00	1.41	1.81	0.06	1.30	1.66	0.54	3.19	5.10	0.48	2.72	4.54
Luxembourg	-0.03	1.44	1.84	-0.04	1.44	1.79	0.31	2.28	2.83	0.29	2.05	2.62
Malta	-0.49	0.93	1.14	-0.79	1.13	1.37	-0.09	1.49	1.87	-0.65	1.75	2.09
Netherlands	0.36	0.60	0.84	0.19	0.61	0.82	0.74	1.32	1.69	0.50	1.22	1.59
Austria	0.10	0.52	0.70	0.01	0.50	0.70	0.49	1.15	1.59	0.35	1.05	1.48
Portugal	0.17	0.73	0.88	0.11	0.66	0.83	0.80	1.12	1.44	0.58	1.04	1.36
Slovenia	0.09	1.38	1.79	-0.14	1.30	1.67	1.03	2.50	3.79	0.50	2.27	3.44
Slovakia	-0.50	1.03	1.30	-0.47	0.88	1.16	0.02	2.22	3.37	-0.13	1.89	3.01
Finland	0.46	1.36	1.65	0.26	1.26	1.55	0.99	2.13	3.03	0.67	1.97	2.82
Euro area	0.17	0.41	0.54	0.09	0.39	0.52	0.57	1.14	1.49	0.38	1.05	1.39
Bulgaria	0.47	0.67	1.27	-0.04	0.86	1.33	1.58	1.96	3.48	0.59	1.98	3.20
Czech Republic	-0.10	1.03	1.18	-0.35	1.08	1.24	0.53	2.15	2.88	0.13	1.97	2.65
Denmark	0.56	0.85	1.08	0.46	0.78	1.00	0.88	1.27	1.80	0.76	1.15	1.66
Hungary	0.11	0.91	1.01	0.09	0.79	0.92	0.76	1.80	2.64	0.46	1.56	2.37
Poland	-0.50	0.93	1.23	-0.42	0.92	1.17	-0.18	1.28	1.42	-0.26	1.22	1.35
Romania	0.31	1.34	1.60	-0.16	1.36	1.62	1.74	2.16	4.30	0.82	2.01	3.80
Sweden	0.06	0.97	1.37	-0.02	0.91	1.30	0.37	1.42	2.07	0.18	1.31	1.93
United Kingdom	0.23	0.49	0.65	0.20	0.43	0.59	0.46	0.89	1.29	0.39	0.84	1.20
EU	0.18	0.44	0.54	0.11	0.41	0.51	0.51	1.13	1.51	0.34	1.03	1.40

Source: EC, Eurostat, own calculations.

Table A.2: **Inflation, error statistics, 2000-2017**

	current year						year-ahead					
	2000-14			2000-17			2000-14			2000-17		
	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE
Belgium	-0.28	0.42	0.53	-0.25	0.37	0.49	-0.27	0.86	1.12	-0.25	0.75	1.03
Germany	0.04	0.23	0.34	0.03	0.21	0.31	0.13	0.49	0.71	0.13	0.46	0.67
Estonia	-0.27	0.79	0.97	-0.23	0.66	0.87	-0.08	2.00	2.50	-0.07	1.72	2.25
Ireland	0.04	0.73	0.97	0.11	0.68	0.91	0.26	1.29	2.02	0.38	1.23	1.90
Greece	-0.16	0.59	0.71	-0.17	0.54	0.66	-0.24	0.93	1.26	-0.14	0.84	1.18
Spain	-0.26	0.48	0.61	-0.21	0.42	0.56	-0.35	0.90	1.06	-0.25	0.84	1.00
France	0.22	0.30	0.41	0.18	0.28	0.38	-0.01	0.57	0.80	0.03	0.51	0.74
Italy	-0.01	0.35	0.42	0.02	0.32	0.39	-0.11	0.77	0.95	-0.04	0.71	0.91
Cyprus	0.34	0.76	0.92	0.40	0.72	0.86	0.42	1.04	1.37	0.46	0.95	1.31
Latvia	-1.62	1.99	2.52	-1.28	1.65	2.25	-1.91	2.80	3.22	-1.48	2.37	2.89
Lithuania	-0.28	0.91	1.13	-0.26	0.81	1.03	-0.27	1.57	1.81	-0.37	1.39	1.69
Luxembourg	-0.20	0.49	0.68	-0.12	0.47	0.65	-0.02	0.75	0.99	0.06	0.76	1.00
Malta	0.38	0.84	0.93	0.37	0.74	0.84	0.37	0.97	1.16	0.38	0.86	1.07
Netherlands	0.08	0.33	0.53	0.10	0.31	0.50	0.25	0.73	1.13	0.25	0.69	1.07
Austria	-0.20	0.35	0.42	-0.19	0.33	0.40	0.02	0.64	0.97	0.04	0.61	0.91
Portugal	-0.13	0.52	0.64	-0.13	0.46	0.59	0.09	0.90	1.42	0.08	0.80	1.30
Slovenia	0.01	0.82	1.03	0.06	0.72	0.94	0.59	1.26	1.60	0.54	1.08	1.44
Slovakia	0.11	0.62	0.76	0.12	0.53	0.68	0.36	1.36	1.61	0.36	1.23	1.49
Finland	0.00	0.38	0.43	0.01	0.37	0.42	-0.07	0.97	1.12	-0.03	0.83	1.03
Euro area	0.01	0.21	0.27	0.02	0.18	0.25	-0.03	0.59	0.82	0.01	0.55	0.77
Bulgaria	-0.07	1.70	2.31	0.06	1.36	1.99	0.31	2.89	3.38	0.41	2.33	2.95
Czech Republic	0.22	0.60	0.65	0.16	0.49	0.58	0.45	0.74	1.07	0.30	0.70	1.01
Denmark	0.06	0.36	0.47	0.11	0.36	0.45	-0.01	0.50	0.60	0.09	0.52	0.66
Hungary	0.05	0.59	0.64	0.06	0.52	0.59	0.06	1.13	1.39	0.15	1.00	1.29
Poland	-0.01	0.53	0.66	0.04	0.46	0.60	0.11	1.24	1.36	0.18	1.11	1.28
Romania	0.29	1.19	1.45	0.31	0.97	1.26	-0.27	1.51	2.23	-0.06	1.23	1.93
Sweden	-0.09	0.31	0.41	-0.11	0.30	0.39	0.30	0.52	0.60	0.26	0.47	0.56
United Kingdom	-0.05	0.57	0.77	-0.01	0.51	0.71	-0.12	0.78	1.07	-0.06	0.71	0.99
EU	0.01	0.18	0.25	0.02	0.16	0.23	-0.02	0.52	0.74	0.03	0.49	0.71

Source: EC, Eurostat, own calculations.

Table A.3: **General government budget balance, error statistics, 2000-2017**

	current year						year-ahead					
	2000-2014			2000-17			2000-2014			2000-17		
	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE
Belgium	0.04	0.55	0.66	-0.03	0.51	0.64	0.11	0.98	1.46	0.00	0.91	1.36
Germany	-0.50	0.83	1.04	-0.5	0.77	0.98	-0.35	1.10	1.39	-0.39	1.02	1.30
Estonia	-0.80	1.57	1.81	-0.7	1.31	1.62	-1.17	2.01	2.42	-0.94	1.68	2.16
Ireland	1.58	3.15	5.81	1.3	2.69	5.31	1.76	3.57	5.38	1.35	3.09	4.92
Greece	2.12	2.28	3.54	1.7	2.51	3.60	2.70	3.16	4.51	2.34	3.37	4.60
Spain	0.69	1.30	1.89	0.6	1.16	1.74	1.07	1.91	2.98	0.93	1.71	2.74
France	0.16	0.48	0.59	0.1	0.43	0.55	0.32	0.88	1.28	0.19	0.81	1.20
Italy	0.17	0.48	0.60	0.1	0.41	0.55	0.35	0.86	1.07	0.29	0.73	0.97
Cyprus	0.28	1.91	2.41	0.0	1.68	2.18	-0.08	1.83	2.73	-0.38	1.76	2.55
Latvia	-0.57	1.22	1.46	-0.5	1.06	1.32	-0.76	2.57	3.02	-0.72	2.16	2.70
Lithuania	-0.03	1.10	1.46	-0.3	1.11	1.41	-0.27	1.66	2.21	-0.50	1.59	2.06
Luxembourg	-0.96	1.01	1.29	-1.0	1.02	1.26	-1.66	1.98	2.27	-1.64	1.91	2.17
Malta	-0.01	0.76	1.09	-0.4	1.01	1.44	-0.15	0.92	1.20	-0.70	1.30	1.77
Netherlands	-0.20	1.06	1.17	-0.3	1.04	1.18	0.11	1.50	2.06	-0.10	1.44	1.96
Austria	-0.42	0.51	0.59	-0.4	0.51	0.59	-0.38	0.84	0.99	-0.39	0.78	0.94
Portugal	0.20	0.93	1.17	0.3	0.95	1.16	1.12	1.57	2.25	0.98	1.46	2.09
Slovenia	0.72	1.29	2.90	0.4	1.15	2.60	0.88	2.37	3.73	0.49	2.06	3.35
Slovakia	0.13	0.75	0.98	0.1	0.68	0.90	0.29	1.17	1.89	0.19	0.97	1.68
Finland	-0.24	1.03	1.19	-0.4	1.01	1.16	-0.20	1.57	2.10	-0.32	1.47	1.99
Euro area	0.04	0.51	0.63	0.0	0.47	0.59	0.24	0.91	1.40	0.13	0.83	1.29
Bulgaria	0.43	1.21	1.55	-0.1	1.27	1.53	1.77	2.32	3.21	0.70	2.27	2.97
Czech Republic	-0.71	1.31	1.57	-0.9	1.33	1.54	-0.78	1.71	2.10	-0.99	1.72	2.03
Denmark	-0.80	1.06	1.46	-0.8	1.13	1.49	-0.74	1.51	1.94	-0.92	1.56	1.96
Hungary	-0.11	1.11	1.42	-0.2	0.94	1.27	-0.58	1.89	3.07	-0.59	1.62	2.75
Poland	0.75	1.71	2.88	0.5	1.46	2.57	0.82	1.80	2.93	0.50	1.55	2.62
Romania	0.37	1.21	1.60	0.2	1.04	1.40	0.76	1.14	1.83	0.36	1.06	1.68
Sweden	-0.63	0.85	1.15	-0.7	0.91	1.16	-0.56	1.25	1.50	-0.79	1.36	1.59
United Kingdom	-0.06	0.87	1.23	-0.1	0.81	1.15	0.29	1.65	2.16	0.19	1.43	1.98
EU	0.01	0.53	0.67	-0.1	0.50	0.64	0.23	0.95	1.42	0.11	0.87	1.32

Source: EC, Eurostat, own calculations.

Table A.4: **Tests for forecast bias, 1969-2017**

	GDP		Inflation		General Government	
	current year	year ahead	current year	year ahead	current year	year ahead
Belgium	-0.07	0.24	-0.03	-0.01	0.11	0.26
Germany	-0.01	0.30*	0.07	0.05	-0.31**	-0.22*
Estonia	-0.06	0.73	-0.23	-0.07	-0.70	-0.94
Ireland	-0.6*	-0.95	0.10	-0.05	0.37	0.54
Greece	0.13	0.59	-0.07	-0.47	1.06*	1.51**
Spain	-0.18	0.11	-0.21***	-0.28*	0.43	0.71
France	0.03	0.35**	0.06	-0.24	-0.05	0.06
Italy	0.41***	0.80***	-0.06	-0.79**	0.16	0.40*
Cyprus	-0.58	0.80	0.40	0.46	0.04	-0.38
Latvia	-0.35	0.48	-1.28	-1.48*	-0.55	-0.72
Lithuania	0.05	0.48	-0.26	-0.37	-0.28	-0.50
Luxembourg	-0.43	0.07	0.03	-0.03	-0.76***	-1.38***
Malta	-0.79**	-0.65	0.37**	0.38***	-0.42	-0.70
Netherlands	-0.04	0.10	0.03	0.24	-0.33**	-0.17
Austria	-0.03	0.32**	-0.05	0.12	-0.32***	-0.37***
Portugal	0.07	0.39*	-0.24	-0.36	-0.06	0.35
Slovenia	-0.14	0.50	0.06	0.54	0.43	0.49
Slovakia	-0.47	-0.13	0.12	0.36	0.05	0.19
Finland	0.15	0.41	-0.01	0.10	-0.35*	-0.29
Euro Area	0.07	0.36	0.01	0.02	-0.06	0.09
Bulgaria	-0.05	0.59	0.06	0.41	-0.07	0.70
Czech Republic	-0.35	0.13	0.16	0.30	-0.86***	-0.99*
Denmark	0.26*	0.42*	-0.11	-0.23	-0.34	-0.31
Hungary	0.09	0.46	0.06	0.15	-0.16	-0.59
Poland	-0.41*	-0.26	0.04	0.18	0.48	0.50
Romania	-0.16	0.82	0.31*	-0.06	0.16	0.36
Sweden	-0.09	0.18	-0.05	0.40***	-0.89***	-0.94***
United Kingdom	0.04	0.29	0.07	-0.24	-0.02	0.27
EU	0.08	0.32**	0.02	-0.15	-0.08	0.10
Overall	-0.07	0.26***	-0.02	-0.10*	-0.10*	0.00

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
Reported values are the estimated average errors, α, from equations (1) and (2).
Source: EC, Eurostat, own calculations.

Table A.5: **Tests for error persistence, current-year, 1969-2017**

	GDP		Inflation		General Government Balance	
	lag 1	lag 2	lag 1	lag 2	lag 1	lag 2
Belgium	0.13	0.02	0.02	0.09	0.13	-0.12
Germany	0.08	0.16*	-0.01	-0.13	0.05	-0.12
Estonia	0.26	-0.37	-0.20	-0.37	0.20**	-0.43*
Ireland	-0.11	0.15	-0.16	0.07	0.20***	0.16*
Greece	0.31**	0.08	0.00	-0.18	0.22***	0.04
Spain	0.43***	-0.18**	-0.03	-0.04	0.21	-0.10
France	0.13	0.05	-0.14*	-0.05	-0.02	-0.17*
Italy	-0.31***	-0.18*	0.21	-0.12	-0.22	-0.07
Cyprus	0.21	-0.09	0.42**	-0.29	-0.13	-0.20
Latvia	0.29**	-0.40	0.61***	0.08	-0.30*	-0.36***
Lithuania	0.08	-0.40	0.01	0.31**	0.32	0.04
Luxembourg	0.31**	-0.26**	0.10	0.04	-0.34***	-0.19
Malta	0.11	-0.19	-0.51**	-0.11	0.42	-0.12
Netherlands	0.15	0.08	-0.01	-0.14*	0.20	0.00
Austria	0.15*	0.18**	0.11	-0.21	-0.11	0.08
Portugal	0.21	0.18	0.15*	0.16	-0.06	-0.11
Slovenia	0.25	-0.07	-0.10	-0.20	-0.02	0.01
Slovakia	0.11	-0.28	-0.15	-0.23	0.41**	-0.33
Finland	-0.14	-0.19	-0.02	0.15	-0.15	-0.06
Euro area	0.03	-0.22	-0.07	-0.04	0.16	-0.53***
Bulgaria	0.11**	0.38**	-0.33**	-0.16***	0.49	-0.36
Czech Republic	0.13	0.02	0.27	-0.15	-0.25	-0.08
Denmark	0.13	-0.08	0.07	0.05	0.20*	0.03
Hungary	0.59**	-0.8***	-0.01	-0.40***	-0.03	-0.25**
Poland	-0.14**	-0.17**	0.56***	-0.32***	-0.13*	-0.01
Romania	0.28	0.15	-0.65***	-0.14	-0.32***	0.00
Sweden	-0.20***	-0.36***	-0.15*	0.21*	0.17	-0.13
United Kingdom	-0.03	-0.12	0.01	0.09	0.31***	-0.12
EU	-0.06	0.01	0.13	0.08	0.08	-0.19*

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
The table reports the Ljung-Box test statistics.
Source: EC, Eurostat, own calculations.

Table A.6: **Tests for error persistence, year-ahead, 1969-2017**

	GDP		Inflation		General Government Balance	
	lag 1	lag 2	lag 1	lag 2	lag 1	lag 2
Belgium	0.14	-0.12	0.24*	-0.11	0.09	0.00
Germany	-0.12	-0.26**	0.19	0.19**	0.00	-0.33**
Estonia	0.40***	-0.42***	-0.35	-0.48**	0.16	-0.52***
Ireland	0.18*	0.01	0.30*	-0.27*	0.58***	-0.04
Greece	0.30	0.23	0.17	0.15**	0.20***	0.00
Spain	0.45***	-0.42***	-0.03	-0.10	0.33*	-0.21
France	0.02	-0.16*	0.13	0.01	0.21	-0.16**
Italy	0.16*	-0.36***	0.22	0.15	0.08	-0.18
Cyprus	0.16	-0.22*	-0.17	0.05	0.02	-0.23
Latvia	0.33	-0.40	0.08	0.10	0.38***	-0.51*
Lithuania	-0.1*	-0.40*	0.01	-0.10**	0.15	-0.23**
Luxembourg	0.12**	-0.18*	0.50***	0.02	0.25**	-0.26*
Malta	0.19	-0.05	-1.04***	-0.40***	0.69*	-0.07
Netherlands	0.04	0.07	0.07	0.12	0.27	-0.03
Austria	-0.23	-0.30*	-0.20	-0.41*	-0.27***	-0.24*
Portugal	-0.08	-0.04	0.19**	-0.15*	0.12*	-0.13
Slovenia	0.14	-0.21	-0.26	-0.38***	-0.39*	-0.20
Slovakia	-0.15	-0.27***	-0.36***	-0.27**	0.29***	-0.33
Finland	-0.01	-0.19	-0.06	-0.08	-0.07	-0.25
Euro Area	-0.10	-0.30	-0.26	-0.20	0.06	-0.33***
Bulgaria	0.05	0.12***	0.05	-0.22	0.23	-0.21*
Czech Republic	0.04	-0.20	-0.03	0.06	0.09	-0.25
Denmark	0.21	-0.05	0.14	0.19	0.46***	-0.04
Hungary	-0.01	0.00	0.07	-0.05	-0.14	-0.26*
Poland	-0.44	-0.74***	0.19	-0.32	-0.19	-0.29*
Romania	0.29***	-0.01	-0.25	0.24***	-0.01	0.20**
Sweden	-0.17	-0.32***	-0.01	0.03	0.21	-0.36***
United Kingdom	0.16	0.02	0.29**	-0.10	0.21	-0.10*
EU	0.00	-0.27**	0.36***	-0.15	0.11	-0.29**

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
The table reports the Ljung-Box test statistics.
Source: EC, Eurostat, own calculations.

Table A.7: **Diebold-Mariano tests, 1969-2017**

	GDP		Inflation		General Government	
	current year	year ahead	current year	year ahead	current year	year ahead
Belgium	3.67***	2.55***	2.98***	1.5*	2.67***	0.33
Germany	2.63***	2.11**	4.4***	1.86**	2.27**	1.57*
Estonia	2.4**	1.81**	1.77**	1.88**	0.40	0.37
Ireland	3.55***	1.32*	3.58***	1.79**	1.09	0.87
Greece	2.64***	-0.28	3.78***	3.89***	0.94	-1.16
Spain	3.37***	1.65*	2.92***	0.91	1.75**	-1.41
France	2.53***	1.79**	2.25**	0.29	2.12**	0.92
Italy	2.86***	1.61*	2.53***	0.15	2.53***	0.47
Cyprus	2.48**	2.23**	2.5**	1.94**	2.63***	2.97***
Latvia	2.36**	1.63*	2.21**	1.69*	-1.07	-1.24
Lithuania	1.98**	1.31	4.13***	2.79***	2.12**	0.81
Luxembourg	2.13**	1.56*	3.76***	0.29	0.57	-3.75
Malta	2.74***	1.99**	3.78***	1.48*	3.19***	2.58***
Netherlands	2.49***	1.45*	3.88***	3.14***	1.37*	-0.73
Austria	2.8***	1.55*	3.86***	2.12**	3.6***	3.92***
Portugal	4.4***	2.21**	3.67***	0.07	2.48***	1.85**
Slovenia	2.07**	1.54*	1.95**	1.66*	2.04**	1.39*
Slovakia	1.94**	1.4*	3.74***	3.5***	2.12**	2.26**
Finland	2.76***	1.83**	3.59***	3.56***	2.84***	2.26**
Euro area	3.08***	2.05**	2.99***	2.01**	2.58***	1.82**
Bulgaria	1.46*	-1.35	2.41**	2.41**	1.49*	-1.82
Czech Republic	2.16**	1.49*	1.85**	2.05**	2.4**	0.10
Denmark	3.28***	2.67***	2.12**	1.17	2.56***	0.42
Hungary	2.47**	1.75**	3.36***	3.56***	2.09**	1.64*
Poland	-3.32	-3.70	3.29***	6.39***	3.67***	3.01***
Romania	1.86**	1.89**	3.39***	2.58***	-5.60	-1.18
Sweden	2.31**	1.82**	3.61***	1.26	2.68***	1.29
United Kingdom	3.24***	1.91**	2.85***	1.75**	2.73***	0.48
EU	2.81***	2.05**	3.59***	1.89**	2.46***	2.38**

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
The table reports the Diebold-Mariano test statistics.
Source: EC, Eurostat, own calculations.

Table A.8: **Tests for directional accuracy, 1969-2017**

		GDP		Inflation		General government balance	
		projected decrease	projected increase	projected decrease	projected increase	projected decrease	projected increase
Current-year	**actual decrease**	335	52	366	58	251	69
	actual increase	68	310	59	296	123	323
	accuracy (%)	84.3***		85***		74.9***	
Year-ahead	**actual decrease**	267	114	308	90	190	117
	actual increase	98	261	108	239	163	278
	accuracy (%)	71.4***		73.4***		62.6***	

Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
The table reports the Pesaran-Timmermann test statistics.
Source: EC, Eurostat, own calculations.

Table A.9: **External assumptions, gross domestic product, year-ahead, 2000-2017**

variables	Base	Non-linear	Uncertainty	Crisis dummy	Uncertainty and crisis dummy	Non-linear with uncertainty and crisis dummy
Structural balance	-0.358***	-0.369***	-0.418***	-0.478***	-0.478***	-0.482***
Structural balance squared		-0.093***				-0.042
Global (exl. EU) growth	1.292***	1.261***	1.192***	0.344*	0.38*	0.372*
NEER	-0.014	-0.017	0.004	-0.038	-0.034	-0.036
Oil	0.023**	0.022*	0.027	0.013	0.015	0.015
Long-term int. rates	-0.611***	-0.551***	-0.58***	-0.396***	-0.405***	-0.381***
Short-term int. rates	-0.071	-0.241**	-0.256***	-0.508***	-0.503***	-0.57***
uncertainty			0.506***		0.061	0.054
dummy (2009)				-5.704***	-5.370***	-5.268***
constant	-0.763***	-0.676***	-0.187***	-0.517***	-0.462***	-0.437***
# observations	249	249	249	249	249	249
# countries	27	27	27	27	27	27
R2 within	0.64	0.65	0.71	0.77	0.77	0.77
R2 overall	0.61	0.62	0.68	0.74	0.74	0.74
F test	64.30	57.53	73.85	100.68	87.96	78.79

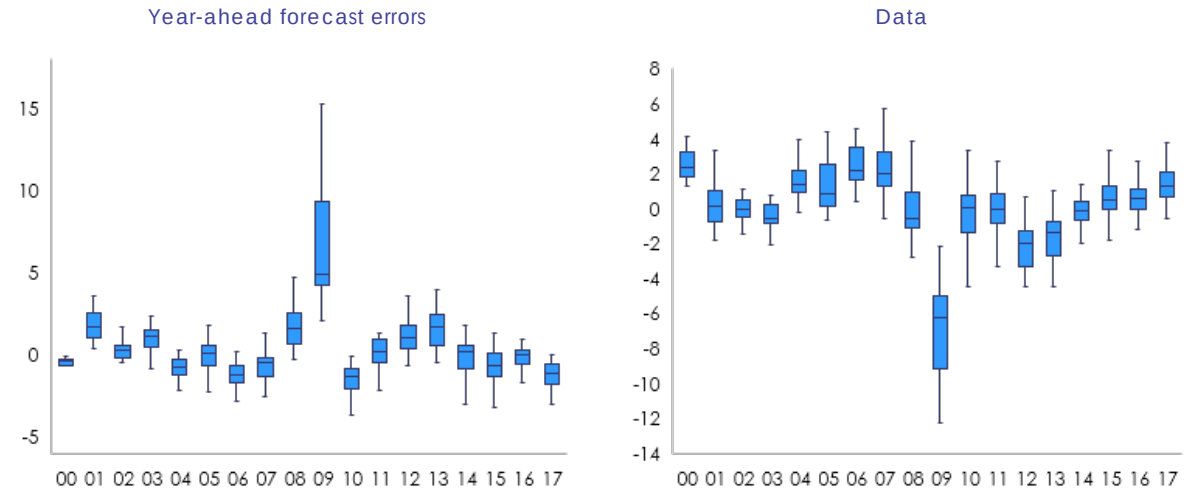
Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
Source: own calculations.

Table A.10: **External assumptions, inflation, year-ahead, 2000-2017**

variables	Base	Non-linear	Uncertainty	Crisis dummy	Uncertainty and crisis dummy	Non-linear with uncertainty and crisis dummy
Structural balance	-0.226***	-0.224***	-0.188***	-0.189***	-0.189***	-0.188***
Structural balance squared		0.029				0.004
Global (exl. EU) growth	0.254	0.275*	0.421***	0.592***	0.423***	0.425***
NEER	0.107***	0.109***	0.088***	0.109***	0.088***	0.088***
Oil	-0.041***	-0.041***	-0.047***	-0.036***	-0.046***	-0.046***
Long-term int. rates	-0.009	-0.029	-0.039	-0.091*	-0.04	-0.042
Short-term int. rates	-0.17**	-0.119	-0.036	-0.016	-0.035	-0.029
uncertainty			-0.339***		-0.335***	-0.335***
dummy (2009)				2.146***	0.039	0.032
constant	0.375***	0.349***	-0.021	0.270***	-0.019	-0.022
# observations	242	242	242	242	242	242
# countries	27	27	27	27	27	27
R2 within	0.44	0.45	0.58	0.52	0.58	0.58
R2 overall	0.38	0.38	0.51	0.45	0.51	0.51
F test	27.91	24.05	41.47	32.31	36.21	31.99

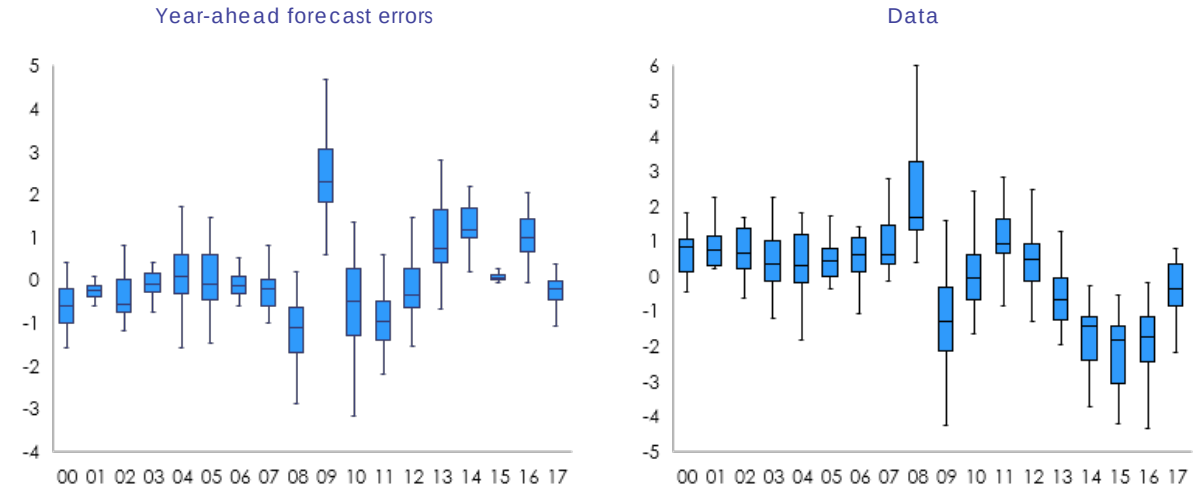
Notes: Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.
Source: own calculations.

Graph A.1: **GDP growth, data and year-ahead forecast errors, 2000-2017**



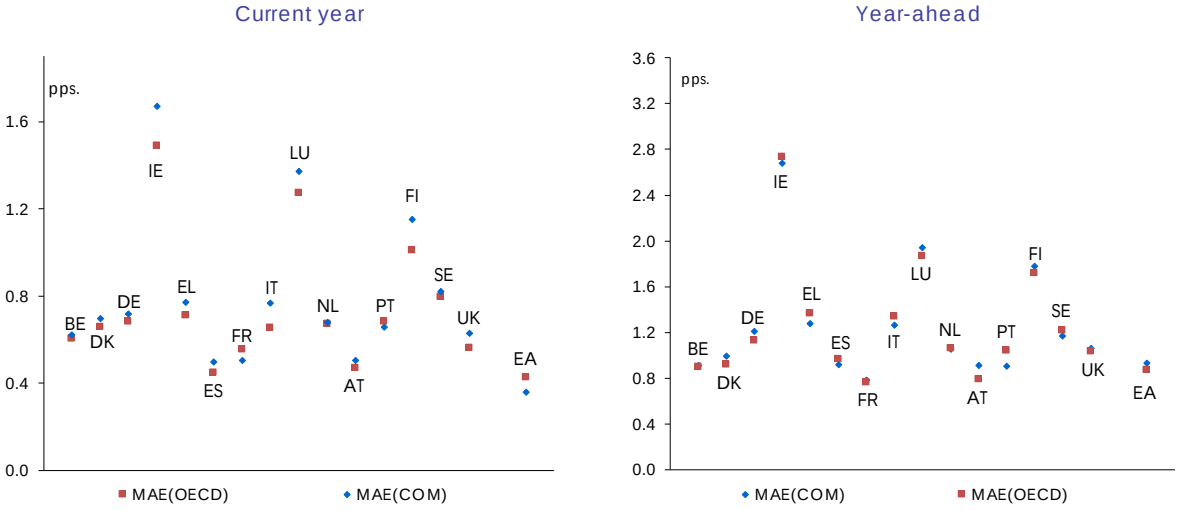
Note: The chart presents the median value (-) along with the interquartile range (bar), and minimum and maximum values.
Source: EC, Eurostat, own calculations.

Graph A.2: **Inflation, data and year-ahead forecast errors, 2000-2017**



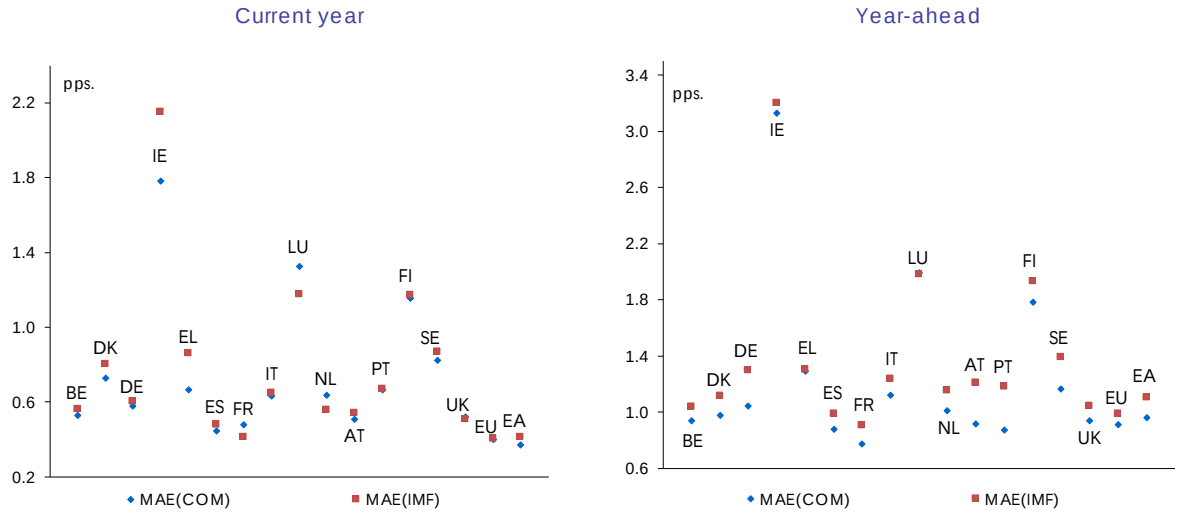
Note: The chart presents the median value (-) along with the interquartile range (bar), and minimum and maximum values.
Source: EC, Eurostat, own calculations.

Graph A.3: **Mean absolute error, EC and OECD forecasts, 1969-2017**



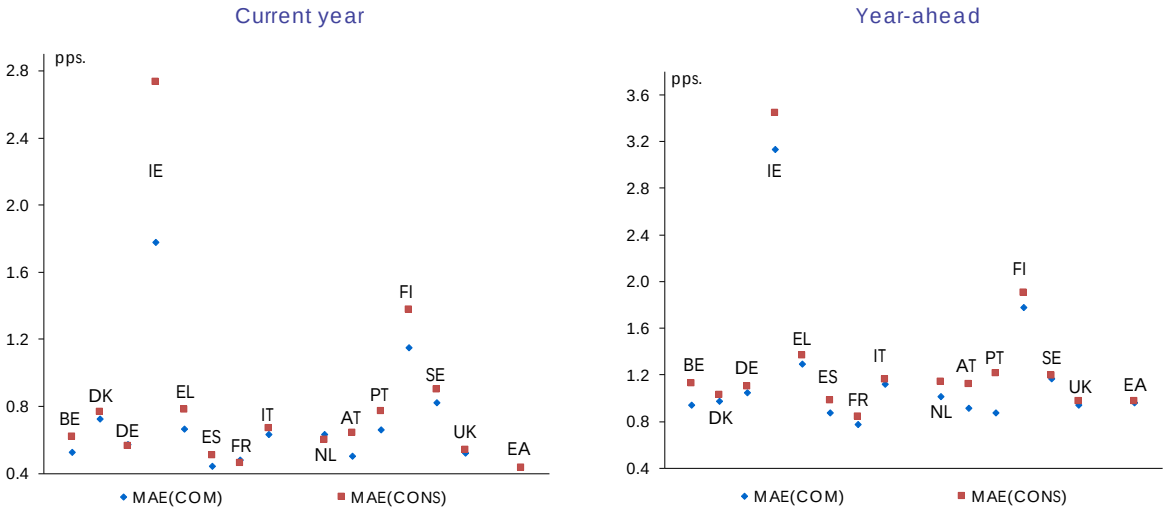
Source: OECD, EC, Eurostat, own calculations.

Graph A.4: **Mean absolute error, EC and IMF forecasts, 1969-2017**



Source: IMF, EC, Eurostat, own calculations.

Graph A.5: **Mean absolute error, EC and Consensus Economics forecasts, 1969-2017**



Source: Consensus Economics, EC, Eurostat, own calculations.

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