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Navigating Uncertainty: Evaluating the European Economic Forecasts Amidst Pandemic and Energy Crises

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Abstract

The European Economic Forecasts (EEFs) are an integral part of the European Commission's Treaty-based economic and budgetary surveillance framework. To increase the transparency and credibility of its forecasts, the Commission regularly evaluates forecast performance, focusing on point estimates of three prominent variables in the Commission's economic surveillance: GDP growth, inflation, and the general government budget balance. This paper updates the previous regular report, covering the additional period 2018-2023. The analysis evaluates the quality of the forecasts – in terms of unbiasedness, efficient use of the information available, and correction of past errors. To this purpose, a number of basic metrics are calculated and econometric methodologies/tests are run, as in past exercises, but with the additional challenge posed by the large volatility in the economic variables due to the pandemic and energy crises. The study also explores the potential sources of forecast inaccuracies, including the role played by the assumptions underpinning the forecasts and economic uncertainty. The analysis is reinforced by model-based decompositions of forecast errors using the Commission's Global Multi-Country Model. Lastly, the report updates the comparison of the Commission's forecast performance with that of other international institutions. Overall, this updated exercise confirms that the Commission's forecasts provide a largely unbiased picture of the near-term economic outlook, accurately foresee the trends in its key variables and tend to perform better than 'naïve' forecasts that utilise no other information than the most recent reading for the target variable. The accuracy of the Commission's GDP growth forecasts was found broadly similar to that of other major international institutions.

JEL Classification: C1, E60, E66.

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

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NON-TECHNICAL SUMMARY

This work presents an assessment of the Commission's European Economic Forecasts. The analysis closely follows the methodology of previous evaluations, (Chabin et al. 2020, Fioramanti et al., 2016), after extending the previous baseline period 2000-2017 with five additional years of forecasts, from 2018 to 2023. The main goal is to assess the performance of the forecasts for those latest years, re-estimate the statistical properties of the forecast errors and compare their performance with that of other international institutions.

Taking account of the large volatility in the key forecast variables (real GDP, inflation[1], general government balance) generated by the pandemic and energy crises, the accuracy and bias of the Commission's forecasts over the full baseline period and especially the latest five years is broadly similar to that over the period 2000-2017 (reference period). Some evidence of error persistence was detected especially for current year forecasts for inflation and the general government balance.

Overall, this updated exercise confirms that the Commission's forecasts provide a largely unbiased picture of the near-term economic outlook, accurately foresee the trends in the underlying variables and tend to perform better than 'naïve' forecasts that utilise no other information than the most recent reading for the target variable.

The accuracy of the Commission's GDP growth forecasts was found broadly similar to that of other major international institutions. The timing of the respective forecast publications may explain part of any differences in accuracy across institutions.

Looking at possible drivers of forecast errors, a large part of the forecast errors is explained by the large and unexpected pandemic and energy crises shocks. Errors in the external assumptions underpinning the Commission forecasts (e.g. for interest and exchange rates) also play a role, though not a crucial one for GDP current year forecasts. Uncertainty, proxied by a measure of dispersion of business managers' and consumers' views about future developments based on the Commission Business and Consumer Survey[2], also plays a role. Other drivers found to have some explanatory power over forecast errors include errors in fiscal policy projections and the cyclical position of the economy. In this respect, it is important to note the "no policy change" assumption that underpins the fiscal (and broader) policy projections in the European Economic forecasts, whereby existing policies are expected to remain in place and new measures are included only if they have been credibly announced and sufficiently specified. This implies that the budgetary projections in the European Economic forecasts do not necessarily anticipate the most likely outcomes, by construction. For the purposes of the Commission's macro-fiscal surveillance, they rather aim to identify the gap between current policies and fiscal objectives.

Drivers of forecast errors are also analysed by means of the Commission's Global Multi-country (GM) model, used to assess the combined role of forecast errors of the entire set of variables forecast by the Commission (real/nominal GDP and its components, including imports and exports, government budget balance, employment, wages, interest rates). The model-based analysis highlights the importance of correctly predicting the domestic private demand components and properly assessing their underpinning exogenous conditions (e.g. external demand, exchange rates, commodity prices). We also show that the forecast errors of most forecast variables add-up in producing the overall forecast error of GDP and inflation (i.e. those forecast errors contribute to over/under-predicting GDP and inflation). However, offsetting contributions (i.e. forecast errors contributing in the opposite direction) are often identified regarding the conditions in the labour and goods market (namely forecast errors about wage and employment growth) and public finances.

Overall, this comprehensive assessment identifies both weak and strong features of the Commission's macroeconomic forecasts. Still, controlling for the unprecedented pandemic shock and energy crisis, the

[1] Proxied by the private consumption deflator.
[2] https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/business-and-consumer-surveys_en

Commission forecasts continue to show a satisfactory track record, broadly comparable to that of other international institutions. The European Economic Forecasts therefore remain a sound basis for the Commission's economic and fiscal surveillance.

1. INTRODUCTION

The COVID-19 pandemic triggered a seismic shift in the global economy. Real GDP contracted sharply in the EU in 2020, by around 6.5% - the largest decline in over two decades. A robust recovery ensued in 2021, driven by the reopening of economies and the release of pent-up demand. However, the rebound was soon hindered by supply-side bottlenecks and, later, by the Russian aggression against Ukraine and the ensuing energy crisis, which led to an unprecedented surge in inflation that started in mid-2021 and peaked in late 2022. Elevated inflationary pressures, above historical norms even when inflation started easing, persisted throughout much of 2023. The cumulative economic impact of these consecutive crises also had a profound effect on public finances. The sudden and substantial deterioration of the general government balance in 2020, triggered by the implementation of emergency measures to support the economy as the fiscal rules under the Stability and Growth Pact were suspended, was comparable in magnitude to that in the Great Financial Crisis, with a government deficit that approached 7% of GDP in the EU (6.7%) in 2020 and continued to exceed the 3% reference value throughout 2023.

Against this challenging background, this study assesses the performance of the European Economic Forecasts (EEFs). The EEFs are an integral part of the European Commission's Treaty-based economic and budgetary surveillance framework. To increase the transparency and credibility of its forecasts, the Commission regularly evaluates the forecast performance, focusing on point estimates of three prominent variables in the Commission's economic surveillance: real GDP growth, inflation, and the general government budget balance. The evaluation criteria remain relatively stable over time, ensuring consistency in the assessment process.[3] The primary evaluation metrics comprise: (a) *forecast accuracy*, which measures the average deviation of forecasts from realized values, (b) *bias*, which assesses the systematic difference (positive or negative) between forecast and actual values, (c) *error persistence*, which examines whether errors are random, persistent or lead to forecast corrections, (d) *comparative performance*, which benchmarks forecasts against "naïve" models that take account of known past values of the target variables as well as against forecasts from other international organisations, (e) *directional accuracy*, which evaluates the frequency with which forecasts correctly predict changes in direction (e.g., accelerations or decelerations in growth variables), and (f) *forecast efficiency*, which assesses the ability of forecasts to maximize accuracy while minimizing forecast volatility and loss of information. In the previous such exercise (including data until 2017), Chabin *et al.* (2020) concluded that "*the forecasts continue to show a satisfactory track record that 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.*" However, they point out that "*The forecasts appear to be prone to repeating errors, which to some extent seem to be related to an overly conservative assessment of the business cycle dynamics and to a lesser extent to errors in technical assumptions.*"

As in previous exercises, the main aim of this study is to assess the performance of recent forecasts compared to findings in the previous evaluation. Given the above-mentioned large shocks that characterised the recent period, special attention is required in calculating meaningful statistics. This is mainly accomplished by calculating statistics over distinct time intervals and by appropriately including dummy variables that capture the effect of specific shocks.

Section 2 frames the analysis by clarifying the forecast variables of interest and the periods considered. Section 3 assess the performance of the EEFs by focusing on basic statistics that are normally used to characterise forecast accuracy and bias, namely the average error, the mean absolute error, and the root mean square error.

[3] The criteria for evaluating forecasts may vary depending on the purpose of forecasts for a particular decision maker or group of decision makers (Skouras et al., 2002), or depending on preferences – e.g. Demetrescu et al. (2020) evaluated EU forecasts under the assumption that loss preferences are asymmetric, i.e., positive errors are weighted differently than negative errors. In both the present and previous studies, the implemented criteria are purely statistical, rendering them relevant in a wide range of circumstances.

Section 4 further assesses the quality of the forecast in terms of their unbiasedness, efficient use of the available information and correction of past errors. To this purpose, a number of econometric methodologies/tests already used in past exercises are run, but with the additional challenge posed by the above-mentioned large volatility of economic outcomes in recent years.

Section 5 explores the potential sources of forecast inaccuracies, including uncertainty, errors in external assumptions[4] and the cyclical position of the economy. We complement regression analysis with a model-based decomposition of the drivers of the forecasts using the Commission's Global Multi-Country Model (GM)[5].

A final aim of this paper – discussed in Section 6 - is to compare the Commission's GDP forecasts with those of the OECD, IMF and the ECB[6]. This is accomplished by simple visualisations of the forecast performance across countries and regions for specific (sub)periods of interest, including the pandemic crisis.

2. DATA DESCRIPTION AND SUMMARY STATISTICS

Three prominent forecast variables are considered in this paper: real GDP growth, inflation, proxied by the private consumption deflator, and the general government balance to GDP ratio. This paper examines the error of the forecast for the year in which the forecast is produced – the "current year" forecast error - and for the following year – the "year-ahead" forecast error. The forecast error for a given country *i* is defined as follows:

$$e_{i,t,t} = y_{i,t,t} - y_{i,,t} \quad \textit{(current year)}$$

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

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/overprediction, whereas negative errors indicate an underestimation/underprediction of the actual outturns.

Data have been processed in a similar manner as in previous evaluations of the Commission forecasts' accuracy.[7] The current year forecasts ($y_{i,t,t}$) and current year realisations ($y_{i,t}$) are extracted from the Commission's spring forecasts, normally 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 the following year (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 normally published in November. The year-ahead forecasts for period *t*+1 are taken from the autumn forecasts in year *t*, while the turn-out for period *t*+1 is taken from the autumn forecast of year *t*+2.[8,9]

[4] The European Economic forecasts are conditional upon a number of assumptions, regarding interest rates, exchange rates and the global economic environment. For economic and fiscal policies, a key assumption underpinning the forecast is that of "no policy change" – whereby the forecast generally assumes continuation of existing budgetary policies, and includes new measures only to the extent that they have been credibly announced and sufficiently specified. See Section 3.3.

[5] A structural macro-econometric model of the euro area. For more information see: https://joint-research-centre.ec.europa.eu/projects-and-activities/macroeconomic-monitoring-fiscal-surveillance-forecasting-and-nowcasting/global-multi-country-model_en. For details see Annex II.

[6] For a related study by the ECB assessing its forecast accuracy for the recent period after pandemic, see: https://www.ecb.europa.eu/press/economic-bulletin/focus/2024/html/ecb.ebbox202407_06~b90aea0ed4.en.html. Unlike the annual setup of the current analysis, ECB assessment is performed in quarterly terms. Similar to the current study, an attempt is made to explain the origins of the forecast errors and the role of external assumptions.

[7] Keereman (1999), Melander, Sismanidis and Grenouilleau (2007), González Cabanillas and Terzi (2012), Fioramanti et al. (2016), Chabin et al (2020).

[8] This choice mirrors the regular release of annual national accounts data.

[9] Outturn data against which the accuracy of current-year forecasts is assessed come from the national account release just before the publication of the latest Spring forecast. The accuracy of the year-ahead forecast is measured against the national account release

The forecast errors are calculated for all EU Member States[10]. The EU and euro area aggregates reflect the changing composition of the two areas over time. We focus on the forecast performance over the 'baseline period' 2000-2023, and especially the recent years 2018-2023. For the sake of comparison, we include results for the period 2000-2017, which was the baseline period of the previous study (Chabin et al., 2020) and refer to that period as the 'reference period'. Data updates and revisions induce some mild differences compared to the respective results in Chabin et al. (2020).[11]

3. FORECASTING PERFORMANCE IN RECENT YEARS

In this section, we assess the performance of recent macroeconomic forecasts over the period 2000-2023 (baseline period) and compare it with that in the reference period 2000-2017, which, as noted, constituted the baseline period of the previous study by Chabin et al (2020). Forecast performance is assessed using the mean forecast error (ME) as a standard measure of forecast bias, along with the mean absolute forecast error (MAE) and the root mean square forecast error (RMSE) as alternative metrics of forecast accuracy or precision. We discuss the ME, MAE and RMSE for real GDP growth, inflation and the general government balance in percentage of GDP. Detailed summary statistics are provided in Annex.

3.1. GROSS DOMESTIC PRODUCT

Regarding current year forecasts, in the first two years (2018-2019) of extension of the baseline period of the previous accuracy study, forecast accuracy remained broadly consistent with the average performance (Graph 3.1, dashed lines) even showing some mild improvement, mainly due to the fairly accurate prediction of the 2019 growth rate. As measured by both the MAE and the RMSE, the forecast error for real GDP growth for the current year shrank somewhat for both the EU and euro area aggregates relative to the reference period 2000-2017 (Table I.1 in Annex I). However, following the outbreak of the pandemic, the uncertainty surrounding the duration of the crisis and its economic impact resulted in significantly elevated forecast errors in both 2020 and 2021, exceeding average forecast under-performance (Graph 3.1, dashed lines). The large (negative) forecast errors reflected (on the one hand) the overprediction of the severity of the initial shock in 2020 and (on the other hand) the underprediction of the pace of economic recovery in 2021. More recently, notwithstanding the disruptive impact of the Ukraine war and the energy supply shock, the precision of current year forecasts for 2022 and 2023 showed some improvement compared to 2020-2021 but remained below average. Overall, relative to the reference period, the period 2018-2023 led to a decrease in forecast precision, but also reduced the positive bias of current year forecasts for the EU and the euro area.[12]

In assessing the performance of current year forecasts, it is important to note that from 2021 onwards, the forecasts for both spring and autumn systematically take account of the preliminary flash estimates for real GDP growth at t+30. The latter were first released by Eurostat on 29 April 2016, but not all the full-fledged forecasts before 2021 could incorporate those flash estimates.[13] *Ceteris paribus*, the incorporation of these preliminary flash estimates for real GDP growth in the latest completed quarter is likely to have improved the accuracy of the forecast for the current year. [14]

For the year-ahead forecasts, errors are markedly larger than for the current year forecasts, which is not surprising given that much less information is available at the time of forecasting. Similar to the current year forecasts, the overall accuracy improved for both the EU and euro area aggregates in 2018-2019,

before the publication of the last Autumn forecast. Evidently, the outturn data for the evaluation of the year-ahead forecasts include possible revisions compared to those used for the evaluation of the current year forecasts.

[10] Croatia is included in this study, while UK is excluded.

[11] The baseline period of the current study has been updated starting from the year 2013 onwards.

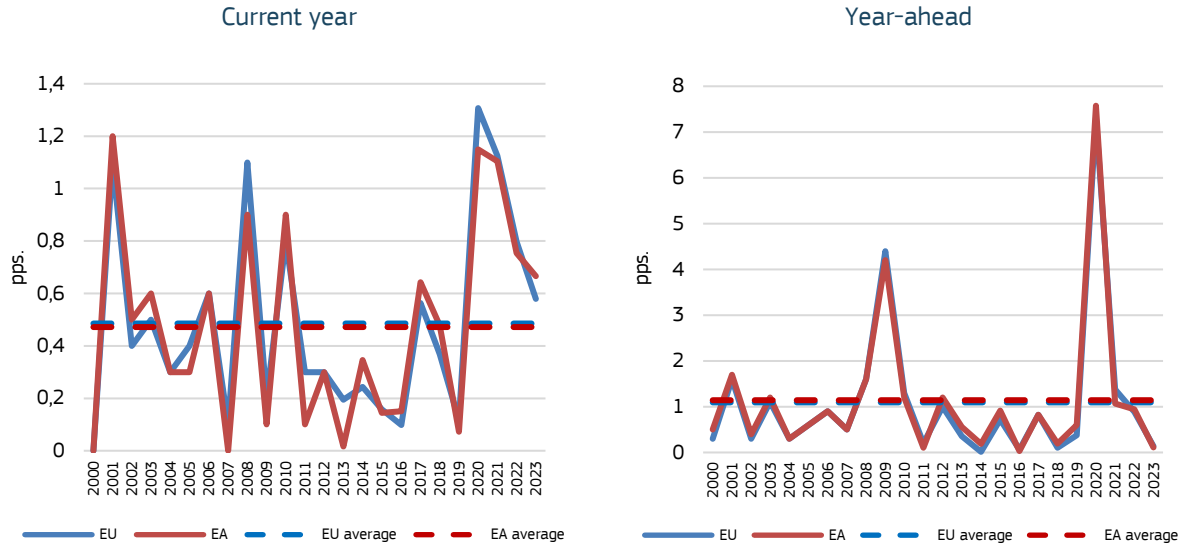
[12] This follows from visual comparison of the respective statistics for bias (Mean Error, ME) and precision (Mean Absolute Error, MAE, Root Mean Square Error, RMSE) between the period 2000-2017 and 2000-2023 in Table I.1 in Annex I.

[13] Due to calendar constraints related to the fiscal surveillance cycle.

[14] Current year (spring) forecast use information up to the first quarter of the current year, while year ahead (autumn) up to the third quarter of the previous year.

with the MAE and RMSE showing a small decrease relative to their average value in 2000-2017 (Table I.1 in Annex I). Also, the positive bias shown by the average ME in the reference period decreases slightly in 2018-2019. In 2020, the forecast error picked to historical highs. This was due to the unprecedented and unpredictable nature of the pandemic, weighing on GDP growth[15]. However, as the situation stabilised and more data became available, forecast errors went back to pre-pandemic magnitudes in the following years. In fact, excluding the year 2020, one-year-ahead forecasts show a smaller bias and higher precision compared to the reference period for both the EU and euro area, as well as on average across countries (Table I.1). Overall, when including the year 2020, the precision of the year-ahead forecasts over the period 2018-2023 decreased relative to the reference period, while bias increased.

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



Source: EC, Eurostat, own calculations.

The impact of the aforementioned unprecedented shocks shows up also at the Member State level. The accuracy of the current-year GDP projections deteriorated for the majority (19 countries in terms of mean absolute error, MAE), while bias deteriorated for a smaller majority (16 countries). Excluding the year 2020, the number of countries with deteriorating bias remained unchanged, while accuracy deteriorated in almost half of the member states (14 countries, in terms of MAE). One-year-ahead forecasts deteriorated in terms of MAE in 19 EU member states, whereas the bias increased in 21 countries. Excluding the year 2020 leaves a minority of countries (fewer than ten out of 27) with losses in both bias and accuracy. Graph I.1 visualises the results of Table I.1, showing that some of the aforementioned increase in the bias stems from an increase in the degree of underprediction of current and year ahead GDP growth by countries, which already underpredicted GDP growth in the reference period (2000-2017).

3.2. INFLATION

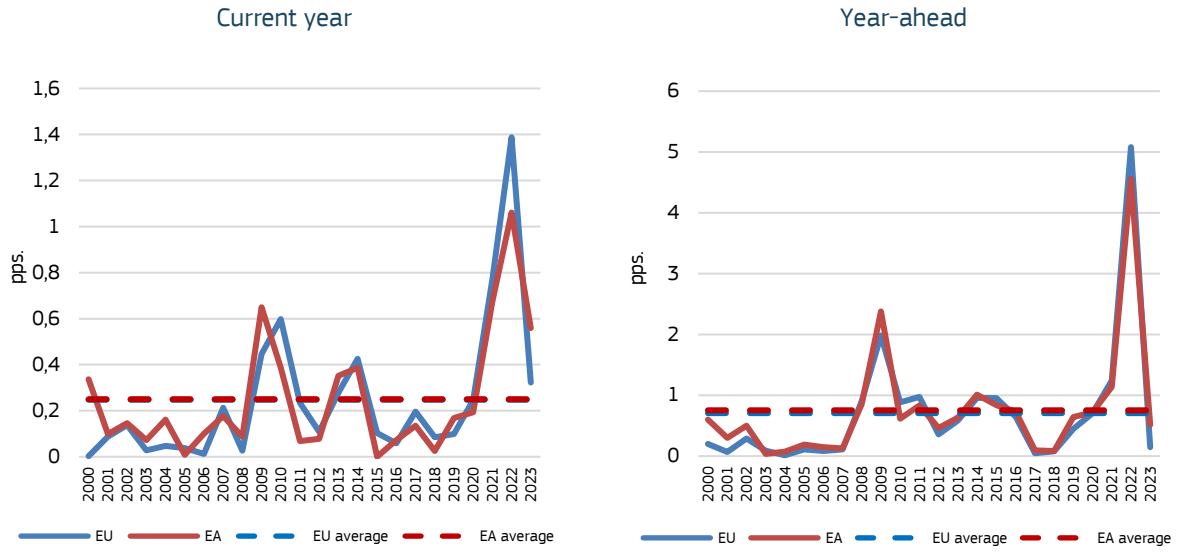
Similar to GDP forecasts, during the first two years (2018-2019) of extension of the baseline period of the previous accuracy study, the current year forecast of inflation showed a roughly similar performance to the reference period in terms of accuracy and bias for the EU and the euro area (Table I.2). Furthermore, unlike the GDP forecast, the 2020 inflation forecast in the Spring Forecast (SF) 2020 remained fairly accurate despite the significant drop in inflation that year. However, over the period 2021-2022, current year forecasts significantly underestimated the surge in inflation, resulting in significant deviations of forecast errors from historical standards (Graph 3.2, dashed lines). In 2023,

[15] In 2020, GDP growth dropped by more than seven percentage points compared to the previous year, to lower than -6% for both the EU (-6.1%) and the euro area (-6.6%). The size of the drop roughly corresponds to more than three times the standard deviation of the historical GDP growth series up to 2020.

forecast errors returned closer to average levels. As a result, the overall performance of the current year forecast over the baseline period (2000-2023) worsened compared to the reference period, in terms of both accuracy and bias. Exclusion of the year 2022 partially improves the performance metrics (Table I.2), without reversing their overall performance.[16]

One year-ahead forecasts showed a broadly similar performance to the current year ones, with a less pronounced underprediction of the inflation increase in 2021 (compared to their respective average forecast errors) and a faster gain in accuracy in 2023 (Graph 3.2). However, unlike current year forecasts, excluding the year 2022 leads to a marginal improvement of RMSE, compared to the reference period (Table I.2).

Graph 3.2. **Inflation, absolute error**



Source: EC, Eurostat, own calculations.

At the EU Member State level, the accuracy of current-year inflation projections deteriorated for the majority (23 countries in terms of mean absolute error, MAE), while bias increased for 19 countries. Excluding the year 2022, accuracy decreased for a smaller majority of 17 countries (in terms of MAE), while bias increased for a smaller majority of 16 countries. One-year-ahead forecasts deteriorated in almost all member states (26 countries, in terms of MAE), whereas the change in bias remained broadly balanced across countries (with 13 countries showing an increase in bias). Excluding the year 2022 reduces the number of countries with losses in precision by almost half (to 14 countries, in terms of MAE), while the number of member states with an increase in bias drops to 10 countries.[17]

3.3. GENERAL GOVERNMENT BALANCE

Turning to the general government balance-to-GDP ratio, the two years preceding the pandemic (2018-2019) saw a small improvement in the accuracy of current-year forecasts for the EU and euro area. A small increase in negative bias also emerged, driven by better-than-expected fiscal outcomes during a period of narrowing fiscal deficits. The fiscal projections for the first two years of the pandemic significantly overestimated deficits – consistent with GDP growth underestimation at the same time - leading to substantial forecast errors over the period 2020-2021 (Graph 3.3). From 2022 onwards, current-year fiscal projections accuracy returned to average levels. Overall, both the bias and magnitude

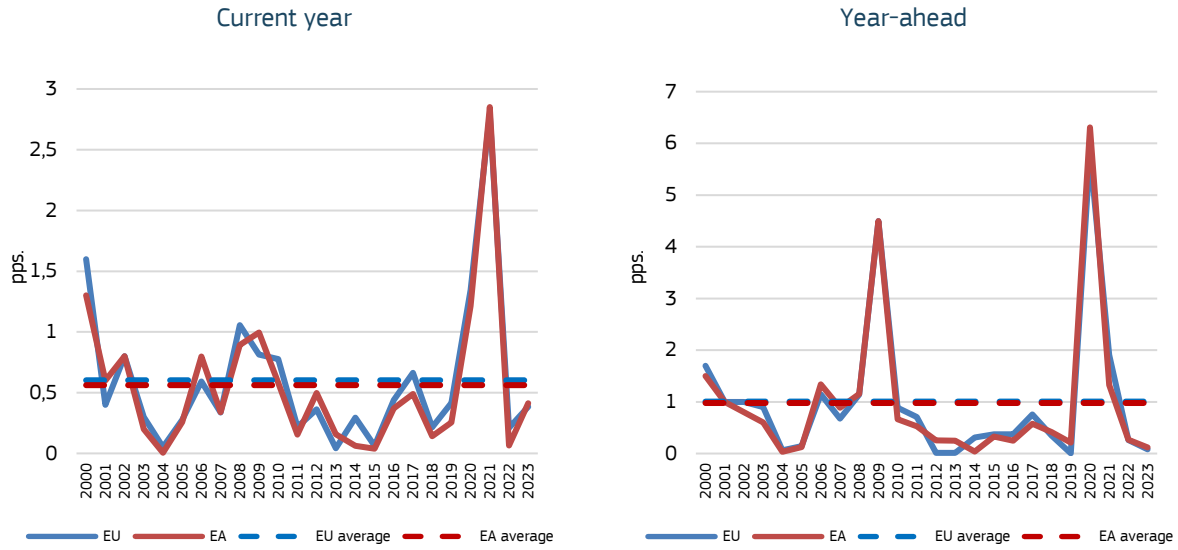
[16] In the peak year 2022, inflation increased above 7% for the EU (7.6%) and closed slightly below that for the euro area (6.9%). Compared to historical volatility, the size of the increase in 2022 inflation was not as large as the respective drop in 2020 GDP growth. However, inflation forecast errors remained large in 2023 as well, compared to the previous period, which led to a drop in forecast accuracy even after excluding the year 2022.

[17] For a visual representation of the change in accuracy and bias across countries, see Graph I.2.

of forecast errors increased over the baseline period (2000-2023) compared to the reference period (Table I.3). The decline in precision is largely attributed to the year 2021; excluding this year from the baseline period results in MAE and RMSE levels similar to those of the reference period. Nevertheless, an increase in negative bias persists, largely reflecting the sequence of seven consecutive years (2016-2022) of better-than-expected fiscal outcomes for the EU and the euro area.

The pattern of the one-year-ahead forecast errors for the EU and the euro area closely resembles the respective pattern of GDP growth; the years 2018-2019 showed a slightly better performance in terms of forecast accuracy and bias compared to the reference period. A large underestimation of the fiscal deficit in 2020 in AF19, due to the unpredictable pandemic shock, resulted in the historic peak in the forecast error (Graph 3.3). Excluding the year 2020, the performance improves in terms of both accuracy and bias compared to the reference period.

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



Source: EC, Eurostat, own calculations.

The assessment of the budgetary projections of the European Economic Forecasts (EEF) needs to take account of the fact that these projections are made on a "no policy change" basis: they generally assume continuation of existing budgetary policies and include new measures only to the extent that they have been credibly announced and sufficiently specified.[18] This means that the forecast does not incorporate a reaction function for the general government, even in cases where such a reaction is likely (e.g. for countries with binding policy targets, even when they are constitutionally mandated). Also, the forecast does not make assumptions on policy orientations still to be substantiated, nor does it include measures on which political consensus is building, but which have not yet led to a government decision. This way, the Commission budgetary projections are not necessarily the most accurate by construction. For the purposes of the Commission's macro-fiscal surveillance, they rather aim to identify the gap between current policies and fiscal objectives – that is, the size of the additional policy action that may be needed to abide by the net expenditure growth rate each Member State has committed to in their medium-term fiscal-structural plans. If the budgetary forecast triggers a policy response from the Member State to close the gap between forecast and target, the budgetary forecast will have fulfilled its main purpose. Thus, paradoxically a good and useful budgetary forecast is the one that leads to actions that will ultimately refute the forecast.

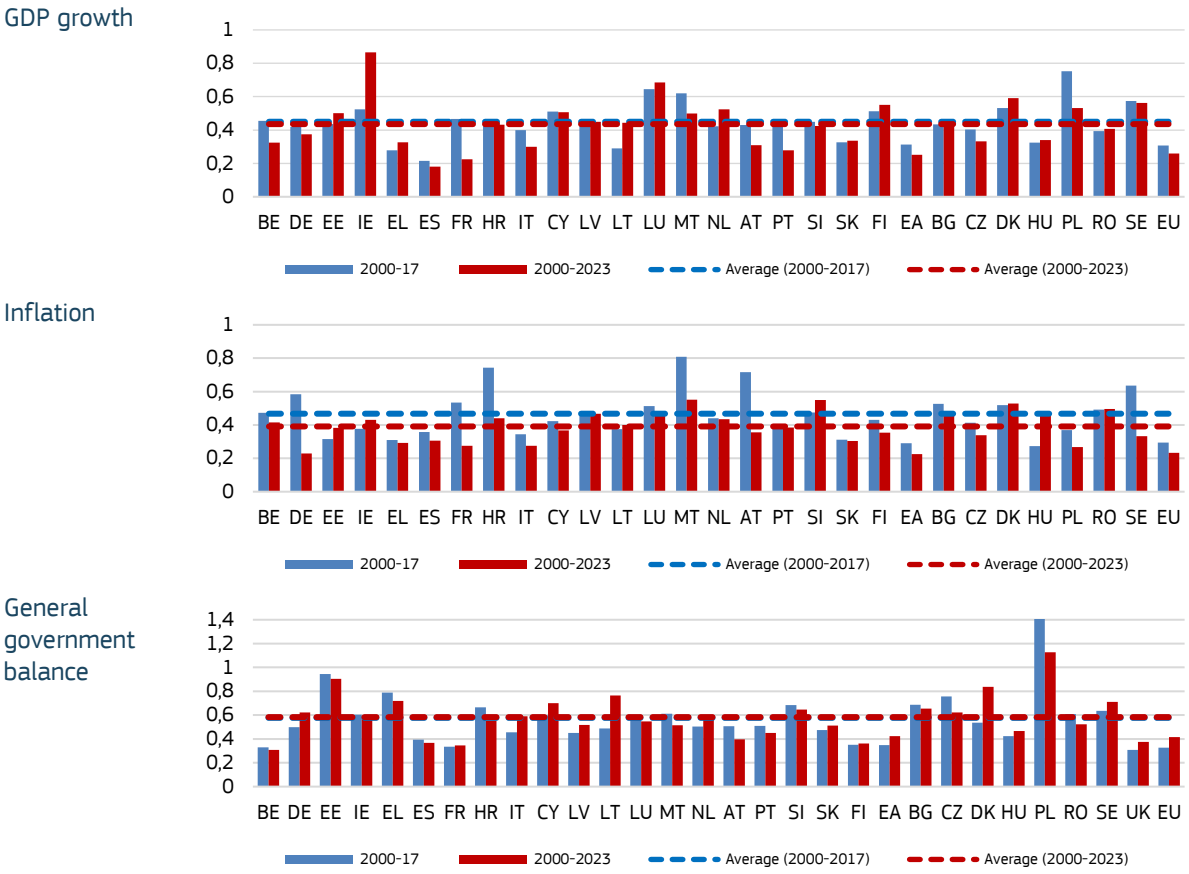
[18] See https://economy-finance.ec.europa.eu/document/download/2e4bd2cc-95ac-409d-8e41-ca39a2ac71e1_en?filename=ip045_en.pdf

At Member State level, accuracy of current year fiscal projections deteriorated for the majority of countries, while the impact on bias was balanced across countries. One year ahead forecasts lost precision in more countries (larger majority), while the bias increased in fewer. The impact of 2020 for the year ahead forecasts was stronger than 2021 on current year forecasts. Excluding the year 2020 leaves a minority of countries (less than ten out of 27) with losses in bias and accuracy.[19]

3.4. VOLATILITY-ADJUSTED FORECAST ERRORS

As in the previous study, this section presents results using a 'relative' measure of forecast precision, which accounts for the volatility of the target variable. In this exercise, the RMSE of the current year forecast is divided by the standard deviation of the target variable. This enables comparison of forecast accuracy across different target variables, such as GDP, inflation, and the general government balance, as well as across different time periods, which exhibit varying volatility, and across countries.[20] This feature is particularly relevant given that our extended baseline period covers both the pandemic and energy crises as two significant sources of volatility.

Graph 3.4. **Volatility-adjusted forecast errors, 2000-2023, RMSE, current-year**



Note: RMSE for each Member State is normalised by the respective standard deviation of the data.

Source: EC, Eurostat, own calculations.

[19] For a visual representation of the change in accuracy and bias across countries, see Graph I.3.

[20] As mentioned in Chabin et al (2020): "In general, forecasts for some countries are more accurate than for others irrespective of the variable in question and the forecast horizon. 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."

The forecasts for the EU and euro area aggregates appear more accurate than for most countries, across all three target variables (GDP, inflation, GGB). Aggregating individual Member State forecasts allows to offset errors and thus increase accuracy. Inflation turned out to be the variable most accurately predicted in the baseline period for the EU and the euro area as well as across countries on average. It is followed by GDP and then by the general government balance.

Despite the forecasting challenges posed by the pandemic and energy crisis, GDP and inflation forecasts gained in accuracy compared to the reference period, on average across countries as well as in the EU and the euro area. The relative accuracy of the fiscal projections remained stable across countries, while it deteriorated for the EU and euro area aggregates

4. PROPERTIES OF THE FORECAST ERRORS

This section updates the results of the statistical tests implemented in the previous forecast accuracy exercise (Chabin et al. 2020) to the extended baseline period 2000-2023.

4.1. ARE THE PROJECTIONS BIASED?

In the previous section, we examined the shifts in average forecast errors relative to the reference period, providing insights into the direction of change (i.e. increase or decrease in bias). However, these changes may not always be statistically significant. The present section undertakes a formal examination of the potential bias in forecast error, incorporating the effects of shocks and accounting for the extension of the sample period. More formally, unbiasedness, requires the forecast errors to be close to zero on average over the period. In other words, unbiasedness means that there is no systematic over- or under-estimation of the target variable. 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. $\alpha = 0$. Overprediction, i.e. forecast higher than outturn, implies $\alpha > 0$, while underprediction implies $\alpha < 0$. In order to test whether the extension of the period 2018-2023 has a statistically significant impact on the bias estimate, we also perform auxiliary regressions adding a dummy variable that shifts the constant term in the above equations after the year 2017. Results are presented in Table 4.1 and Table 4.2 below.

4.1.1. Gross Domestic Product

For the reference period (2000-2017), Chabin et al. (2020) confirmed previous findings of no evidence of bias in the Commission's projections for GDP growth for the EU and euro area aggregates. In the current study the same results hold for the current year forecast, while a statistically significant upward bias is detected in one period ahead forecasts (Table 4.1). Controlling for effect of the year 2020- by including an appropriate dummy variable for the year 2020 in equation (1) or (2) above-, the magnitude of the bias decreases by half and becomes statistically insignificant (Table 4.2).

At the Member State level, the period extension exerted a negative average impact on the bias of current-year forecasts (Table 4.1), which was statistically significant for six countries (out of 27). For one year-ahead forecasts, the period extension had a positive average impact on bias (though statistically significant only for two countries), largely reflecting the worse-than-expected real GDP outcome during the pandemic outbreak. Consistently with this, the effect of the 2020 pandemic outbreak on year ahead forecast bias was positive and statistically significant for all countries except Ireland (Table 4.2). When controlling for this effect, the magnitude of bias falls for the majority of countries, with two countries

(France, Italy) still remaining on the positive side and two others (Poland, Malta) on the negative. Comparing current with year ahead forecasts, most countries display overpredicting year-ahead forecasts and underpredicting current-year forecasts. A small subset of three countries (Malta, Poland, and Ireland) displays underpredictions and six countries (France, Italy, Austria, Portugal, Finland and Denmark) overpredictions for both horizons.

4.1.2. Inflation

Chabin et al (2020) found the Commission's forecast of inflation for the euro area and the EU unbiased on both the current and year ahead forecasts. Despite the negative impact of the extension of the period (Table 4.1) inflation forecasts for the two aggregates continue to display no statistically significant bias.

Table 4.1. **Tests for forecast bias, 2000-2023**

	GDP				Inflation				GGB			
	Current year		Year ahead		Current year		Year ahead		Current year		Year ahead	
	α	year > 2017	α	year > 2017	α	year > 2017	α	year > 2017	α	year > 2017	α	year > 2017
BE	-0.12	-0.66*	0.31	0.31	-0.35*	-0.47	-0.49	-1.07	-0.15	-0.48	0.09	0.38
DE	-0.07	0.10	0.58	1.62**	-0.06	-0.36*	-0.07	-0.94	-0.68**	-0.72	-0.16	0.87
EE	-0.36	-0.99	0.65	0.19	-0.51	-0.95	-0.70	-2.49	-0.95**	-0.84	-0.65	0.93
IE	-1.43	-2.73	-1.63	-0.92	-0.22	-1.30***	-0.25	-1.85*	0.67	-2.31	0.85	-1.98
EL	-0.06	-1.57*	0.99	0.22	-0.18	-0.17	0.07	-0.19	1.19	-2.16**	2.14**	-0.82
ES	-0.08	0.24	0.52	1.65	-0.25**	-0.14	-0.40	-0.65	0.48	-0.62	0.93	0.00
FR	0.12	-0.25	0.68*	1.11	0.10	-0.46**	-0.09	-0.87	0.00	-0.37	0.34	0.59
HR	-1.22*	-1.26	-0.11	0.41	-0.20	-1.92*	-0.39	-3.09	-0.68	0.21	-0.65	1.96
IT	0.16	-1.02**	1.03***	0.45	-0.02	-0.24	-0.14	-0.53	0.07	-0.33	0.71**	1.66**
CY	-0.83**	-0.85	0.29	-0.01	0.24	-0.50	0.30	-1.16	0.01	-0.10	0.26	2.13
LV	-0.43	-0.31	0.65	0.67	-1.19**	0.31	-1.57*	-0.71	-0.77**	-0.74	-0.19	1.74
LT	-0.45	-1.70	0.21	-0.64	-0.56	-0.96	-0.96	-2.56	-0.78	-1.69	-0.56	-0.20
LU	-0.11	-0.26	0.56	1.20	-0.10	-0.11	0.09	-0.57	-0.94***	0.14	-1.27***	1.42*
MT	-0.94**	-0.49	-0.61	0.32	0.28	-0.68*	0.13	-1.19*	-0.34	0.30	0.05	2.38
NL	-0.07	-1.06	0.41	0.08	-0.19	-1.00*	-0.13	-1.46*	-0.64*	-1.35**	-0.32	-0.81
AT	0.02	0.01	0.61	1.31	-0.32**	-0.44	-0.24	-1.13	-0.30**	0.49	0.02	1.61
PT	0.04	-0.30	0.58	0.54	-0.22	-0.31	-0.16	-0.83	-0.08	-1.37***	0.62	-1.44
SI	-0.39	-0.83	0.32	0.55	-0.40	-1.44	0.06	-2.07	0.07	-1.21	0.38	-0.37
SK	-0.22	0.80*	0.47	2.40*	-0.24	-1.10**	-0.12	-1.72	-0.20	-0.85*	0.13	-0.14
FI	0.08	-0.70	0.79*	0.85	-0.07	-0.26	-0.19	-0.56	-0.45*	-0.39	-0.18	0.53
EA	-0.01	-0.41	0.61*	0.99	-0.08	-0.41*	-0.17	-0.87	-0.18	-0.68	0.26	0.53
BG	-0.29	-0.73	0.39	0.03	-0.19	-0.66	-0.75	-2.01	-0.33	-0.75	0.56	-0.35
CZ	-0.25	0.33	0.56	1.67	-0.07	-0.84	-0.19	-1.93	-0.77***	0.30	-0.45	1.77*
DK	0.01	-1.78***	0.55	-0.92	-0.01	-0.28	-0.01	-0.39	-1.36***	-2.05**	-1.35***	-1.73**
HU	-0.23	-1.06*	0.46	0.19	-0.41	-1.98*	-0.53	-2.80*	0.19	1.14**	0.18	2.50**
PL	-0.55**	-0.44	-0.21	0.45	-0.13	-0.68	-0.20	-1.82	-0.01	-1.64*	0.57	0.28
RO	-0.37	-0.58	0.74	0.30	-0.43	-1.69**	-0.87	-2.13	0.11	-0.14	0.33	-0.09
SE	-0.18	-0.63	0.29	0.35	-0.25**	-0.64***	-0.02	-1.17*	-0.84***	-0.48	-0.56*	0.96*
EU	-0.02	-0.51	0.56*	0.84	-0.09	-0.48*	-0.18	-0.96	-0.23	-0.71	0.22	0.42
Average	-0.28	-0.68	0.39	0.56	-0.21	-0.69	-0.28	-1.37	-0.27	-0.67	0.08	0.51

Notes: Reported values are the estimated coefficient α, from equations (1) and (2) for each individual country/region. The column 'year > 2017' reports the estimated coefficient (and the corresponding significant level) of a dummy variable that shifts the intercept of equations (1) and (2) after the year 2017 in auxiliary regression. Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.

Source: EC, Eurostat, own calculations.

The extension of the period induced negative bias, i.e. underprediction, for almost all countries at both horizons (though statistically significant only for a minority of them). Specifically, the year 2022 had a significant negative impact on both horizons and almost all countries (Table 4.2), with significant

underestimation of the inflationary impact of the Russian war of aggression and the subsequent energy crisis. Nevertheless, the vast majority of countries remains unbiased.

4.1.3. General government balance

The government budget balance projections for the EU and euro area aggregates appear unbiased (i.e. statistically indifferent from zero) at both horizons, in line with the previous study.

On average across countries/regions, the extension to the new baseline period had a negative impact on the bias of the current year and a positive on the year ahead. Unlike GDP and inflation, the peak years of forecast errors were different across horizons; for current forecasts, the peak year was 2021, when the deficit in the EU turned out smaller than expected, while for year-ahead forecasts it was 2020, when the EU deficit was larger than expected in the Autumn Forecast (AF) 2019, before the pandemic outbreak. The impact of these years on the average bias is almost uniform across countries (Table 4.2). However, the majority of countries remained unbiased at both horizons, with ten countries exhibiting statistically significant negative bias in current year forecasts.

Table 4.2. **Tests for forecast bias, 2000-2023 (effects of specific years)**

	GDP				Inflation				GGB			
	Current year		Year ahead		Current year		Year ahead		Current year		Year ahead	
	α	year = 2020	α	year = 2020	α	year = 2022	α	year = 2022	α	year = 2021	α	year = 2020
BE	-0.09	-0.79***	0.04	6.58***	-0.27**	-1.92***	-0.19	-7.32***	-0.06	-2.04***	-0.20	6.99***
DE	0.00	-1.57***	0.36	5.22***	-0.04	-0.58***	0.12	-4.70***	-0.54**	-3.27***	-0.38	5.32***
EE	-0.16	-3.85***	0.41	4.68***	-0.24	-5.36***	-0.05	-13.04***	-0.84**	-2.37***	-0.97**	6.41***
IE	-1.00	-10.36***	-1.60	-0.74	-0.22	-0.20	-0.09	-3.79***	0.83	-3.87***	0.66	4.56***
EL	0.00	-1.50***	0.54	10.77***	-0.13	-1.10***	0.31	-5.62***	1.35*	-3.92***	1.75**	9.34***
ES	-0.15	1.60***	0.01	12.30***	-0.24**	-0.33***	-0.18	-5.17***	0.53	-1.25***	0.59	8.15***
FR	0.13	-0.27**	0.31*	8.83***	0.14*	-1.00***	0.00	-2.17***	0.09	-2.13***	0.06	6.78***
HR	-1.23	0.13	-1.20	11.94***	0.27	-5.12***	0.51***	-9.89***	-0.58	-1.10**	-1.45**	8.84***
IT	0.19	-0.84***	0.66**	8.71***	0.05	-1.61***	0.08	-5.26***	0.26	-4.72***	0.42*	6.83***
CY	-0.75*	-1.55***	-0.11	7.99***	0.34*	-2.13***	0.57	-5.38***	0.19	-3.60***	-0.17	8.53***
LV	-0.28	-3.05***	0.36	5.83***	-1.00*	-3.78***	-1.07	-10.07***	-0.81**	0.83**	-0.41	4.35***
LT	-0.11	-6.92***	0.09	2.43**	-0.25	-6.07***	-0.19	-15.28***	-0.45	-6.74***	-0.97	8.22***
LU	0.07	-4.14***	0.39	3.94***	-0.12	0.38**	0.24	-3.73***	-0.93***	-0.31**	-1.55***	6.51***
MT	-1.05**	2.24***	-1.29*	13.75***	0.34*	-1.25***	0.31*	-3.60***	-0.15	-3.69***	-0.51	11.23***
NL	0.06	-3.16***	0.21	4.87***	-0.20	0.21	0.07	-4.76***	-0.57*	-1.87***	-0.53	5.20***
AT	-0.03	1.11***	0.28	7.85***	-0.25***	-1.82***	-0.06	-4.25***	-0.24	-1.41***	-0.35**	8.91***
PT	0.00	0.80***	0.17	9.97***	-0.15	-1.67***	0.08	-5.68***	0.00	-1.87***	0.39**	5.43***
SI	-0.34	-1.11**	-0.03	7.00***	-0.11	-5.76***	0.48*	-8.37***	0.25	-3.53***	-0.03	8.20***
SK	-0.13	-1.82***	0.13	6.84***	-0.09	-3.04***	0.30	-8.50***	-0.20	-0.14	-0.10	4.43***
FI	0.24	-3.80***	0.65	3.32***	-0.03	-1.11***	-0.01	-4.15***	-0.39*	-1.62***	-0.36	4.40***
EA	0.03	-1.19***	0.31	7.27***	-0.04	-1.02***	0.02	-4.58***	-0.06	-2.79***	0.00	6.31***
BG	-0.12	-2.91***	-0.05	7.44***	0.08	-4.71***	-0.17	-9.91***	-0.41	1.29**	0.29	4.56***
CZ	-0.23	-0.39	0.17	7.81***	0.15	-4.43***	0.38	-11.36***	-0.67**	-1.98***	-0.76*	6.22***
DK	0.15	-3.28***	0.42	3.14***	0.11	-2.96***	0.23	-5.92***	-1.23***	-3.21***	-1.44***	2.15***
HU	-0.13	-1.96***	0.09	7.36***	0.00	-8.08***	0.05	-11.57***	0.20	-0.20	-0.18	7.15***
PL	-0.50**	-1.07***	-0.53**	6.42***	0.01	-2.65***	0.25	-9.04***	0.11	-2.51***	0.23	6.66***
RO	-0.26	-1.85***	0.32	7.17***	-0.14	-4.96***	-0.30	-9.72***	0.17	-1.09***	0.04	4.89***
SE	-0.04	-3.20***	0.14	3.68***	-0.20**	-1.24***	0.19*	-5.07***	-0.75***	-2.28***	-0.71**	3.65***
EU	0.04	-1.34***	0.27	7.04***	-0.04	-1.35***	0.04	-5.12***	-0.12	-2.67***	-0.03	5.84***
Average	**-0.20**	**-1.93**	**0.05**	**6.88**	**-0.08**	**-2.58**	**0.07**	**-7.00**	**-0.17**	**-2.21**	**-0.23**	**6.42**

Notes: Reported values are the estimated coefficient α, from equations (1) and (2) for each individual country/region. The columns 'year = 2020', 'year = 2021', 'year = 2022' reports the estimated coefficient (and the corresponding significant level) of a dummy variable that shifts the intercept of equations (1) and (2) at the respective year in auxiliary regression. Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.

Source: EC, Eurostat, own calculations.

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. As in the previous exercises, we employ the Ljung-Box test for testing serial correlation in errors up to three lags.[21]

4.2.1. Gross Domestic Product

Similar to Chabin et al (2020), this study finds no statistically significant evidence of serial correlation in GDP growth forecast errors over the extended period for the EU and the euro area, either for current-year or year-ahead forecasts.

At the Member State level, the majority of countries exhibit no statistically significant serial correlation at either horizon. Eight countries (Estonia, Greece, Italy, Latvia, Luxembourg, Netherlands, Denmark, Hungary) exhibit some form of statistically significant serial correlation for current year forecasts, while four countries (Estonia, Greece, Latvia, Poland) showed statistically significant autocorrelation for year ahead forecasts.

Table 4.3. **Tests for forecast errors persistence, current year**

	GDP						Inflation						GGB					
	2000-2017			2000-2023			2000-2017			2000-2023			2000-2017			2000-2023		
	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3
BE	-0.2	-0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.4*	0.0	-0.1	0.0	-0.1	0.1	0.1	-0.2	0.0
DE	0.3	-0.1	-0.1	0.1	-0.2	0.0	-0.3	-0.2	0.1	0.1	0.0	0.1	0.1	0.0	-0.1	0.2	-0.2	-0.1
EE	0.4	-0.4*	-0.6***	0.4*	-0.3*	-0.4**	-0.2	-0.4	0.3	0.1	-0.3	0.0	0.2	-0.4	-0.2	0.3	-0.2	-0.3
IE	-0.2	0.2	0.1	0.1	0.0	-0.2	0.2	-0.1	-0.3	0.3*	0.2	0.0	0.2	0.1	0.0	0.2	0.2	0.0
EL	0.6***	0.2**	0.0*	0.6***	0.1***	0.0**	0.0	-0.1	-0.3	0.1	-0.1	-0.2	0.1	-0.2	-0.3	0.2	0.0	-0.2
ES	0.3	-0.2	-0.2	0.2	-0.3	-0.2	-0.2	0.1	-0.2	-0.1	0.1	-0.2	0.2	-0.2	0.2	0.2	-0.2	0.2
FR	-0.2	0.1	-0.2	-0.2	0.1	-0.2	0.1	-0.4	-0.3	0.3*	-0.1	0.0	0.2	-0.3	-0.3	0.2	-0.3	-0.2
HR	0.0	-0.6	-0.1	0.4	-0.1	-0.2	0.0	-0.2	-0.2	0.4	0.1	0.0	0.1	-0.2	-0.3	0.0	-0.3	-0.4
IT	-0.1	-0.2	0.0	0.3*	0.1	0.1	0.4*	0.3	0.3	0.2	0.1	0.1	-0.1	-0.5**	0.3**	0.1	-0.4**	-0.2**
CY	0.2	0.0	0.2	0.2	0.0	0.1	0.3	-0.1	0.2	0.2	-0.1	0.1	-0.1	-0.2	0.3	0.0	-0.2	0.0
LV	0.3	-0.3	-0.5**	0.3	-0.3	-0.5**	0.5**	0.2*	0.0	0.3	0.1	0.0	0.0	-0.3	-0.3	0.0	-0.1	-0.1
LT	0.2	-0.4	-0.4*	0.3	-0.2	-0.2	-0.2	0.4	-0.3	0.1	0.0	-0.2	0.3	0.1	-0.1	0.3	0.0	0.0
LU	0.0	-0.5*	0.1	0.1	-0.5**	-0.2**	0.2	0.2	0.3	0.0	0.1	0.3	-0.1	-0.2	0.0	-0.1	-0.3	0.1
MT	0.0	-0.2	0.1	0.1	-0.3	-0.2	-0.1	0.0	0.1	0.1	0.1	0.2	0.2	-0.1	0.1	-0.1	-0.1	-0.2
NL	0.3	0.2	-0.1	0.4**	0.0*	-0.1	0.1	-0.2	0.0	0.1	0.2	0.1	0.2	-0.1	-0.3	0.4**	0.1*	-0.1
AT	0.1	0.1	-0.3	0.0	-0.1	-0.2	-0.2	-0.3	0.3	0.4*	-0.1	-0.1	-0.1	0.2	-0.2	-0.3*	0.0	0.0
PT	0.1	0.1	0.1	0.0	0.1	0.1	0.2	-0.2	0.2	0.2	-0.1	0.1	-0.2	-0.3	0.1	0.1	0.0	0.2
SI	0.2	0.0	0.1	0.3	0.0	0.1	0.0	-0.2	0.0	0.3	-0.2	-0.1	0.0	0.0	-0.2	0.1	0.1	-0.1
SK	0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	-0.3	-0.5	0.3	0.0	-0.1	0.3	-0.2	-0.1	0.2	0.1	0.0
FI	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	0.1	0.1	-0.2	0.2	0.0	-0.2	-0.1	0.0	-0.2	0.0	-0.1	-0.2
EA	**0.1**	**-0.1**	**-0.1**	**0.2**	**-0.1**	**-0.1**	**-0.1**	**-0.1**	**0.1**	**0.4****	**0.1***	**0.0**	**0.1**	**-0.5***	**-0.2**	**0.3**	**-0.2***	**-0.1**
BG	0.1	0.2	0.0	0.1	0.2	0.0	0.1	-0.1	0.0	0.0	-0.1	0.0	0.3	-0.3	-0.2	0.4	-0.3	-0.2
CZ	0.3	0.1	-0.1	0.2	0.0	-0.1	0.0	-0.1	-0.1	-0.2	0.1	0.0	-0.1	-0.1	0.3	-0.1	-0.2	0.1
DK	0.0	-0.2	-0.2	0.5**	0.2**	0.3**	0.3	-0.1	-0.3	0.0	-0.2	-0.1	0.0	-0.4	0.1	0.4**	0.0*	0.1
HU	0.2	-0.6**	-0.1*	0.4*	-0.2	-0.1	0.4*	-0.2	-0.5*	0.1	0.0	0.0	0.2	-0.3	0.1	0.1	-0.1	0.3
PL	-0.2	-0.1	0.1	-0.1	-0.2	0.1	0.4*	0.2	-0.1	0.2	0.0	-0.1	-0.1	0.0	-0.3	0.1	0.2	-0.1
RO	0.1	0.2	0.1	0.0	0.2	0.1	-0.6**	0.2**	0.0	0.0	0.2	0.1	0.0	-0.2	0.2	0.0	-0.3	0.1
SE	-0.1	-0.2	-0.2	0.0	-0.2	-0.2	-0.2	0.1	0.0	0.2	0.3	0.2	0.0	-0.3	-0.3	0.2	-0.3	-0.3*
EU	**-0.1**	**-0.2**	**0.0**	**0.2**	**-0.1**	**0.0**	**0.0**	**-0.2**	**0.0**	**0.4****	**0.1***	**0.0**	**0.1**	**-0.4***	**-0.2**	**0.3**	**-0.2***	**-0.1**

Notes: Table reports the autocorrelation coefficients. Star superscripts correspond to significance levels of Ljung-Box test of null hypothesis of no serial correlation up to the specific lag: (*) 0.10, (**) 0.05, (***) 0.01.

Source: EC, Eurostat, own calculations.

[21] We use the maximum number of lags (three) used in the two previous related studies (Chabin et al, 2020, Fioramanti et al., 2016).

4.2.2. Inflation

Current year forecasts for the EU and the euro area exhibit positive serial correlation for lags up to two years. This constitutes a significant upward revision from the reference period (2000-2017), reflecting the persistent underprediction of the current year inflation, due to the unprecedent energy crisis shocks. One period ahead forecast errors exhibit no significant autocorrelation across most countries and regions.

4.2.3. General government balance

Apart from a negative correlation at the second lag for current period forecast, our analysis on the extended baseline period found no other compelling evidence of persistence of forecast errors for neither the EU nor the euro area. One-year-ahead forecast errors reveal no statistically significant serial correlation, at both aggregate level – for the EU and euro area – and across countries.

Table 4.4. **Tests for forecast errors persistence, year-ahead**

	GDP						Inflation						GGB					
	2000-2017			2000-2023			2000-2017			2000-2023			2000-2017			2000-2023		
	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3	lag 1	lag 2	lag 3
BE	-0.3	-0.2	-0.1	-0.3	-0.1	-0.2	-0.1	-0.4	0.2	0.1	-0.2	-0.1	-0.1	-0.2	-0.2	0.0	-0.3	-0.3
DE	-0.1	-0.3	-0.2	0.0	0.0	-0.2	-0.3	0.0	-0.1	0.1	-0.1	-0.1	0.1	-0.3	-0.4*	0.0	-0.2	-0.3
EE	0.4*	-0.3*	-0.5**	0.3	-0.2	-0.4*	-0.1	-0.4	-0.1	0.2	-0.3	-0.1	0.2	-0.4	-0.4*	0.1	-0.2	-0.2
IE	0.1	0.0	0.0	0.1	-0.1	0.1	0.1	-0.3	-0.1	0.2	-0.1	0.0	0.5**	0.2**	-0.2*	0.5**	0.2**	-0.1*
EL	0.4**	0.2*	0.2	-0.1	0.1	0.0	0.1	0.2	0.0	-0.1	0.0	0.0	0.0	-0.2	-0.3	0.0	-0.2	-0.3
ES	0.3	-0.2	0.0	0.0	-0.1	-0.2	0.0	0.0	-0.2	0.1	-0.2	-0.2	0.3	-0.1	0.2	0.1	-0.1	0.0
FR	-0.1	0.0	-0.2	-0.2	0.1	-0.3	0.1	-0.1	-0.2	0.4*	0.0	-0.1	0.0	-0.2	-0.4	-0.1	-0.2	-0.2
HR	0.3	-0.5	-0.3	-0.4	0.1	-0.2	-0.4	0.3	-0.4	0.3	0.0	0.0	0.4	-0.2	-0.5	0.2	-0.2	-0.3
IT	0.0	-0.3	0.0	-0.3	-0.1	-0.2	0.1	-0.1	-0.2	0.1	-0.2	-0.1	-0.1	-0.6**	0.2**	-0.2	0.0	0.2
CY	0.1	-0.1	0.0	-0.1	-0.1	-0.2	0.2	0.1	0.0	0.2	-0.1	0.0	0.0	-0.2	0.0	0.1	-0.1	-0.3
LV	0.3	-0.3	-0.4*	0.3	-0.3	-0.4**	0.3	0.2	0.2	0.1	0.0	0.1	0.3*	-0.4*	-0.5**	0.4*	-0.3*	-0.4**
LT	0.0	-0.4	-0.1	0.0	-0.3	-0.1	0.1	0.0	0.0	0.1	-0.1	0.0	0.2	-0.2	-0.1	0.0	-0.1	-0.3
LU	0.0	-0.3	-0.1	0.0	-0.2	0.0	0.4*	0.2	0.3	0.3	0.1	0.2	-0.2	-0.4*	0.2	-0.1	-0.1	0.1
MT	0.2	-0.1	-0.1	-0.2	0.0	-0.3	-0.3	0.3	-0.2	0.1	0.2	0.0	0.4	0.1	0.1	0.3	-0.1	-0.3
NL	-0.1	-0.1	-0.1	-0.2	-0.2	-0.1	0.0	-0.1	-0.3	0.3	0.0	-0.1	0.1	-0.1	-0.3	0.0	0.0	-0.3
AT	-0.1	-0.2	-0.4	-0.1	-0.2	-0.2	-0.1	-0.4	0.1	0.2	-0.2	0.0	-0.2	-0.1	-0.1	-0.1	0.0	-0.1
PT	-0.1	0.0	0.0	-0.1	-0.2	-0.3	-0.1	-0.2	0.2	0.0	-0.1	0.0	0.0	-0.4	-0.1	0.0	-0.3	-0.1
SI	0.1	-0.1	0.1	0.0	0.0	0.0	0.1	-0.3	-0.3	0.3	-0.2	-0.2	-0.3	0.0	-0.2	-0.2	-0.1	-0.3
SK	0.0	-0.2	-0.2	0.1	0.0	-0.2	-0.2	-0.1	-0.4	-0.1	-0.1	-0.1	0.2	-0.2	0.0	0.1	-0.3	-0.1
FI	-0.1	-0.2	-0.1	-0.1	-0.2	-0.1	0.0	-0.1	-0.3	0.1	-0.1	-0.2	0.0	-0.3	-0.1	-0.1	-0.3	-0.1
EA	**-0.1**	**-0.2**	**-0.1**	**-0.2**	**-0.1**	**-0.2**	**0.0**	**-0.1**	**-0.2**	**0.2**	**-0.1**	**-0.1**	**0.1**	**-0.3**	**-0.3**	**-0.1**	**-0.2**	**-0.2**
BG	0.0	0.0	0.1	-0.2	0.1	-0.1	0.0	-0.4	0.1	0.1	-0.3	0.0	0.2	-0.1	-0.2	0.2	-0.1	-0.2
CZ	0.2	-0.1	-0.1	0.1	0.0	-0.2	-0.1	-0.1	-0.4	-0.2	0.0	0.0	0.0	-0.2	0.3	0.2	-0.1	0.1
DK	0.2	0.0	-0.2	0.0	0.1	-0.3	0.0	0.4	-0.1	-0.1	-0.1	-0.1	0.1	-0.2	0.1	0.0	0.2	0.0
HU	0.0	0.0	0.1	-0.2	0.0	0.1	0.1	0.3	0.0	0.1	0.1	0.1	0.1	-0.2	0.0	0.2	0.0	0.2
PL	-0.3	-0.5*	0.2*	-0.4*	-0.2*	0.1	0.3	-0.2	-0.2	0.1	-0.1	-0.1	0.1	-0.2	-0.3	-0.1	-0.1	-0.3
RO	0.1	-0.1	0.1	0.0	0.0	-0.1	-0.3	0.2	0.0	-0.1	0.0	0.1	0.3	0.1	0.0	-0.1	-0.2	0.1
SE	-0.1	-0.3	-0.2	-0.1	-0.2	-0.2	-0.1	0.0	-0.2	0.1	-0.1	0.1	0.2	-0.4	-0.4**	0.1	-0.3	-0.3*
EU	**-0.1**	**-0.2**	**-0.1**	**-0.2**	**-0.1**	**-0.2**	**-0.1**	**-0.1**	**-0.1**	**0.1**	**-0.1**	**-0.1**	**0.1**	**-0.3**	**-0.3**	**-0.1**	**-0.2**	**-0.2**

Notes: Table reports the autocorrelation coefficients. Star superscripts correspond to significance levels of Ljung-Box test of null hypothesis of no serial correlation up to the specific lag: (*) 0.10, (**) 0.05, (***) 0.01.

Source: EC, Eurostat, own calculations.

4.3. HOW DO PROJECTIONS COMPARE TO NAÏVE FORECASTS?

In this section we first update the assessment of whether the EC's forecasts systematically beat naïve forecasts. As in Chabin et al (2000), 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, while the one period ahead forecast for year t+1, performed in year t, would also be the actual 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.[22] The Diebold-Mariano test is used to statistically assess the difference between the two forecasts.[23]

The test statistics for all three forecast variables (GDP, inflation, general government balance) and both forecast horizons come out almost uniformly positive (Table 4.5), suggesting that Commission's forecasts for most Member States were more accurate than the naïve counterparts in quantitative terms. In many cases, however, the difference between the performances of the two forecast types is not sufficient to safely reject the null hypothesis (of equal accuracy between the two types).

Table 4.5. **Diebold-Mariano test**

	GDP				Inflation				GGB			
	2000-2017		2000-2023		2000-2017		2000-2023		2000-2017		2000-2023	
	Current	year ahead	Current	year ahead	Current	year ahead	Current	year ahead	Current	year ahead	Current	year ahead
BE	0.93**	0.78**	1.57**	1.18**	0.63*	0.59**	0.78**	0.64***	0.29	0.43**	0.63*	0.68***
DE	1.16**	1.08**	1.47***	1.14**	0.35***	0.21*	0.49***	0.38**	0.35	0.87***	0.27	1.03***
EE	2.63	3.52*	2.60**	2.67*	1.82**	1.88***	2.29***	1.80***	-0.08	0.38	-0.03	0.39
IE	1.23**	2.44**	0.62	2.10***	0.62**	1.08**	0.56**	0.94**	1.65	2.88*	1.50*	2.34*
EL	0.55	0.84*	1.44*	1.61**	0.62**	0.39	0.91***	0.47	0.35	0.53	0.69	1.22*
ES	0.89**	1.04***	1.86**	1.75**	0.65**	0.20	0.85***	0.34*	0.53	0.94*	0.97**	1.15**
FR	0.57**	0.69**	1.63*	1.36**	0.31	0.28	0.47**	0.42**	0.39**	0.71***	0.63**	0.81***
HR	0.32	1.24**	2.70	3.09	0.60	0.50	0.96**	1.02*	-0.20	0.70	1.09	1.14*
IT	0.98**	0.99**	1.83**	1.66**	0.44*	0.32	0.69**	0.49*	0.41**	0.58***	0.28	0.45*
CY	0.62**	1.37**	1.18**	1.72***	0.62	0.44	1.05**	0.71**	0.80	2.02**	1.22*	1.38
LV	2.33	3.62*	2.25*	3.06**	1.83*	1.63	1.96**	1.51**	0.59	1.06	0.71**	1.05**
LT	2.72	2.26	2.14	1.84*	1.52***	1.34***	2.12**	1.36***	0.39	1.19**	0.39	0.66
LU	1.02**	1.38***	1.15**	1.32***	0.70*	0.32	0.73**	0.51**	0.28	0.34	0.61	0.41
MT	0.70	0.42	1.61	1.07	0.36	-0.31	0.37	0.05	0.21	0.42**	0.68*	1.14*
NL	1.06**	1.09***	1.27***	1.40***	0.60***	0.56**	0.60***	0.61***	0.30	0.85***	0.28	0.77***
AT	0.91*	0.78**	1.61**	1.46**	0.27**	0.42***	0.36**	0.60**	0.36*	0.46**	0.75**	0.94**
PT	0.93***	0.92**	1.76**	1.50**	0.62*	0.55**	0.62**	0.58**	0.61**	0.98*	0.84***	1.07**
SI	1.58	1.59**	2.30**	1.92***	1.10**	0.64	1.21***	0.77**	1.55*	1.30	1.50**	1.31*
SK	1.84	1.75**	1.93**	1.35**	1.16***	0.61	1.21***	0.78*	0.50*	1.27**	0.67***	1.04***
FI	1.40**	1.35**	1.44**	1.35**	0.48***	0.65***	0.57***	0.63***	0.49*	1.10***	0.58**	0.95***
EA	**1.04****	**1.02****	**1.68****	**1.52****	**0.45****	**0.32****	**0.58*****	**0.49****	**0.52****	**0.87*****	**0.63*****	**1.04*****
BG	1.22	1.19	1.57*	1.53*	1.47*	1.84*	2.06**	1.68**	0.37	0.81	0.33	0.98**
CZ	1.43*	1.25**	2.05**	1.54***	0.82*	0.80***	1.17*	0.84***	0.16	0.35	0.42	0.76**
DK	0.84**	0.83*	0.98***	0.81**	0.33**	0.17**	0.51**	0.11	0.47	0.80**	0.17	0.27
HU	1.59**	1.24***	2.25**	1.82**	0.86**	1.27***	0.82***	1.58***	1.12	1.21**	0.90*	0.88**
PL	0.65***	0.84**	1.32**	1.38**	0.72***	0.78***	0.98**	0.97***	-0.06	0.25	0.43	0.41
RO	2.02	2.03	2.32**	2.06**	1.33***	1.02**	1.57***	1.09***	0.51**	1.68***	0.61	1.07**
SE	1.17**	1.45**	1.42***	1.69***	0.17**	0.20*	0.31*	0.36*	0.27	0.51	0.30*	0.50*
UK	0.95*	0.83**	2.01**	1.36**	0.29**	0.46**	0.50**	0.53***	0.85**	1.36***	1.00**	1.54***
EU	**1.01****	**0.95****	**1.62****	**1.42****	**0.45****	**0.30****	**0.61*****	**0.50****	**0.56*****	**0.95*****	**0.63*****	**1.02*****

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

Source: EC, Eurostat, own calculations.

We also examine whether the Commission forecasts are more informative than, or encompass, the naïve forecast, which relies on lagged values of the target variables. For current year forecasts, in a panel regression of the outcome value ($y_{i,t}$) of each of the three variables on their lagged values ($y_{i,t-1}$) and their forecasts ($y_{i,t,t}$), we test whether the coefficient on the lagged value (corresponding to the naïve

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

forecast) equals zero, which means that the naïve forecast becomes redundant once current year Commission forecasts are included in the regression. Evidently, the coefficient on the current year forecast value should remain statistically significant and positive, indicating a positive relation between the forecast and the realisation. The regression equation for the year-ahead forecasts includes the current year spring forecast ($y_{i,t,t}$) on top of the two variables as described above.

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

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

That is, for the current year, the European Commission forecasts encompass the naïve forecast if $\beta = 0$ and $\delta > 0$. For the year ahead forecast, the Commission forecasts encompass both the naïve forecast and the current year spring forecast, if $\beta = 0$, $\gamma = 0$ *and* $\delta > 0$.

Table 4.6. **Forecast encompassing tests**

	Current year forecast						Year ahead forecast					
GDP	**2000-2017**			**2000-2023**			**2000-2017**			**2000-2023**		
α	-0.1	0.0	0.0	0.4	0.5	0.1	-0.8	-0.6	0.2	-0.5	-0.3	0.6
β	-0.2***	-0.2***	-0.2**	-0.1	-0.1**	-0.2**	-0.1	-0.1	0.0	-0.1	-0.1	0.0
γ							-0.7**	-0.7***	-0.4***	-0.4***	-0.5***	-0.4**
δ	1.2***	1.2***	1.3***	1.0***	1.0***	1.2***	1.9***	1.7***	1.3***	1.4***	1.3***	1.1***
year = 2009			0.6			0.2			-5.0***			-5.4***
year = 2010			-0.4			0.0			-0.5			-0.5
year = 2020						3.6***						-6.9***
year = 2021						0.3						-1.1
year = 2022						1.8***						-0.4
AR(1)		0.2	0.2		0.3**	0.3***		0.2	0.1		0.2	0.2**
Inflation												
α	-0.2*	-0.1	-0.2*	-0.1	0.0	-0.1	-0.5	-0.3	0.0	0.2	1.5	0.1
β	0.0	0.0	0.0	-0.2**	-0.2***	-0.1	0.1	0.1	0.0	0.0	-0.1	0.0
γ							-0.4	-0.4*	-0.1	-0.4	-0.6***	-0.1
δ	1.1***	1.1***	1.1***	1.3***	1.3***	1.1***	1.4***	1.3***	1.1***	1.5***	1.1***	1.0***
year = 2009			-0.6**			-0.4			-3.1***			-2.8***
year = 2010			0.5***			0.4***			0.1			0.2
year = 2020						0.2*						-1.0***
year = 2021						1.1***						1.3***
year = 2022						2.2***						6.8***
AR(1)		0.0	0.0		0.1	0.0		0.2*	0.4***		0.4***	0.3
GGB												
α	0.2	0.2	0.2	0.1	-0.2	0.1	-0.3	-0.6	0.1	-0.8	-1.3	-0.1
β	0.0	0.0	0.1	0.1	-0.1	0.2**	0.0	0.0	0.0	0.0	0.1	0.1
γ							-0.2	-0.1	0.1	-0.3	-0.3	0.1
δ	1.0***	1.1***	0.9***	0.9***	0.9***	0.8***	1.1***	0.9***	0.7***	1.0***	0.7***	0.6***
year = 2009			-1.9**			-2.1***			-4.8***			-4.7***
year = 2010			-0.1			-0.3			-0.9			-1.4***
year = 2020						-1.0						-6.3***
year = 2021						2.1***						-0.1
year = 2022						1.0***						0.6**
AR(1)		0.1	0.0		0.3**	0.0		0.3***	0.2***		0.3***	0.3***

Notes: The table reports the estimated coefficients from the models in equations (3) and (4) where the error terms are allowed to exhibit first order autocorrelation and include country specific fixed effects. Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.

Source: EC, Eurostat, own calculations.

4.3.1. Gross Domestic Product

Regarding current-year forecasts, the results are mixed, with some specifications indicating that naïve forecasts do not have explanatory power once the Commission forecasts are included in the model (i.e. β is statistically indistinguishable from zero). Part of the Commission forecast superiority owes to its capacity to factor in the occurrence of shocks; when explicitly adding year-specific dummy variables naïve forecasts gain some predictive ability. Regarding one-year-ahead, i.e. autumn forecasts, they appear to cover the information content of the naïve forecasts, as evidenced by the coefficient β in equation (4) being statistically insignificant. However, the coefficient γ of the current year spring forecast is found statistically significant. This indicates that the current year spring forecast ($y_{i,t,t}$) preserves ability to predict next year growth beyond the autumn forecast ($y_{i,t+1,t}$) despite being released before the autumn forecast. This implies that some relevant information captured in spring forecasts may have not been fully taken on board in the autumn forecasts.

4.3.2. Inflation

The Commission's current-year forecasts for inflation have been found to possess significant informational value (δ>0). However, their comparative performance relative to naïve forecasts is not robust across alternative periods and specifications. In the baseline period, naïve forecasts have been found to exhibit some additional informative capacity in models without year-specific effects. One-year-ahead forecasts (i.e. autumn forecasts) seem to uniformly encompass naïve forecasts. However, not all examined specifications indicate that they also encompass current year forecasts (i.e. spring forecasts) released at the same year.

4.3.3. General government balance

Fiscal forecasts show stronger evidence, than GDP and inflation, of encompassing naïve forecasts as the β coefficient is statistically insignificant in most specifications, periods and both forecast horizons as well. Furthermore, current year forecasts were found to preserve no additional informational capacity in predicting one year ahead growth beyond the year ahead forecasts.

4.4. 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 and the EU/euro area aggregates, we employ the Pesaran-Timmermann (1992) test that examines the ability of a forecast to detect the correct sign of a change in the underlying series. Overall, despite the increased volatility, the performance of current-year forecasts for all variables has been slightly improved compared to the reference sample. The performance of year-ahead GDP forecasts has slightly improved, while year ahead inflation and general government balance forecasts show slightly less directional accuracy.

4.4.1. Gross Domestic Product

Pick-ups and slowdowns of GDP growth were found to be accurately predicted by the Commission's current year forecasts. A deceleration in economic activity was accurately predicted in 87% of cases while acceleration was foreseen in 78%. Overall directional accuracy of the current year forecasts thus reached 82%. This performance is slightly improved compared to the reference period in the previous study (80%). In contrast, the year-ahead forecasts, remained less accurate than current forecasts even they slightly improved relative to the reference period to 67% directionally accuracy, correctly predicting 69% of slowdowns and 67% of pick-ups.

4.4.2. Inflation

The directional accuracy of inflation current year forecasts remained higher than GDP. Pick-ups in inflation were correctly identified in 85% of all cases. For the year-ahead forecasts, the overall

directional accuracy is 66%, with 64% of pick-ups predicted correctly, and 67% 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 4.7. **Tests for directional accuracy**

		2000-2017								
		GDP			Inflation			GGB		
	Count *% row*	projected decrease	projected increase	Total	projected decrease	projected increase	Total	projected decrease	projected increase	Total
Current year	**actual decrease**	175	33	208	182	40	222	146	33	179
		84	*16*	*100*	*82*	*18*	*100*	*82*	*18*	*100*
	actual increase	53	181	234	35	185	220	80	183	263
		23	*77*	*100*	*16*	*84*	*100*	*30*	*70*	*100*
	Total	228	214	442	217	225	442	226	216	442
		52	*48*	*100*	*49*	*51*	*100*	*51*	*49*	*100*
	Accuracy (%)	80 ***			83 ***			74 ***		
Year ahead	**actual decrease**	136	72	208	156	66	222	104	75	179
		65	35	100	70	30	100	58	42	100
	actual increase	82	152	234	82	138	220	62	201	263
		35	65	100	37	63	100	24	76	100
	Total	218	224	442	238	204	442	166	276	442
		49	51	100	54	46	100	38	62	100
	Accuracy (%)	64 ***			67 ***			69 ***		

		2000-2023								
		GDP			Inflation			GGB		
	Count *% row*	projected decrease	projected increase	Total	projected decrease	projected increase	Total	projected decrease	projected increase	Total
Current year	**actual decrease**	294	43	337	258	47	305	210	45	255
		87	*13*	*100*	*85*	*15*	*100*	*82*	*18*	*100*
	actual increase	61	218	279	47	264	311	117	244	361
		22	*78*	*100*	*15*	*85*	*100*	*32*	*68*	*100*
	Total	355	261	616	305	311	616	327	289	616
		58	*42*	*100*	*50*	*50*	*100*	*53*	*47*	*100*
	Accuracy (%)	82 ***			85 ***			74 ***		
Year ahead	**actual decrease**	233	104	337	196	109	305	148	107	255
		69	*31*	*100*	*64*	*36*	*100*	*58*	*42*	*100*
	actual increase	93	186	279	102	209	311	96	265	361
		33	*67*	*100*	*33*	*67*	*100*	*27*	*73*	*100*
	Total	326	290	616	298	318	616	244	372	616
		53	*47*	*100*	*48*	*52*	*100*	*40*	*60*	*100*
	Accuracy (%)	67 ***			66 ***			67 ***		

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

Source: EC, Eurostat, own calculations.

4.4.3. 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 (67%) when decreases in the general government budget balance-to-GDP ratio were correctly predicted in 148 out of 255 cases (58%). On the other hand, positive changes were forecast with a higher accuracy (73%). Compared to the findings in the previous study, 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.

4.5. ARE THE PROJECTIONS EFFICIENT?

In this section, we conduct a test to determine whether the forecast time series exhibit the same mean and variance as their corresponding target variables. If this condition is met, it implies that all relevant information about the forecast variable has been effectively incorporated into the projection. Conversely, if forecasts exhibit greater volatility than their target variables, they can be considered to be inefficient, as they introduce excessive noise. If, instead, forecasts are less volatile than their target variables, they are not able to capture the actual volatility of their target variable and therefore can be seen as lacking predictive ability. As proposed in the previous study, a test of weak efficiency is based on a regression analysis[24] with the outcome as a dependent variable and an intercept and the projection as predictors.

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

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

The Commission's forecast can be considered unbiased and 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 α represents an additive factor while the slope coefficient β is a multiplicative factor. For example, if α is positive, this means that forecasts were underpredicting their target variable, while if β is higher than unity, forecasts were less volatile than their target variables.

Similar to the reference period, the baseline period fails to reject the efficiency hypothesis for most of the target variables and horizons. Given the increased volatility in the baseline sample, this could also reflect increased estimation uncertainty, which could lead to larger coefficient standard errors and non-rejection of the weak efficiency hypothesis.

4.5.1. Gross Domestic Product

The null hypothesis of efficiency was not rejected for both current-year and one-year-ahead GDP projections. The tests, which are robust to autocorrelation, and failed to reject the hypothesis of unbiasedness and efficiency. This implies that GDP forecasts adequately capture the mean and variance of the realised GDP growth series.

4.5.2. Inflation

The null hypothesis of efficiency was not rejected in the baseline sample for both current-year and one-year-ahead inflation projections, similar to the GDP results.

4.5.3. General government balance

Similar to the reference period, the baseline period fails to reject the null hypothesis for current year forecasts. However, most specifications reject the null hypothesis for one period ahead forecast errors. This is because most specifications estimate the coefficient β to be lower than unity. This implies that projections appear more volatile than actual outturns, violating weak efficiency.

[24] For the early implementation and interpretation of the test see Mincer and Zarkowitz (1969).

Table 4.8. **Forecast efficiency tests**

	Current year						Year ahead					
GDP	**2000-2017**			**2000-2023**			**2000-2017**			**2000-2023**		
A	-0.2	-0.1	-0.1	0.3	0.3	-0.2	-0.5	-0.8	0.3	-0.8	-0.7	0.3
β	1.1***	1.1***	1.1***	1.0***	1.0***	1.1***	1.1***	1.3***	0.9***	1.1***	1.1***	0.9***
year = 2009			-0.4			-0.4			-6.3***			-6.4***
year = 2010			1.1***			1.2***			1.3***			1.2***
year = 2020						2.7***						-7.0***
year = 2021						1.9***						2.5***
year = 2022						1.2***						-0.3
AR(1)		0.1	0.1		0.2**	0.2**		0.0	0.2		0.0	0.2**
p(α = 0, β = 1)	0.2	0.2	0.7	0.4	0.6	0.7	0.9	0.7	0.8	0.7	0.6	0.5
Inflation												
α	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.3	-0.3	-0.2	0.2	0.5	0.1
β	1.1***	1.1***	1.1***	1.2*	1.2***	1.1***	1.1***	1.1***	1.1***	1.0***	0.9***	1.0***
year = 2009			-0.5***			-0.6***			-3.3***			-3.1***
year = 2010			0.4***			0.4***			0.3			0.2
year = 2020						0.2*						-1.0***
year = 2021						1.2***						1.4***
year = 2022						2.4***						6.9***
AR(1)		0.1	0.1		0.0	0.0		0.0	0.3**		0.2	0.2*
p(α = 0, β = 1)	0.0***	0.0*	0.0*	0.2	0.2	0.4	0.7	0.7	0.8	0.8	0.7	0.9
GGB												
α	0.2	0.2	0.1	0.1	0.0	0.0	-0.2	-0.6	0.0	-0.6	-1.2	-0.2
β	1.1***	1.0***	1.0***	0.9***	0.9***	0.9***	0.9***	0.7***	0.9***	0.8***	0.5***	0.7***
year = 2009			-1.4***			-1.5***			-4.7***			-4.5***
year = 2010			-0.1			-0.4			-0.6			-0.9**
year = 2020						0.1						-6.2***
year = 2021						1.9***						0.2
year = 2022						0.9***						0.3
AR(1)		0.1*	0.1**		0.2***	0.1***		0.3**	0.2***		0.3***	0.3***
p(α = 0, β = 1)	0.7	0.8	0.6	0.2	0.2	0.3	0.6	0.0***	0.0***	0.2	0.0***	0.0***

Notes: The table reports the estimated coefficients and F test statistics, from the models in equations (5) and (6) where the error terms are allowed to exhibit first order autocorrelation and include country specific fixed effects. Significance levels: (*) 0.10, (**) 0.05, (***) 0.01.

Source: EC, Eurostat, own calculations.

5. DRIVERS OF THE FORECAST ERRORS

The Commission's forecasts are underpinned by several assumptions, underlying trends and projections. Firstly, the forecasts are based on a set of assumptions for key variables, including the growth of the world economy and international trade, commodity prices, exchange rates, and short- and long-term interest rates. Furthermore, subject to the no-policy change assumption, the forecasts take account of fiscal projections, incorporating both the expected fiscal policy impulse on the economy and the feedback of expected macroeconomic outcomes on public finances. Moreover, the forecasts aggregate expected outcomes and trends in individual sectors of the economy, such as labour and goods markets.

This section examines the extent to which errors in the aforementioned assumptions and projections underlying the Commission forecasts impact the direction and magnitude of the Commission forecast errors for GDP and inflation. To this end, both regression analysis and model-based forecast error decompositions are conducted, with the latter relying on the Global Multi-country (GM) model. Regression analysis also investigates the role of uncertainty and the economic cycle.

5.1. REGRESSION BASED ANALYSIS

We closely follow the methodology described in the previous assessment of the Commission's forecasts (Chabin et al., 2020, Fioramanti et al., 2016). In a panel regression, we regress GDP growth or inflation forecast errors on errors in the external assumptions [for interest rates, exchange rates, commodity prices, global (excl-EU) economic and trade growth] and errors in fiscal policy projections[25], based on the below general specification:

$$e_{i,t} = \beta X_{i,t} + u_i + \varepsilon_{i,t}, \quad (7)$$

where i indexes countries, (i = 1,..,27) and t years, $e_{i,t}$ stands for forecast errors in either GDP or inflation, $X_{i,t}$ is a vector including errors in the external assumptions, fiscal projection errors and other explanatory variables (including dummy variables that capture the impact of 'crises' years, such as the Great Financial Crisis the pandemic and the energy crisis), u_i, stands for country specific fixed effects and $\varepsilon_{i,t}$ a disturbance terms that is allowed to exhibit possible first order autocorrelation.

Our baseline specification includes errors in external assumptions and fiscal policy projection errors, along with country specific slopes. The second model includes the squared fiscal policy projection errors, exploring possible nonlinear effects. Uncertainty in the future course of economic developments is the subject of interest in the third model. Uncertainty is measured here using a dispersion index derived from the Commission's Business and Consumer Surveys.[26] In the fourth model, we isolate the impact of specific years that correspond to crises periods, introducing respective dummy variable. In the last two specifications, we add the uncertainty variable (the fifth model) and nonlinearity (the sixth model) to the model with the dummy variables.

Overall, the analysis confirms previous findings that projections or assumptions errors in the underlying drivers play an important role in the accuracy of the Commission's GDP growth and inflation forecasts, with a smaller impact for current-year forecasts. The pandemic and energy crises were found to explain much of the variation in current and year-ahead forecast errors.[27] In addition to the results presented below, Appendix I provides estimates for a sub-period of the ten most recent years (2013-2023), which allows focusing on the effects of the recent crises.

5.1.1. GDP growth forecasts

Regarding current-year forecasts, the explanatory power of errors in external assumptions (Table 5.1, "Baseline" specification) fell rapidly in the current baseline period (2000-2023) compared to the previous study (2000-2017). This possibly reflects the inclusion of higher volatility in the new baseline, which was largely unexplained due to the pandemic and energy crises. The effect of errors in long-term interest rates remains significant across model specifications as in the previous accuracy study. The same is true for errors in NEER. The effect of inaccuracies in global growth assumptions also appears significant, but it seems to be captured by the strong effects of year dummy variables (which capture years of specific

[25] Errors in assumptions are calculated similar to forecast errors. Fiscal policy projection errors are measured by the error in the projection of the general government structural balance. A positive (negative) projection error implies that discretionary fiscal policy turned out to be looser (stricter) than expected in the forecast, made on the 'no-policy-change' bases (see Section 3.3). This error will generally imply errors in the impact of the projected budgetary measures on the economy and the second-round effects of the economic outturns onto public finances. At the same time, errors in the projection of the general government structural balance could also reflect estimation errors regarding the output gap, which is used in the calculation of the structural balance.

[26] The index is based on the dispersion in the assessments of economic actors about the future, following Bachmann et al. (2013). The rationale of this measure is that, in times of high uncertainty, expectations of future economic developments are more diverse than in times of low uncertainty.

[27] Caution is needed when interpreting the regression coefficients, since variables enter the regressions in terms of their difference from their expected, assumed, or projected values. Let y denote the realisation of the dependent variable (i.e., GDP growth or inflation), x one of the regressors (i.e., oil price changes, NEET, or others), and the superscript ($\sim$) their respective forecast, assumption, or projection. Assuming for simplicity that all variables have zero mean, their covariance (estimated by the regression coefficient) can be written and decomposed as $E\big((\tilde{x}-x)(\tilde{y}-y)\big) = E(\tilde{x}\tilde{y}) - E(\tilde{x}y) - E(x\tilde{y}) + E(xy)$. This implies that the estimated regression coefficient will not only reflect the correlation of the realisations of variables but also the correlation coefficients between the forecasts and those between realisations and forecasts.

shocks). In contrast, errors in oil prices have lost their explanatory power in the current baseline compared to the reference period.

Economic uncertainty appears with a positive effect, which is robust across different specifications. The positive effect suggests that at times of high uncertainty, positive forecast errors are more likely to occur, i.e. outturns to be lower than expected by the Commission.

The positive coefficient of the year 2009 dummy variable indicates that the Commission overpredicted current growth at the outburst of the Great Financial Crisis. In opposite, the negative coefficients of the dummy variables for the years of the pandemic and energy crises (2020, 2021, 2022), indicate that the Commission underestimated the current growth developments. In the specifications with year dummies, the effect of fiscal projection errors was found significant, with a negative coefficient, which implies that positive projection errors for the change in general government structural balance (i.e. looser-than-projected fiscal policy) is associated with a negative GDP forecast error (i.e. higher-than-expected GDP growth) and vice versa.

Table 5.1. **Forecast error drivers, gross domestic product, current year**

	Baseline		Nonlinear		Uncertainty		Crises		Crises & Uncertainty		Crises & Uncertainty & Non-linearity	
	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23
Structural balance	0.20**	0.01	0.13	0.01	0.04	-0.04	0.01	-0.11*	-0.07	-0.22***	-0.07	-0.20***
Global (excl EU) growth	0.37**	0.36**	0.48**	0.41**	0.31*	0.35*	0.77**	0.09	0.02	0.14	0.05	0.15
NEER	0.32***	0.15*	0.29***	0.14*	0.20**	0.12	0.40***	0.29***	0.32***	0.24***	0.31***	0.23***
Oil	-0.06***	0.00	-0.05***	0.00	-0.06***	0.00	0.01	0.00	0.00	-0.01	0.00	-0.01
Long-term int. rates	-0.45***	-0.35**	-0.44***	-0.33**	-0.48***	-0.35**	-0.49***	-0.53***	-0.52***	-0.49***	-0.52***	-0.47***
Short-term int. rates	-0.13	0.42*	-0.09	0.42*	-0.03	0.44*	-0.38*	-0.29	-0.25	-0.18	-0.24	-0.17
Structural balance sq.			0.11***	0.06**							0.02	0.03
Uncertainty (st/sed)					0.47***	0.10			0.39***	0.39***	0.37***	0.38***
Year = 2009							2.48***	1.40***	1.28*	1.18***	1.27*	1.06**
Year = 2010							-0.62	-1.39***	-1.60***	-1.55***	-1.57***	-1.53***
Year = 2020								-1.72***		-2.20***		-2.29***
Year = 2021								-2.21***		-2.60***		-2.66***
Year = 2022								-2.29***		-2.40***		-2.39***
Constant	0.18*	-0.29***	-0.04	-0.40***	0.20**	-0.30***	-0.18	0.12	0.15	0.18*	0.11	0.15
# observations	248	402	248	402	239	393	248	402	239	393	239	393
# countries	27	27	27	27	27	27	27	27	27	27	27	27
R-square	0.15	0.03	0.18	0.03	0.24	0.04	0.27	0.28	0.33	0.34	0.33	0.33
R-square adjusted	0.08	-0.04	0.12	-0.03	0.13	-0.05	0.21	0.22	0.26	0.27	0.25	0.27

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

Source: own calculations.

For the year-ahead forecasts (Table I.4 in the Annex), errors in external assumptions keep playing a more prominent role than in current-year forecasts. Oil prices remain statistically insignificant in specifications with richer sets of explanatory variables, including year dummy variables. On the other hand, external growth gains statistical significance across all specifications. Errors in interest rates (both long- and short-term ones) also remain an important factor. The impact of errors in fiscal policy and uncertainty remains (as in the case of current year forecasts) positive and statistically significant in larger models. Across the included year dummies, robust effects are detected for the year 2009 (positive, suggesting growth overprediction) and 2022 (negative, suggesting growth underprediction).

5.1.2. Inflation forecasts

The effect of inaccuracies in the external assumptions on the performance of current-year inflation forecast turned stronger than in the case of the GDP growth forecasts in the current baseline period.

Errors in oil prices also turned insignificant impact in the latter period. In contrast, errors in interest rates, both short and long term, were found to be an important factor. External growth was also found significant but only in models without year dummies. Errors in fiscal projections were also found to be significantly correlated with inflation forecast errors in most of the specifications.[28] The inclusion of year dummies indicates a significant underprediction of inflation during the pandemic and the subsequent energy crises, for three years in a row (2020, 2021, 2022), increasing the explanatory power of the model compared to the baseline case.

The errors in external assumptions explain a much larger share of variation in the year-ahead inflation forecast errors (Table I.5, Annex). This time, the coefficients on the interest rates are found to be insignificant in models with year dummies. Similarly, errors in external growth assumptions show significant correlation in models without year dummies. In contrast, errors in assumptions for oil prices, the nominal effective exchange rate and fiscal projections are significant across all model specifications.

Table 5.2. **Forecast error drivers, inflation, current year**

	Baseline		Nonlinear		Uncertainty		Crises		Crises & Uncertainty		Crises & Uncertainty & Non-linearity	
	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23
Structural balance	0.03	0.13***	0.04	0.13***	0.05	0.16***	0.01	0.07*	0.02	0.07*	0.02	0.06
Global (excl EU) growth	0.19*	0.18*	0.18*	0.17	0.26**	0.17*	-0.01	0.06	0.17	0.07	0.17	0.07
NEER	-0.04	-0.17***	-0.04	-0.17***	-0.04	-0.16***	-0.01	-0.07	-0.01	-0.07	-0.01	-0.07
Oil	-0.03***	0.00	-0.03***	0.00	-0.03***	0.00	-0.02	0.00	-0.01	0.00	-0.01	0.00
Long-term int. rates	0.07	0.29***	0.07	0.29***	0.11	0.31***	0.04	0.13	0.09	0.17*	0.09	0.16*
Short-term int. rates	0.54***	1.13***	0.54***	1.14***	0.54***	1.07***	0.49***	0.75***	0.48***	0.75***	0.48***	0.75***
Structural balance sq.			0.00	-0.02							0.00	-0.02
Uncertainty (st/sed)					-0.07	-0.14**			-0.08	-0.01	-0.09	0.00
Year = 2009							0.08	0.18	0.31	0.11	0.31	0.17
Year = 2010							-0.54**	-0.41	-0.44	-0.51*	-0.43	-0.53**
Year = 2020								-0.43**		-0.43**		-0.38*
Year = 2021								-1.12***		-1.11***		-1.07***
Year = 2022								-2.05***		-2.00***		-2.02***
Constant	0.14***	-0.20***	0.15**	-0.16***	0.11**	-0.21***	0.19**	0.06	0.11	0.05	0.10	0.07
# observations	248	402	248	402	239	393	248	402	239	393	239	393
# countries	27	27	27	27	27	27	27	27	27	27	27	27
R-square	0.14	0.27	0.14	0.27	0.17	0.28	0.16	0.44	0.19	0.45	0.19	0.45
R-square adjusted	0.03	0.21	0.02	0.21	0.04	0.23	0.05	0.41	0.07	0.42	0.06	0.42

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

Source: own calculations.

5.1.3. The role of the economic cycle

The previous accuracy study by Chabin et al. (2020) provided graphical evidence of a counter-cyclical behaviour of GDP forecast errors. The current study employs regression analysis and confirms an inverse relationship between GDP forecast errors and the output gap, which is a typical measure of the economic cycle.[29] This means that the Commission tends to overpredict GDP (positive forecast errors) at

[28] The positive coefficient implies that a looser-than-expected fiscal policy (a positive projection error of structural balance change) is associated with lower-than-forecasted inflation (a positive inflation forecast error) and vice versa. This could reflect unexpected government energy measures (looser than expected fiscal policy) that reduce inflation by more than expected, causing positive inflation forecast errors. A positive regression coefficient can also occur when the size of the forecast change (from one period to the other) is larger than the respective change in the realisation of the target variable. For instance, the annual increase in the inflation forecast could often be much higher than the respective increase in the realised inflation. This can result in a positive inflation forecast error, even in cases where fiscal policy turns looser than expected. For a related reference in more technical terms, see also footnote 27.

[29] Results are presented from specifications that include year dummy variables, but remain qualitatively the same in unreported specifications without the use of dummy variables.

times or for countries with more negative (or less positive) output gap, and underpredict it when the output gap is higher. This may reflect that GDP forecasts, especially year-ahead ones, often 'revert' to potential output.[30]

Table 5.3. **Cyclicality, GDP forecast error**

(a) current year

	OG		Nonlinear		Sign		Nonlinear	
Variables	**2000-17**	**2000-23**	**2000-17**	**2000-23**	**2000-17**	**2000-23**	**2000-17**	**2000-23**
OG	-0.03	-0.09***	-0.05*	-0.11***				
D2009	0.82***	0.37	0.73**	0.31	0.90***	0.77**	0.89***	0.79**
D2010	-1.13***	-1.41***	-1.18***	-1.45***	-1.08***	-1.17***	-1.09***	-1.17***
D2020		-2.67***		-2.59***		-2.26***		-2.19***
D2021		-2.14***		-2.22***		-2.10***		-2.13***
D2022		-1.27***		-1.30***		-1.33***		-1.35***
absOG			-0.07*	-0.08**			-0.04	-0.03
OGsign					-0.05	-0.04	-0.07	-0.05
Constant	-0.01	0.08	0.16	0.27***	0.00	0.07	0.10	0.15
# observations	382	544	382	544	382	544	382	544
# countries	27	27	27	27	27	27	27	27
R-square	0.08	0.21	0.07	0.21	0.08	0.20	0.07	0.20
R-square adjusted	0.01	0.16	0.02	0.16	0.01	0.14	0.01	0.14

(b) year ahead

	OG		Nonlinear		Sign		Nonlinear	
variables	**2000-17**	**2000-23**	**2000-17**	**2000-23**	**2000-17**	**2000-23**	**2000-17**	**2000-23**
OG	-0.12***	-0.19***	-0.14***	-0.21***				
D2009	5.67***	5.24***	5.61***	5.21***	6.00***	5.99***	6.01***	5.96***
D2010	-1.86***	-2.10***	-1.89***	-2.12***	-1.68***	-1.69***	-1.68***	-1.70***
D2020		5.91***		5.97***		6.71***		6.63***
D2021		-2.25***		-2.30***		-2.23***		-2.20***
D2022		0.58		0.57		0.43		0.44
absOG			-0.06	-0.06			0.01	0.03
OGsign					-0.21*	-0.19*	-0.21*	-0.19*
Constant	-0.01	0.02	0.14	0.16	0.03	0.05	0.01	-0.02
# observations	366	528	366	528	366	528	366	528
# countries	27	27	27	27	27	27	27	27
R-square	0.47	0.58	0.46	0.57	0.46	0.56	0.46	0.56
R-square adjusted	0.45	0.61	0.45	0.61	0.44	0.58	0.43	0.58

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

Source: own calculations.

Chabin et al. (2020) report a weaker counter-cyclical behaviour of current year inflation forecasts compared to GDP. By contrast, the current study detects a stronger inverse relation (Table 5.4a). Year-ahead forecast errors also exhibit a strong counter-cyclicality similar to GDP forecasts (Table 5.4b). This implies that actual inflation turns out higher than the Commission forecast (negative forecast error) at times or for countries where output gap increases and turns out lower when output gap falls. Furthermore, positive output gaps are often associated with inflation underpredictions. These results imply that the Commission forecast is surrounded by risks related to the economic cycle.

[30] Results indicate some nonlinear effects between output gap and GDP forecast errors. These effects however appear only at the baseline period (2000-2023) and maybe sensitive to the increased volatility due to the pandemic and the energy crisis.

Table 5.4. **Cyclicality, Inflation forecast error**

(a) current year

	OG		Nonlinear		Sign		Nonlinear	
variables	**2000-17**	**2000-23**	**2000-17**	**2000-23**	**2000-17**	**2000-23**	**2000-17**	**2000-23**
OG	-0.04***	-0.04***	-0.06***	-0.06***				
D2009	0.44***	0.44**	0.46***	0.47***	0.44***	0.43**	0.51***	0.49***
D2010	-0.52***	-0.51***	-0.55***	-0.52***	-0.52***	-0.53***	-0.50***	-0.51***
D2020		-0.29		-0.21		-0.28		-0.18
D2021		-1.22***		-1.27***		-1.23***		-1.26***
D2022		-2.71***		-2.74***		-2.66***		-2.69***
absOG			-0.08***	-0.06***			-0.06***	-0.04**
OGsign					-0.17***	-0.18***	-0.18***	-0.19***
Constant	0.01	0.00	0.21***	0.14**	0.02	0.01	0.16***	0.11**
# observations	382	544	382	544	382	544	382	544
# countries	27	27	27	27	27	27	27	27
R-square	0.09	0.37	0.17	0.39	0.10	0.38	0.15	0.39
R-square adjusted	0.04	0.35	0.10	0.37	0.05	0.36	0.08	0.37

(b) year ahead

	OG		Nonlinear		Sign		Nonlinear	
variables	**2000-17**	**2000-23**	**2000-17**	**2000-23**	**2000-17**	**2000-23**	**2000-17**	**2000-23**
OG	-0.10***	-0.08***	-0.12***	-0.10***				
D2009	2.69***	2.51***	2.50***	2.47***	2.78***	2.52***	2.75***	2.53***
D2010	-0.52**	-0.69**	-0.71***	-0.74***	-0.47**	-0.69***	-0.51**	-0.70***
D2020		0.49*		0.58**		0.53**		0.61**
D2021		-1.56***		-1.61***		-1.58***		-1.60***
D2022		-7.22***		-7.23***		-7.13***		-7.14***
absOG			-0.09***	-0.06**			-0.04	-0.03
OGsign					-0.32***	-0.32***	-0.33***	-0.33***
Constant	-0.04	0.02	0.19**	0.17**	-0.02	0.04	0.08	0.12
# observations	366	528	366	528	366	528	366	528
# countries	27	27	27	27	27	27	27	27
R-square	0.27	0.64	0.33	0.65	0.28	0.65	0.29	0.65
R-square adjusted	0.37	0.64	0.35	0.65	0.37	0.65	0.36	0.65

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

Source: own calculations.

5.2. GM MODEL-BASED FORECAST ERROR DECOMPOSITIONS

This subsection analyses the drivers of the Commission's forecast errors of GDP and inflation by means of the Commission's Global Multi-country (GM) model[31], to account for the combined role of forecast errors of the *entire set of variables* forecast by the Commission – that is, all GDP components and their deflators, employment and wages, government budget balance, interest rate, exchange rate and external variables. The focus of the analysis is the forecasts for the euro area, since the GM model represents the euro area. Results presented in this section covers a shorter period (Spring Forecast 2017 to 2024), than the remainder of the paper.

Forecasting such a comprehensive set of variables entails a complex consistency effort, so that, for example, GDP is matched by all its components and prices account for their respective drivers (such as

[31] The Commission's Global Multi-country (GM) model is an estimated structural DSGE model of the euro area. https://joint-research-centre.ec.europa.eu/projects-and-activities/macroeconomic-monitoring-fiscal-surveillance-forecasting-and-nowcasting/global-multi-country-model_en. For details see Annex II.

production costs/wages, energy/import contents). Hence, it seems important to analyse how the forecast errors of GDP and inflation are the combined result of forecast errors for all demand components, prices, labour market factors and so on. In some cases, such errors will add-up, in others they will offset each other, in forming the overall forecast error of GDP and inflation.

To assess such a combined effect, we introduce a new approach that deploys the GM model to decompose GDP and inflation forecast errors into their structural macroeconomic drivers (or shocks) that are identified when using the model to filter forecast and ex-post realised data. Hence, this procedure exploits full information, by including all national account series observed and forecasted by the Commission.

We identify structural drivers as follows.

- In each time period, given the state of the economy as described by the full information available until the previous period, the model assumes that all variables follow the dynamic general equilibrium conditions that represent households consumption/saving/labour supply decisions; firms investment/labour demand/pricing decisions; domestic demand for energy and imported goods; external demand for home goods (demand for exports); fiscal and monetary policy rules; and so on.
- After computing the dynamic equilibrium conditions for the current period, all structural shocks can be identified[32] (or inverted) from the deviation between the model's households/firms first order optimality conditions and the data, be they the Commission's forecasts or ex-post realisations[33].
- Kalman filtering and smoothing algorithms ensure that all those identified shocks are consistent with the model forecasts and the data in current period. This provides the updated state of the economy, and the procedure continues for the next period.

Thanks to the fact that those structural drivers have a clear economic meaning, they can proxy the observed variable they are mostly associated with: saving shock for consumption, risk premium shock for investment, mark-up shocks for price/wages, and so on.

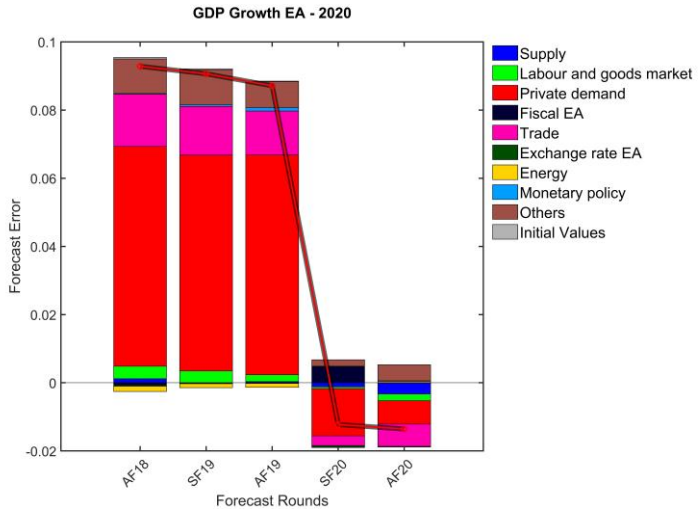
Therefore, by comparing (i.e. by taking the difference of) the structural shocks identified by the model when observing the Commission's forecasts with respect to the shocks identified using ex-post realised data, one can identify drivers of the Commission's forecast errors[34]. By grouping such drivers into economically meaningful categories[35], one can indirectly infer how the forecast errors of the associated variables (consumption, investment, prices/wages, imports/exports, etc.) affect the forecast of GDP and inflation. Hence, using ex-post actual data and the Commission's forecast vintages, this analysis provides a detailed decomposition of the Commission's forecast errors for each vintage, that also accounts for the forecast errors of all other variables considered in the EC forecast exercise.

[32] This is obtained with canonical Kalman filter and smoothing algorithms, using the linearised (first order approximation) GM model.
[33] For example, a saving shock (or discount factor shock) may be identified from the deviation of the household consumption decision as derived from the model Euler equation with respect to observed consumption; an investment risk premium shock may be identified by the wedge between the investment decision by the firms in the model (Tobin's q equation) and the observed investment; price and wage mark-up shocks may be identified via the difference between labour/goods market demand/supply model dynamic equilibria and the observed prices/wages; and so on.
[34] By means of this difference, the model effect is cancelled, allowing for a structural interpretation of the Commission's forecast error.
[35] We define nine categories: domestic supply, labour and goods markets, private demand, fiscal policy, external economy, exchange rate, energy, monetary policy, and a residual category. For example, domestic (private) demand shocks incorporate deviations of consumption and investment data (forecasted or realised) with respect to the consumption and investment decisions that are prescribed by the model first order optimality conditions by households and firms. The category of labour and good markets include analogous deviations in wages, employment and consumer prices data. Monetary policy shocks represent deviations of the assumed or realised policy rate trajectory from the level prescribed by the Taylor rule incorporated in the model, where the central bank's interest rate responds to inflation gap from target and GDP growth from potential output growth.

5.2.1. Selected years

The model-based decompositions of forecast errors for the euro area GDP growth rate in 2020 provide an interesting perspective, given this was the year of the pandemic outbreak (Graph 5.1). The overprediction of year-ahead forecasts (conducted in the Autumn Forecast 2019, AF19) was largely driven by private demand conditions (consumption and investment), which were severely impacted by the pandemic shock. The external environment forecast also contributed to the overprediction, albeit to a lesser extent. Conversely, current-year forecasts (conducted in the Spring Forecast 2020, SF20) underestimated 2020 growth, primarily due to underpredictions in private demand and external conditions, which ultimately performed better than anticipated. Notably, the fiscal impact on GDP was lower than projected, suggesting a more stringent fiscal policy than expected.

Graph 5.1. **GM-based decomposition of 2020 GDP forecast error**



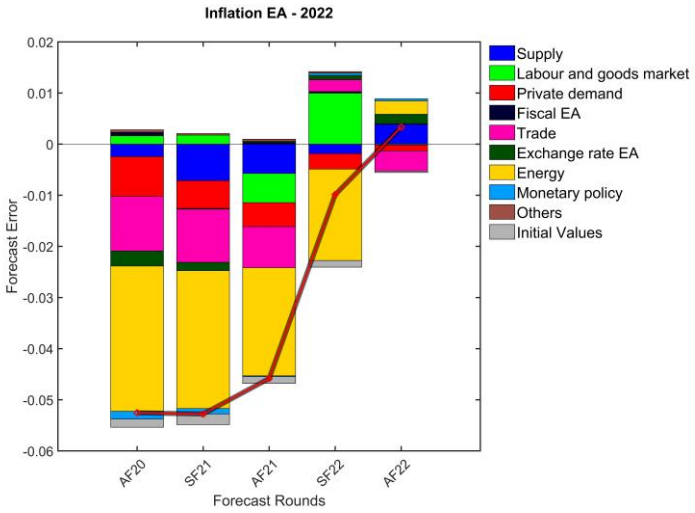
Source: EC, Eurostat, GM model and own calculations.

Another case of interest is the decomposition of the inflation forecast errors for 2022 (Graph 5.2), a year marked by the largest inflation shock in the last two decades. The year-ahead forecast (conducted in the Autumn Forecast 2021, AF21) underestimated inflation, with all drivers contributing to the negative forecast error, except for the fiscal, which showed a slightly positive contribution[36]. Notably, the energy price increases were a primary driver of this underprediction.[37] Current-year forecasts (conducted in the Spring Forecast 2022, SF22) continued to underestimate inflation, as the inflation shock was initially expected to be transitory, albeit to a lesser extent. The underprediction of energy inflation was partly offset by the developments in the labour and goods markets, which exerted a smaller inflationary impact than expected.

[36] The forecast error for the government budget balance in 2022 was negative, indicating that fiscal policy was less expansionary than expected. In conjunction with the other model drivers, this resulted in a prediction that fiscal policy would contribute to higher than released inflation.

[37] Oil prices surged to $100.7 per barrel in 2022, up from $70.2 per barrel in 2021, while natural gas prices more than doubled to €131.9 per megawatt-hour, compared to €47.1 per megawatt-hour in 2021.

Graph 5.2. **GM-based decomposition of 2022 Inflation forecast error**

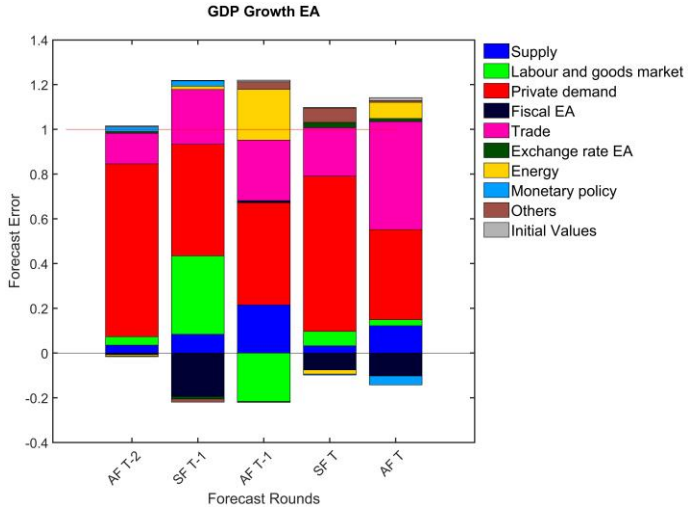


Source: EC, Eurostat, GM model and own calculations.

5.2.2. Average contribution to forecast errors

The normalised contributions[38] to GDP current year forecast errors (conducted in the current year Spring Forecast, SFT in the below graph) confirm the key role of external factors (or assumptions) in driving GDP forecast errors along with private demand (Graph 5.3).[39]

Graph 5.3. **GM-based average contributions to GDP forecast error**



Source: EC, Eurostat, own calculations.

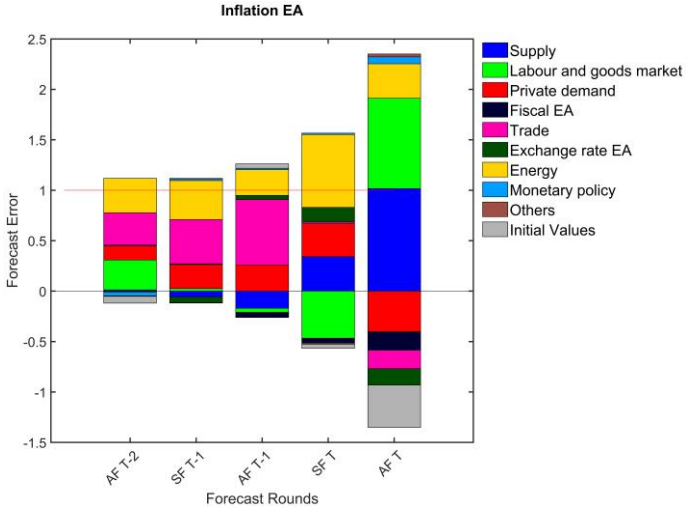
Interestingly, the contribution of the fiscal forecast errors are in the opposite direction to the GDP forecast errors (i.e. compensating instead of contributing).[40] Similarly, the contribution of the forecast errors of labour and goods markets are in the opposite direction to the GDP forecast errors (i.e.

[38] Each bar is normalised, such that the sum of all the components is always one. If a factor is represented with a positive bar, it means that it went in the same direction as the forecast error.
[39] These shocks are not directly linked with the variables used in the previous section regression analysis, with the exception of uncertainty and financing conditions, which may affect private demand.
[40] This is not necessarily at odds with the regression results of the previous section, which consider the forecast error of the general government structural balance (as an indicator of discretionary fiscal policy) and which is different from the fiscal shock in the context of the GM model-based decomposition.

compensating instead of contributing). Forecast errors for all remaining variables contribute in the same direction of the year ahead GDP forecast errors (conducted in the previous year Autumn Forecast, AFT-1 in Graph 5.3).

Current year forecast errors of inflation (conducted in the current year Spring Forecast, SFT in Graph 5.4) were primarily driven by errors in forecasting energy conditions.[41] The contribution of the labour and goods markets forecast error ran in the opposite direction to the inflation forecast errors (i.e. compensating instead of contributing). The decomposition of year ahead forecast errors (conducted in the previous year Autumn Forecast, AFT-1 in the below graph) confirm the prominent role of forecast errors of external conditions, in line with the regression results. Conversely, the contribution of the forecast errors of domestic supply ran in the opposite direction to the inflation forecast errors (i.e. compensating instead of contributing).

Graph 5.4. **GM-based average contributions to Inflation forecast error**



Source: EC, Eurostat, own calculations.

6. COMPARING FORECAST ACCURACY ACROSS 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 and the ECB (in this case only for the euro area aggregate) are compared with those of the Commission for the reference (2000-2017) and baseline (2000-2023) periods, both including and excluding the year 2020. Accuracy is measured by the mean absolute forecast error (MAE) taking also account of sampling uncertainty.

The following forecasts for the other institutions have been examined for the purposes of our analysis:

- The current year and year-ahead forecasts from the OECD are taken respectively from the June and December OECD Economic Outlook.
- The IMF forecasts come from the April and October World Economic Outlook.
- The forecasts from the ECB are taken from the March ECB Staff macroeconomic projections and the September projections.

[41] The forecasts for energy conditions (oil, gas) are based on future markets.

Detailed results are shown in Graph I.4 and Graph I.5 in Annex and briefly discussed below.

6.1. COMMISSION COMPARED TO OECD

In the baseline period, all institutions appear equally accurate on average across countries and the euro area regarding their current year GDP forecast[42] at a level of MAE slightly higher than one percentage point. The Commission seems slightly better at forecasting euro area GDP growth in both the baseline and reference period, with a MAE of around 0.5 percentage points. Excluding the pandemic outbreak year 2020, the OECD current-year forecasts come out more accurate, in line with the previous accuracy study, although the difference in the MAE for the large majority of countries and the euro area aggregate appears statistically insignificant.

The OECD forecasts also appear more accurate, regarding year-ahead forecasting accuracy, in both the reference and the baseline period, albeit the difference in the MAE is not statistically significant. As also stated in the previous accuracy study, 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, respectively, of the forecast 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.

6.2. COMMISSION COMPARED TO IMF

Relative to the IMF, the Commission's forecast accuracy for the current year comes out very similar, with the difference in forecast errors for most countries within the bounds of statistical uncertainty. For the EU and euro-area aggregates, the forecast accuracy remains close to the previous forecast accuracy study, with IMF becoming slightly more accurate in the baseline period. Excluding the year 2020, the Commission forecast is slightly more accurate for the euro area and less for the EU.

For the year-ahead forecasts, the Commission keeps displaying smaller errors than the IMF for a majority of Member States and on average. This also holds for the EU and euro area aggregates in the baseline period both including and excluding 2020.

6.3. COMMISSION COMPARED TO 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. For the current year forecasts, the MAE for both institutions is found to be the same (0.44 percentage points) in the baseline period excluding the year 2020. Including 2020, the Commission slightly outperforms ECB. For the year ahead forecasts, the Commission's forecast error remains somewhat lower than the ECB regardless of the exclusion or not of the year 2020. As stated in the previous accuracy study, 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, (Chabin et al. 2020, Fioramanti et al., 2016). In the current analysis, we extend the previous period by adding five years of forecasts, from 2018 to 2023. This period includes two very large and unforeseen external shocks, the pandemic and the energy price surge caused by the Russian war of aggression. The main

[42] The forecast for 2020 corresponds to the 'double-hit' scenario.

goal is to assess the performance of the newly added forecasts, re-estimate the statistical properties of the forecast errors and compare their performance with that of other international institutions.

Table 7.1 summarises the results for the EU/EA aggregates. Taking account of the impact of the pandemic and the energy crises in terms of increases in the volatility of the target variables, the accuracy and bias of the Commission's forecast over the full baseline period is broadly similar to that over the reference period. For GDP and inflation this 'conditional' performance might have been slightly better for current year forecasts as indicated by the relative RMSE in Graph 3.4.

Table 7.1. **Summary results with focus on EU/EA aggregates**

	GDP	Inflation	GGB
Accuracy (MAE, RMSE)	Current year: Decrease in accuracy for EU/EA/Average MS. Year ahead: Decrease in accuracy – Controlling for 2020 results are reversed for EU/EA/Average MS	Current year: Decrease in accuracy for EU/EA/Average MS. Year ahead: Decrease in accuracy – Controlling for 2022 performance remains as in the reference period for EU/EA/Average MS	Current year: Decrease in accuracy for EU/EA/Average MS. Controlling for 2021. Performance remains as in the reference period Year ahead: Decrease in accuracy for EU/EA/Average MS – Controlling for 2020 performance remains as in the reference period
Relative RMSE – Current year	Improvement relative to reference on average and in the EU/EA	Improvement relative to reference on average and in the EU/EA	Small deterioration relative to reference on average and in the EU/EA
Bias (ME)	Current year: Negative impact (i.e. underprediction) but EU/EA unbiased. Year ahead: Positive impact (overprediction) and EU/EA positively biased, – No bias in EU/EA excluding 2020 for both current and year ahead forecasts	Current year: Negative impact (i.e. underprediction) and EU/EA positively biased Year ahead: Negative impact but EU/EA unbiased – No bias in EU/EA excluding 2022 for both current and year ahead forecasts	Current year: Negative impact (i.e. underprediction) but EU/EA unbiased Year ahead: Positive impact but EU/EA unbiased – No bias in EU/EA excluding 2021 and 2020 for current and year ahead forecasts respectively
Serial correlation in forecast error	Current year: No evidence of serial correlation up to three lags (years) in EU/EA. Year ahead: No evidence of serial correlation up to three lags in EU/EA	Current year: Positive serial correlation in the EU/EA for lags up to two (years). Year ahead: No evidence of serial correlation up to three lags in EU/EA	Current year: Negative serial correlation at lag (year) 2 for the EU/EA Year ahead: No evidence of serial correlation up to three lags in EU/EA
Comparison with 'naïve forecast'	Better than naïve forecasts for current and year ahead forecasts in the EU/EA/MS	Better than naïve forecasts for current and year ahead forecasts in the EU/EA/MS	Better than naïve forecasts for current and year ahead forecasts in the EU/EA/MS
Encompassing naïve and current year spring forecast (panel data of MS/EA/EU)	Current year: mixed results Year ahead: forecast encompass naïve but not spring forecast	Current year: mixed results Year ahead: forecast encompass naïve but not spring forecast	Current year: mixed results Year ahead: forecast encompass naïve and spring forecast
Directional accuracy (panel data of MS/EA/EU)	Slight increase in accuracy for both current and year ahead forecasts.	Current year: slight increase in accuracy Year ahead: slight decrease in accuracy	Current year: similar performance Year ahead: slight decrease in accuracy
Efficiency (panel data of MS/EA/EU)	Non rejection of efficiency with evidence of autocorrelation in residuals (both current and year ahead forecasts)	Non rejection of efficiency with evidence of autocorrelation in residuals of year ahead forecasts	Current year: Non rejection of efficiency under autocorrelation in residuals Year ahead: mixed results as forecasts appear to have low correlation with outturns (i.e. too volatile). Autocorrelation in residuals detected.

Notes: Total period: 2000-2023, reference period: 2000-2017.

Overall, this updated exercise confirms that the Commission's forecasts provide a largely unbiased picture of the near-term economic outlook and accurately foresee the trends in the underlying variables. This study also confirms some evidence of forecast error persistence detecting serial correlation of current year inflation and government balance forecast errors. Furthermore, in case of GDP and inflation, auxiliary regressions reveal a negative relation between forecast errors and output gaps, highlighting that forecasts are subject to risks related to the business cycle.

The accuracy of the Commission's GDP growth forecasts is broadly similar to that of other major international institutions the Commission's forecasts. The timing of the various forecast publications may explain part of any differences in accuracy across institution.

Regarding the drivers of forecast errors, incorrect assumptions and unexpected events, such as the pandemic and energy crises, were found to contribute to errors. While these assumptions and projection errors do play a role, they are not the main source, especially when it comes to predicting the current year's GDP growth. However, the major shocks caused by the pandemic and energy crises, seem to account more crucially for the overall forecast error. Uncertainty, measured by the degree of disagreement among people and businesses about the future, also contributes to errors. Additionally, errors in predicting government spending and the overall state of the economy in the business cycle can also lead to forecast errors, highlighting the importance of considering these factors to make more accurate predictions.

The GM model decomposition of year-specific and average forecast errors provides new insights into the underlying drivers of inflation and GDP forecast errors. Using a novel methodology to identify factors explaining deviations between forecasts and actual outcomes, the analysis highlights specific years in which forecasting proved particularly challenging. To the best of our knowledge, this is the first study to develop such a methodology, which proves highly valuable for understanding the dimensions along which forecasters tend to make systematic errors (an especially relevant contribution in times of heightened uncertainty, such as those experienced in recent years). Results from this complementary exercise stood broadly in line with the aforementioned regression-based analysis, highlighting the importance of acquiring correct predictions for private demand, external environment conditions and the energy conditions in the euro area. Furthermore, forecast errors of the conditions in the labour and goods market were found to often run in the opposite direction of the GDP and inflation forecasts.

Overall, this comprehensive assessment identifies both weak and strong characteristics of the Commission's macroeconomic forecasts. Controlling for the unprecedented pandemic shock and energy crisis, the Commission 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 remain a sound basis for the Commission's economic and fiscal surveillance[43].

[43] Future work might also consider analysing the GDP deflator – in complement to the private consumption deflator - given its direct relation to nominal GDP, which is typically used in the context of the economic governance framework in the EU.

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ANNEX I – TABLES AND FIGURES

Table I.1. **Gross domestic product, error statistics, 2000-2023**

(a) Current year

	2000-07			2000-17			2000-19			2000-2022			00-22 (ex 2020)			2000-2023			00-23 (ex 2020)		
	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE
BE	0.15	0.72	0.91	0.05	0.51	0.68	0.05	0.49	0.65	-0.12	0.59	0.77	-0.08	0.58	0.77	-0.12	0.57	0.76	-0.09	0.56	0.75
DE	0.18	0.51	0.75	-0.09	0.50	0.79	-0.04	0.50	0.77	-0.09	0.53	0.80	-0.02	0.49	0.75	-0.07	0.53	0.79	0.00	0.49	0.74
EE	-1.38	2.18	2.44	-0.06	2.27	2.75	-0.16	2.09	2.60	-0.51	2.38	2.90	-0.32	2.29	2.83	-0.36	2.40	2.89	-0.16	2.31	2.82
IE	-0.73	1.48	1.78	-0.75	1.76	2.29	-0.81	1.72	2.22	-1.88	2.67	3.90	-1.44	2.27	3.17	-1.43	2.92	4.21	-1.00	2.55	3.59
EL	-0.35	0.43	0.48	0.33	0.77	1.09	0.32	0.71	1.03	-0.08	0.98	1.44	-0.02	0.95	1.43	-0.06	0.95	1.41	0.00	0.93	1.41
ES	-0.21	0.37	0.45	-0.14	0.38	0.46	-0.11	0.36	0.44	-0.06	0.48	0.61	-0.13	0.43	0.54	-0.08	0.48	0.61	-0.15	0.44	0.54
FR	0.36	0.60	0.65	0.19	0.49	0.56	0.19	0.46	0.54	0.13	0.48	0.58	0.14	0.50	0.59	0.12	0.47	0.57	0.13	0.48	0.58
HR	na	na	na	-0.53	0.57	0.79	-0.40	0.47	0.68	-1.19	1.24	1.99	-1.20	1.26	2.07	-1.22	1.27	1.95	-1.23	1.28	2.02
IT	0.40	0.60	0.71	0.41	0.64	0.75	0.39	0.61	0.72	0.15	0.72	0.89	0.19	0.72	0.90	0.16	0.70	0.88	0.19	0.71	0.88
CY	-0.20	0.25	0.34	-0.57	1.25	1.58	-0.53	1.12	1.48	-0.87	1.36	1.73	-0.79	1.31	1.70	-0.83	1.30	1.69	-0.75	1.25	1.65
LV	-2.35	2.35	2.57	-0.34	2.56	3.30	-0.33	2.39	3.12	-0.55	2.28	2.97	-0.39	2.22	2.95	-0.43	2.25	2.92	-0.28	2.19	2.90
LT	-0.85	0.95	1.06	0.06	1.30	1.66	-0.04	1.23	1.59	-0.52	1.52	2.23	-0.16	1.22	1.58	-0.45	1.49	2.18	-0.11	1.20	1.55
LU	-0.59	1.35	1.67	-0.04	1.45	1.80	0.03	1.37	1.73	-0.23	1.50	1.90	-0.05	1.39	1.73	-0.11	1.55	1.93	0.07	1.44	1.78
MT	-0.73	0.73	0.83	-0.79	1.13	1.37	-0.67	1.10	1.32	-0.90	1.39	1.78	-1.01	1.40	1.80	-0.94	1.40	1.77	-1.05	1.41	1.80
NL	0.45	0.80	1.06	0.19	0.61	0.81	0.18	0.57	0.77	-0.15	0.80	1.15	-0.02	0.70	0.97	-0.07	0.84	1.18	0.06	0.74	1.01
AT	0.18	0.50	0.73	0.01	0.50	0.70	0.01	0.46	0.66	-0.04	0.54	0.73	-0.09	0.51	0.71	0.02	0.57	0.76	-0.03	0.54	0.74
PT	0.50	0.66	0.84	0.11	0.65	0.83	0.09	0.62	0.79	0.03	0.66	0.80	0.00	0.65	0.80	0.04	0.64	0.79	0.00	0.63	0.79
SI	-1.08	1.08	1.23	-0.14	1.30	1.67	-0.07	1.19	1.57	-0.39	1.34	1.70	-0.34	1.33	1.71	-0.39	1.29	1.66	-0.34	1.28	1.67
SK	-1.68	1.68	1.73	-0.47	0.88	1.16	-0.32	0.87	1.15	-0.24	0.97	1.23	-0.15	0.91	1.18	-0.22	0.93	1.20	-0.13	0.87	1.14
FI	-0.03	1.25	1.59	0.26	1.26	1.55	0.27	1.18	1.48	0.03	1.23	1.58	0.19	1.13	1.42	0.08	1.23	1.56	0.24	1.13	1.41
EA	**0.21**	**0.44**	**0.57**	**0.09**	**0.39**	**0.52**	**0.10**	**0.38**	**0.51**	**-0.04**	**0.46**	**0.60**	**0.01**	**0.43**	**0.56**	**-0.01**	**0.47**	**0.60**	**0.03**	**0.44**	**0.57**
BG	-0.10	0.10	0.10	-0.04	0.86	1.33	0.02	0.79	1.24	-0.29	0.95	1.40	-0.11	0.81	1.21	-0.29	0.91	1.36	-0.12	0.78	1.17
CZ	-1.38	1.38	1.45	-0.35	1.08	1.24	-0.27	0.97	1.16	-0.29	0.89	1.08	-0.27	0.90	1.10	-0.25	0.87	1.06	-0.23	0.88	1.08
DK	0.23	0.63	0.81	0.46	0.78	1.00	0.40	0.75	0.97	0.08	0.92	1.20	0.23	0.82	1.03	0.01	0.95	1.22	0.15	0.85	1.06
HU	0.20	0.70	0.77	0.09	0.79	0.92	-0.06	0.83	0.94	-0.32	0.97	1.12	-0.22	0.90	1.04	-0.23	0.99	1.14	-0.13	0.93	1.06
PL	-0.38	0.98	1.08	-0.42	0.92	1.17	-0.42	0.85	1.11	-0.61	0.97	1.21	-0.56	0.94	1.18	-0.55	0.95	1.18	-0.50	0.92	1.16
RO	0.70	0.70	0.70	-0.16	1.36	1.62	-0.17	1.25	1.51	-0.45	1.33	1.57	-0.34	1.28	1.53	-0.37	1.31	1.55	-0.26	1.26	1.51
SE	0.11	0.76	0.94	-0.02	0.91	1.30	0.00	0.84	1.24	-0.17	0.90	1.34	-0.03	0.80	1.18	-0.18	0.88	1.31	-0.04	0.78	1.16
EU	**0.20**	**0.43**	**0.53**	**0.11**	**0.41**	**0.51**	**0.11**	**0.39**	**0.50**	**-0.05**	**0.48**	**0.61**	**0.01**	**0.44**	**0.56**	**-0.02**	**0.49**	**0.61**	**0.04**	**0.45**	**0.56**
Ave.	-0.33	0.91	1.06	-0.10	1.02	1.30	-0.09	0.96	1.24	-0.35	1.13	1.50	-0.26	1.06	1.40	-0.30	1.13	1.50	-0.21	1.07	1.41
StD.	0.75	0.55	0.60	0.33	0.54	0.67	0.30	0.50	0.63	0.44	0.57	0.78	0.41	0.53	0.70	0.39	0.60	0.82	0.38	0.55	0.74

(b) Year ahead

	2000-07			2000-17			2000-19			2000-2022			00-22 (ex 2020)			2000-2023			00-23 (ex 2020)		
	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE
BE	0.24	1.06	1.23	0.24	0.95	1.21	0.22	0.88	1.15	0.38	1.16	1.80	0.09	0.91	1.18	0.31	1.15	1.78	0.04	0.92	1.18
DE	0.18	1.03	1.25	0.18	1.07	1.55	0.25	1.06	1.51	0.62	1.32	1.92	0.40	1.13	1.57	0.58	1.28	1.89	0.36	1.10	1.53
EE	-1.88	3.48	3.58	0.59	3.49	4.95	0.28	3.28	4.68	0.49	3.49	4.68	0.23	3.40	4.65	0.65	3.50	4.63	0.41	3.42	4.61
IE	-1.04	1.79	2.32	-1.40	3.40	6.11	-1.53	3.33	5.88	-2.08	3.64	6.00	-2.07	3.70	6.12	-1.63	3.86	6.14	-1.60	3.92	6.25
EL	-0.39	0.49	0.52	0.93	1.54	2.13	0.88	1.43	2.03	1.09	1.90	3.10	0.62	1.47	2.07	0.99	1.87	3.05	0.54	1.46	2.04
ES	-0.21	0.44	0.54	0.11	0.90	1.26	0.12	0.83	1.20	0.62	1.28	2.80	0.09	0.77	1.14	0.52	1.30	2.76	0.01	0.82	1.18
FR	0.40	0.65	0.83	0.40	0.71	0.97	0.37	0.65	0.92	0.73	1.06	2.12	0.35	0.70	0.94	0.68	1.04	2.08	0.31	0.69	0.93
HR	na	na	na	-0.34	1.07	1.15	-0.22	0.81	0.97	0.11	2.45	4.20	-1.07	1.53	2.61	-0.11	2.44	4.07	-1.20	1.60	2.58
IT	0.54	0.84	1.00	0.92	1.22	1.68	0.89	1.17	1.61	1.09	1.56	2.53	0.71	1.21	1.64	1.03	1.51	2.48	0.66	1.17	1.61
CY	-0.18	0.33	0.38	0.29	1.45	1.94	0.21	1.37	1.84	0.39	1.77	2.57	-0.03	1.43	1.88	0.29	1.76	2.53	-0.11	1.44	1.86
LV	-3.05	3.05	3.22	0.45	3.74	5.64	0.40	3.42	5.29	0.79	3.34	5.08	0.49	3.18	5.01	0.65	3.28	4.97	0.36	3.12	4.90
LT	-1.48	1.48	1.50	0.40	2.72	4.55	0.21	2.52	4.27	0.22	2.48	4.03	0.09	2.48	4.10	0.21	2.36	3.93	0.09	2.35	3.99
LU	-0.43	2.23	2.78	0.26	2.13	2.65	0.29	1.98	2.52	0.49	2.06	2.58	0.32	1.96	2.47	0.56	2.06	2.56	0.39	1.96	2.45
MT	-0.63	1.78	1.91	-0.70	1.80	2.12	-0.73	1.70	2.04	-0.39	2.51	3.81	-1.10	1.96	2.59	-0.61	2.62	3.86	-1.29	2.10	2.75
NL	0.38	1.13	1.37	0.39	1.17	1.53	0.40	1.10	1.46	0.41	1.33	1.83	0.19	1.16	1.52	0.41	1.30	1.79	0.21	1.14	1.49
AT	0.11	0.81	1.05	0.28	0.95	1.39	0.28	0.88	1.33	0.58	1.14	2.10	0.24	0.82	1.27	0.61	1.15	2.07	0.28	0.84	1.27
PT	0.64	0.94	1.21	0.45	0.93	1.23	0.37	0.87	1.18	0.69	1.27	2.40	0.26	0.87	1.17	0.58	1.29	2.38	0.17	0.91	1.20
SI	-1.45	1.45	1.66	0.16	2.26	3.50	0.14	2.00	3.27	0.41	2.30	3.50	0.04	2.04	3.20	0.32	2.25	3.42	-0.03	2.00	3.13
SK	-2.23	2.23	2.36	-0.25	1.80	2.99	-0.12	1.70	2.83	0.54	2.08	3.18	0.19	1.80	2.83	0.47	2.02	3.11	0.13	1.75	2.76
FI	-0.15	1.33	1.67	0.57	1.89	2.77	0.62	1.81	2.64	0.76	1.80	2.61	0.61	1.70	2.53	0.79	1.78	2.57	0.65	1.69	2.50
EA	**0.21**	**0.76**	**0.88**	**0.37**	**0.94**	**1.32**	**0.37**	**0.89**	**1.26**	**0.64**	**1.19**	**1.99**	**0.33**	**0.90**	**1.24**	**0.61**	**1.14**	**1.95**	**0.31**	**0.86**	**1.21**
BG	-0.20	0.20	0.20	0.38	1.83	3.15	0.38	1.60	2.90	0.46	2.09	3.45	0.00	1.74	3.00	0.39	2.02	3.35	-0.05	1.68	2.92
CZ	-1.75	1.75	1.83	0.06	1.92	2.59	0.09	1.72	2.43	0.58	1.99	2.92	0.17	1.66	2.34	0.56	1.90	2.85	0.17	1.58	2.28
DK	0.10	0.78	0.92	0.78	1.17	1.67	0.67	1.13	1.60	0.68	1.20	1.69	0.55	1.09	1.55	0.55	1.25	1.73	0.42	1.15	1.61
HU	-0.05	0.70	0.86	0.40	1.61	2.37	0.18	1.58	2.27	0.43	1.93	2.80	0.04	1.63	2.27	0.46	1.89	2.73	0.09	1.59	2.23
PL	-0.78	1.63	1.65	-0.34	1.17	1.33	-0.44	1.16	1.31	-0.25	1.47	1.98	-0.59	1.23	1.48	-0.21	1.43	1.93	-0.53	1.19	1.45
RO	-0.20	0.20	0.20	0.63	2.21	3.86	0.54	1.93	3.55	0.82	2.18	3.74	0.38	1.83	3.34	0.74	2.09	3.63	0.32	1.75	3.24
SE	0.13	0.90	1.15	0.21	1.33	1.93	0.23	1.24	1.84	0.32	1.35	1.93	0.16	1.24	1.80	0.29	1.31	1.89	0.14	1.20	1.76
EU	**0.20**	**0.70**	**0.83**	**0.35**	**0.89**	**1.32**	**0.34**	**0.83**	**1.26**	**0.60**	**1.14**	**1.95**	**0.29**	**0.86**	**1.25**	**0.56**	**1.09**	**1.91**	**0.27**	**0.82**	**1.22**
Ave.	-0.51	1.26	1.43	0.22	1.72	2.53	0.18	1.60	2.39	0.41	1.93	3.01	0.05	1.65	2.46	0.37	1.91	2.97	0.04	1.65	2.43
StD.	0.93	0.81	0.86	0.49	0.82	1.41	0.48	0.77	1.33	0.59	0.72	1.09	0.60	0.78	1.28	0.52	0.74	1.09	0.56	0.79	1.28

Source: EC, Eurostat, own calculations.

Table I.2. **Inflation, error statistics, 2000-2023**

(a) Current year

	2000-07			2000-17			2000-19			2000-2022			00-22 (ex 2022)			2000-2023			00-23 (ex 2022)		
	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE
BE	-0.41	0.47	0.57	-0.23	0.37	0.49	-0.19	0.36	0.47	-0.28	0.43	0.64	-0.19	0.35	0.46	-0.35	0.49	0.74	-0.27	0.42	0.61
DE	0.04	0.15	0.20	0.03	0.22	0.32	0.04	0.21	0.31	-0.05	0.26	0.36	-0.02	0.24	0.34	-0.06	0.26	0.36	-0.04	0.25	0.35
EE	-0.38	0.57	0.77	-0.23	0.68	0.87	-0.21	0.61	0.82	-0.54	1.00	1.62	-0.26	0.75	1.01	-0.51	0.96	1.58	-0.24	0.71	0.99
IE	-0.43	0.61	0.84	0.10	0.69	0.92	0.05	0.66	0.88	-0.16	0.78	1.06	-0.15	0.79	1.08	-0.22	0.82	1.10	-0.22	0.83	1.12
EL	-0.20	0.33	0.37	-0.14	0.52	0.65	-0.10	0.48	0.62	-0.17	0.56	0.70	-0.12	0.53	0.67	-0.18	0.55	0.69	-0.13	0.52	0.66
ES	-0.39	0.42	0.56	-0.22	0.41	0.56	-0.20	0.38	0.53	-0.26	0.41	0.55	-0.24	0.40	0.55	-0.25	0.40	0.54	-0.24	0.39	0.54
FR	0.18	0.27	0.37	0.21	0.28	0.39	0.19	0.26	0.37	0.12	0.27	0.39	0.17	0.24	0.35	0.10	0.28	0.39	0.14	0.26	0.36
HR	na	na	na	0.85	0.85	0.95	0.66	0.66	0.81	-0.11	1.07	1.71	0.41	0.65	0.80	-0.20	1.07	1.66	0.27	0.69	0.83
IT	-0.28	0.30	0.36	0.04	0.34	0.40	0.06	0.33	0.39	-0.03	0.37	0.49	0.04	0.31	0.38	-0.02	0.36	0.48	0.05	0.31	0.37
CY	-0.20	0.52	0.57	0.39	0.71	0.86	0.35	0.68	0.82	0.22	0.72	0.88	0.33	0.66	0.80	0.24	0.72	0.87	0.34	0.66	0.79
LV	-3.22	3.22	3.67	-1.29	1.64	2.25	-1.14	1.45	2.10	-1.33	1.59	2.25	-1.13	1.41	2.02	-1.19	1.57	2.21	-1.00	1.40	1.99
LT	-0.45	1.11	1.44	-0.27	0.84	1.04	-0.19	0.79	0.99	-0.62	1.15	1.82	-0.30	0.86	1.12	-0.56	1.12	1.77	-0.25	0.84	1.10
LU	-0.34	0.35	0.49	-0.08	0.50	0.67	-0.10	0.49	0.65	-0.08	0.50	0.64	-0.09	0.51	0.65	-0.10	0.50	0.64	-0.12	0.51	0.65
MT	-0.01	0.78	0.83	0.49	0.85	0.94	0.47	0.80	0.91	0.36	0.75	0.86	0.43	0.74	0.86	0.28	0.77	0.88	0.34	0.77	0.88
NL	-0.15	0.25	0.26	0.06	0.30	0.49	0.04	0.28	0.47	-0.05	0.34	0.55	-0.05	0.35	0.56	-0.19	0.47	0.89	-0.20	0.49	0.91
AT	-0.17	0.42	0.46	-0.21	0.34	0.40	-0.18	0.32	0.38	-0.28	0.40	0.58	-0.20	0.33	0.40	-0.32	0.44	0.63	-0.25	0.37	0.47
PT	-0.48	0.48	0.52	-0.14	0.50	0.61	-0.11	0.46	0.58	-0.20	0.50	0.67	-0.12	0.44	0.56	-0.22	0.51	0.67	-0.15	0.46	0.57
SI	-0.30	0.87	1.15	0.03	0.83	1.01	0.02	0.78	0.96	-0.38	1.16	1.73	-0.07	0.90	1.12	-0.40	1.14	1.70	-0.11	0.89	1.11
SK	-0.10	0.58	0.75	0.09	0.52	0.68	0.06	0.48	0.64	-0.23	0.68	1.01	-0.07	0.54	0.74	-0.24	0.67	0.99	-0.09	0.54	0.72
FI	-0.16	0.44	0.50	-0.01	0.35	0.40	0.01	0.33	0.39	-0.07	0.38	0.47	-0.03	0.34	0.41	-0.07	0.36	0.46	-0.03	0.33	0.40
EA	**-0.09**	**0.14**	**0.16**	**0.02**	**0.18**	**0.25**	**0.03**	**0.18**	**0.24**	**-0.06**	**0.24**	**0.35**	**-0.02**	**0.20**	**0.27**	**-0.08**	**0.25**	**0.36**	**-0.04**	**0.21**	**0.29**
BG	-3.55	3.55	3.55	0.04	1.38	2.00	-0.02	1.23	1.85	-0.43	1.41	2.07	-0.15	1.20	1.77	-0.19	1.54	2.19	0.08	1.35	1.93
CZ	0.02	0.53	0.64	0.18	0.49	0.58	0.10	0.49	0.57	-0.21	0.70	1.13	0.02	0.50	0.58	-0.07	0.80	1.24	0.15	0.61	0.81
DK	0.01	0.31	0.42	0.06	0.31	0.43	0.09	0.32	0.43	-0.06	0.45	0.74	0.06	0.34	0.44	-0.01	0.48	0.76	0.11	0.38	0.49
HU	-0.21	0.65	0.67	0.19	0.61	0.65	0.08	0.62	0.66	-0.49	1.08	2.02	-0.07	0.69	0.83	-0.41	1.08	1.99	0.00	0.71	0.85
PL	-0.43	0.60	0.63	0.08	0.52	0.64	0.07	0.48	0.60	-0.22	0.68	0.93	-0.08	0.57	0.73	-0.13	0.73	0.98	0.01	0.63	0.80
RO	-0.42	0.42	0.42	0.16	1.04	1.29	0.03	1.07	1.31	-0.47	1.37	1.84	-0.16	1.12	1.38	-0.43	1.30	1.79	-0.14	1.06	1.33
SE	-0.13	0.26	0.30	-0.09	0.29	0.38	-0.12	0.30	0.39	-0.22	0.38	0.51	-0.17	0.33	0.42	-0.25	0.40	0.53	-0.20	0.35	0.45
EU	**-0.04**	**0.07**	**0.10**	**0.03**	**0.17**	**0.24**	**0.02**	**0.16**	**0.23**	**-0.08**	**0.24**	**0.40**	**-0.02**	**0.19**	**0.28**	**-0.09**	**0.25**	**0.39**	**-0.04**	**0.20**	**0.28**
Ave.	-0.47	0.71	0.82	0.00	0.61	0.77	-0.01	0.57	0.74	-0.23	0.72	1.05	-0.08	0.60	0.78	-0.22	0.73	1.06	-0.08	0.62	0.82
StD.	0.86	0.81	0.86	0.35	0.34	0.46	0.30	0.31	0.43	0.31	0.38	0.60	0.28	0.31	0.43	0.28	0.38	0.58	0.25	0.31	0.42

(b) Year ahead

	2000-07			2000-17			2000-19			2000-2022			00-22 (ex 2022)			2000-2023			00-23 (ex 2022)		
	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE
BE	-0.55	0.60	0.74	-0.22	0.77	1.03	-0.19	0.76	1.01	-0.49	1.08	1.85	-0.17	0.78	1.00	-0.49	1.05	1.81	-0.19	0.77	0.99
DE	0.11	0.22	0.25	0.16	0.48	0.68	0.18	0.46	0.65	-0.08	0.69	1.18	0.12	0.51	0.71	-0.07	0.67	1.16	0.12	0.50	0.70
EE	-0.55	1.50	1.96	0.04	1.80	2.26	0.05	1.67	2.13	-0.63	2.41	3.71	0.06	1.81	2.24	-0.70	2.39	3.65	-0.05	1.83	2.23
IE	-0.30	1.07	1.42	0.22	1.17	1.87	0.10	1.15	1.79	-0.13	1.36	1.97	0.04	1.24	1.84	-0.25	1.42	2.01	-0.09	1.31	1.89
EL	-0.34	0.49	0.55	0.12	1.10	1.41	0.18	1.06	1.36	-0.01	1.23	1.72	0.23	1.04	1.35	0.07	1.26	1.73	0.31	1.08	1.38
ES	-0.51	0.52	0.62	-0.23	0.81	0.98	-0.19	0.78	0.94	-0.39	0.99	1.45	-0.16	0.80	0.95	-0.40	0.98	1.43	-0.18	0.79	0.94
FR	-0.24	0.24	0.29	0.13	0.63	0.86	0.14	0.61	0.83	0.01	0.69	0.92	0.11	0.62	0.82	-0.09	0.76	1.03	0.00	0.70	0.95
HR	na	na	na	1.30	1.35	1.53	1.06	1.10	1.32	-0.21	1.92	3.20	0.81	1.09	1.27	-0.39	1.94	3.12	0.51	1.20	1.39
IT	-0.42	0.49	0.63	-0.01	0.73	0.91	0.06	0.72	0.89	-0.17	0.94	1.40	0.06	0.75	0.90	-0.14	0.93	1.37	0.08	0.74	0.89
CY	-0.30	0.30	0.31	0.65	1.19	1.54	0.54	1.09	1.45	0.29	1.26	1.77	0.57	1.06	1.42	0.30	1.22	1.73	0.57	1.03	1.38
LV	-2.84	2.84	2.88	-1.36	2.50	2.95	-1.20	2.21	2.76	-1.62	2.64	3.65	-1.09	2.17	2.68	-1.57	2.55	3.56	-1.07	2.09	2.61
LT	-0.23	0.83	0.91	-0.19	1.54	1.77	-0.12	1.39	1.66	-1.01	2.18	3.92	-0.21	1.45	1.72	-0.96	2.08	3.82	-0.19	1.37	1.67
LU	-0.50	0.50	0.79	0.23	0.88	1.19	0.22	0.81	1.13	0.09	0.90	1.30	0.25	0.78	1.10	0.09	0.87	1.27	0.24	0.75	1.07
MT	-0.01	0.82	1.02	0.49	0.96	1.16	0.44	0.93	1.11	0.22	0.98	1.27	0.42	0.85	1.05	0.13	1.01	1.29	0.31	0.89	1.08
NL	-0.16	0.43	0.45	0.23	0.68	1.03	0.19	0.64	0.98	-0.13	0.86	1.41	0.08	0.68	1.04	-0.13	0.83	1.38	0.07	0.66	1.02
AT	0.07	0.32	0.40	0.04	0.59	0.90	0.03	0.56	0.86	-0.18	0.71	1.21	0.01	0.55	0.83	-0.24	0.75	1.24	-0.06	0.60	0.89
PT	-0.52	0.52	0.63	0.05	0.73	1.27	0.09	0.70	1.21	-0.14	0.87	1.63	0.11	0.66	1.16	-0.16	0.86	1.60	0.08	0.65	1.14
SI	0.25	1.15	1.32	0.69	1.24	1.56	0.63	1.20	1.49	0.15	1.68	2.40	0.59	1.34	1.63	0.06	1.67	2.37	0.48	1.35	1.62
SK	0.10	0.95	1.05	0.39	1.26	1.50	0.28	1.16	1.42	-0.31	1.55	2.35	0.13	1.18	1.45	-0.12	1.64	2.41	0.30	1.29	1.60
FI	-0.04	0.99	1.09	-0.05	0.86	1.04	-0.01	0.81	0.99	-0.17	0.94	1.29	0.01	0.79	0.97	-0.19	0.92	1.27	-0.01	0.78	0.96
EA	**-0.23**	**0.25**	**0.31**	**0.05**	**0.58**	**0.79**	**0.07**	**0.56**	**0.76**	**-0.15**	**0.76**	**1.22**	**0.05**	**0.59**	**0.78**	**-0.17**	**0.75**	**1.20**	**0.02**	**0.59**	**0.77**
BG	-3.80	3.80	3.80	-0.04	2.24	2.81	-0.08	1.94	2.59	-0.76	2.64	3.65	-0.14	2.14	2.73	-0.75	2.52	3.54	-0.17	2.05	2.64
CZ	0.22	0.32	0.44	0.39	0.78	1.06	0.27	0.75	1.01	-0.41	1.26	2.69	0.18	0.72	0.98	-0.19	1.39	2.76	0.38	0.89	1.30
DK	-0.10	0.32	0.39	0.09	0.52	0.61	0.16	0.55	0.63	-0.09	0.80	1.35	0.16	0.58	0.67	-0.01	0.85	1.38	0.23	0.64	0.76
HU	-0.30	1.10	1.18	0.31	1.18	1.47	0.17	1.13	1.40	-0.60	1.70	3.00	0.01	1.15	1.46	-0.53	1.65	2.93	0.05	1.13	1.43
PL	0.32	1.02	1.18	0.34	1.34	1.49	0.34	1.21	1.39	-0.38	1.69	2.51	0.08	1.29	1.54	-0.20	1.77	2.55	0.25	1.40	1.67
RO	0.30	0.30	0.30	-0.12	1.41	2.02	-0.30	1.39	1.93	-0.97	2.05	3.18	-0.36	1.52	2.01	-0.87	1.97	3.08	-0.30	1.47	1.96
SE	0.19	0.43	0.50	0.27	0.47	0.52	0.22	0.44	0.50	-0.05	0.67	1.15	0.17	0.48	0.55	-0.02	0.66	1.13	0.19	0.48	0.55
EU	**-0.10**	**0.12**	**0.15**	**0.06**	**0.51**	**0.72**	**0.08**	**0.49**	**0.69**	**-0.18**	**0.73**	**1.28**	**0.04**	**0.53**	**0.73**	**-0.18**	**0.71**	**1.25**	**0.04**	**0.52**	**0.71**
Ave.	-0.39	0.85	0.97	0.14	1.08	1.38	0.12	1.01	1.31	-0.30	1.36	2.12	0.08	1.04	1.34	-0.29	1.36	2.10	0.07	1.05	1.36
StD.	0.90	0.81	0.82	0.43	0.51	0.60	0.38	0.44	0.55	0.41	0.61	0.94	0.34	0.47	0.57	0.40	0.59	0.91	0.32	0.45	0.55

Source: EC, Eurostat, own calculations.

Table I.3. **General government budget balance, error statistics, 2000-2023**

(a) Current year

	2000-07			2000-17			2000-19			2000-2022			00-22 (ex 2021)			2000-2023			00-23 (ex 2021)		
	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE
BE	-0.26	0.37	0.40	-0.03	0.51	0.64	-0.02	0.51	0.63	-0.13	0.61	0.77	-0.04	0.54	0.65	-0.15	0.60	0.76	-0.06	0.54	0.64
DE	-0.26	0.87	1.14	-0.50	0.77	0.98	-0.50	0.74	0.94	-0.72	0.94	1.32	-0.58	0.81	1.08	-0.68	0.91	1.29	-0.54	0.78	1.06
EE	-0.82	1.27	1.42	-0.70	1.31	1.62	-0.58	1.18	1.52	-1.02	1.53	1.93	-0.90	1.43	1.83	-0.95	1.47	1.88	-0.84	1.37	1.79
IE	-0.74	1.77	1.93	1.25	2.69	5.31	1.09	2.46	5.04	0.70	2.38	4.76	0.87	2.35	4.83	0.67	2.29	4.66	0.83	2.25	4.72
EL	0.74	0.95	1.37	1.73	2.51	3.60	1.47	2.34	3.42	1.23	2.38	3.33	1.40	2.37	3.36	1.19	2.29	3.26	1.35	2.28	3.29
ES	-0.40	0.60	0.69	0.63	1.16	1.74	0.59	1.07	1.65	0.52	1.00	1.56	0.58	1.01	1.58	0.48	0.98	1.53	0.53	0.99	1.55
FR	0.22	0.44	0.57	0.09	0.43	0.55	0.09	0.41	0.52	-0.03	0.48	0.66	0.06	0.41	0.52	0.00	0.49	0.67	0.09	0.42	0.53
HR	na	na	na	-0.80	1.66	1.82	-0.53	1.30	1.56	-0.78	1.38	1.64	-0.67	1.34	1.64	-0.68	1.27	1.57	-0.58	1.23	1.56
IT	0.06	0.45	0.60	0.15	0.41	0.55	0.12	0.43	0.56	-0.06	0.75	1.23	0.14	0.58	0.83	0.07	0.84	1.34	0.26	0.68	1.01
CY	-1.53	1.53	2.37	0.04	1.68	2.18	0.54	1.97	2.67	0.08	2.03	2.64	0.27	1.95	2.59	0.01	1.99	2.59	0.19	1.92	2.54
LV	-1.11	1.22	1.36	-0.55	1.06	1.32	-0.51	0.96	1.24	-0.72	1.10	1.46	-0.77	1.16	1.50	-0.77	1.13	1.47	-0.81	1.19	1.51
LT	-0.44	0.84	1.06	-0.28	1.11	1.41	-0.25	0.99	1.32	-0.77	1.44	2.23	-0.42	1.12	1.55	-0.78	1.41	2.19	-0.45	1.11	1.53
LU	-1.17	1.26	1.56	-0.98	1.02	1.26	-0.99	1.03	1.25	-0.96	0.99	1.21	-0.95	0.98	1.21	-0.94	0.97	1.19	-0.93	0.96	1.19
MT	-0.50	0.50	0.51	-0.43	1.01	1.44	-0.39	0.98	1.37	-0.34	1.22	1.73	-0.15	1.07	1.53	-0.34	1.17	1.69	-0.15	1.03	1.49
NL	-0.41	1.24	1.30	-0.30	1.04	1.18	-0.33	0.99	1.14	-0.60	1.18	1.37	-0.51	1.12	1.30	-0.64	1.20	1.39	-0.57	1.14	1.32
AT	-0.29	0.47	0.54	-0.43	0.51	0.59	-0.43	0.51	0.59	-0.33	0.64	0.86	-0.27	0.59	0.80	-0.30	0.62	0.84	-0.24	0.57	0.79
PT	-0.11	0.71	0.83	0.27	0.95	1.16	0.19	0.91	1.11	-0.02	0.98	1.16	0.06	0.94	1.12	-0.08	0.99	1.17	0.00	0.95	1.13
SI	-0.53	0.63	0.80	0.43	1.15	2.60	0.38	1.03	2.43	0.14	1.18	2.39	0.33	1.06	2.33	0.07	1.18	2.35	0.25	1.07	2.29
SK	-0.42	0.78	0.78	0.05	0.68	0.90	0.08	0.66	0.87	-0.15	0.78	1.03	-0.14	0.80	1.05	-0.20	0.80	1.04	-0.20	0.82	1.06
FI	-0.80	1.15	1.35	-0.36	1.01	1.16	-0.29	0.95	1.12	-0.48	1.06	1.23	-0.41	1.01	1.18	-0.45	1.02	1.20	-0.39	0.98	1.15
EA	**-0.14**	**0.54**	**0.67**	**-0.01**	**0.47**	**0.59**	**-0.03**	**0.45**	**0.57**	**-0.20**	**0.57**	**0.84**	**-0.08**	**0.46**	**0.60**	**-0.18**	**0.56**	**0.82**	**-0.06**	**0.46**	**0.59**
BG	-1.43	1.43	1.43	-0.07	1.27	1.53	-0.26	1.27	1.50	-0.17	1.18	1.39	-0.24	1.20	1.42	-0.33	1.29	1.53	-0.41	1.31	1.56
CZ	-1.85	1.85	2.09	-0.86	1.33	1.54	-0.73	1.20	1.45	-0.81	1.21	1.47	-0.71	1.13	1.38	-0.77	1.16	1.44	-0.67	1.08	1.34
DK	-0.62	0.75	1.17	-0.85	1.13	1.49	-0.95	1.20	1.58	-1.39	1.60	2.21	-1.25	1.48	2.05	-1.36	1.57	2.17	-1.23	1.45	2.01
HU	0.76	1.63	1.83	-0.16	0.94	1.27	-0.13	0.85	1.19	0.05	0.88	1.28	0.06	0.93	1.32	0.19	0.97	1.39	0.20	1.03	1.43
PL	-0.90	1.38	1.43	0.48	1.46	2.57	0.30	1.39	2.43	-0.02	1.45	2.37	0.11	1.40	2.37	-0.01	1.38	2.31	0.11	1.33	2.31
RO	-0.73	0.73	0.73	0.16	1.04	1.40	0.16	0.96	1.31	-0.01	0.92	1.25	0.06	0.92	1.27	0.11	0.98	1.30	0.17	0.99	1.32
SE	-0.82	0.94	1.16	-0.72	0.91	1.16	-0.66	0.83	1.10	-0.87	1.02	1.34	-0.77	0.92	1.21	-0.84	0.98	1.31	-0.75	0.89	1.18
EU	**-0.17**	**0.54**	**0.71**	**-0.06**	**0.50**	**0.64**	**-0.08**	**0.49**	**0.61**	**-0.26**	**0.61**	**0.86**	**-0.15**	**0.51**	**0.65**	**-0.23**	**0.60**	**0.85**	**-0.12**	**0.51**	**0.64**
Ave.	-0.55	0.99	1.17	-0.10	1.14	1.59	-0.09	1.08	1.54	-0.28	1.20	1.70	-0.18	1.13	1.61	-0.28	1.18	1.69	-0.18	1.12	1.60
StD.	0.61	0.44	0.52	0.62	0.54	1.00	0.57	0.51	0.97	0.56	0.48	0.87	0.58	0.49	0.90	0.55	0.45	0.84	0.56	0.46	0.87

(b) Year ahead

	2000-07			2000-17			2000-19			2000-2022			00-22 (ex 2020)			2000-2023			00-23 (ex 2020)		
	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE	ME	MAE	RMSE
BE	-0.07	0.64	0.84	-0.01	0.92	1.37	0.00	0.90	1.32	0.16	1.22	1.93	-0.14	0.96	1.35	0.09	1.23	1.92	-0.20	0.99	1.36
DE	-0.45	1.15	1.38	-0.38	1.00	1.29	-0.40	0.96	1.24	-0.15	1.07	1.55	-0.38	0.89	1.18	-0.16	1.04	1.52	-0.38	0.87	1.16
EE	-2.06	2.06	2.17	-0.93	1.68	2.16	-0.79	1.50	2.02	-0.64	1.81	2.40	-0.98	1.61	2.10	-0.65	1.77	2.35	-0.97	1.57	2.06
IE	-0.57	1.99	2.15	1.35	3.09	4.92	1.17	2.82	4.67	0.92	3.01	4.63	0.72	2.91	4.60	0.85	2.91	4.53	0.66	2.81	4.50
EL	1.34	1.79	2.19	2.35	3.37	4.60	2.06	3.08	4.37	2.26	3.28	4.70	1.86	2.93	4.19	2.14	3.17	4.60	1.75	2.82	4.10
ES	-0.63	0.74	0.89	0.93	1.71	2.74	0.88	1.58	2.60	1.01	1.89	3.09	0.66	1.58	2.55	0.93	1.85	3.03	0.59	1.55	2.50
FR	0.25	0.61	0.80	0.19	0.80	1.20	0.17	0.75	1.14	0.35	1.05	1.82	0.05	0.79	1.15	0.34	1.01	1.78	0.06	0.76	1.13
HR	na	na	na	-1.72	2.11	2.37	-1.40	1.68	2.05	-0.56	2.24	3.05	-1.45	1.66	2.07	-0.65	2.17	2.94	-1.45	1.65	2.02
IT	0.18	0.86	0.98	0.29	0.73	0.97	0.22	0.74	0.97	0.58	1.08	1.83	0.28	0.80	1.05	0.71	1.18	1.93	0.42	0.92	1.27
CY	-1.80	2.00	2.77	-0.38	1.76	2.54	0.13	2.00	2.81	0.32	2.35	3.33	-0.13	2.02	2.80	0.26	2.28	3.26	-0.17	1.96	2.73
LV	-1.80	1.80	1.92	-0.71	2.15	2.70	-0.66	1.92	2.53	-0.15	2.03	2.62	-0.37	1.93	2.52	-0.19	1.98	2.56	-0.41	1.88	2.47
LT	-1.24	1.24	1.46	-0.50	1.59	2.06	-0.45	1.42	1.92	-0.39	1.97	2.74	-0.82	1.68	2.24	-0.56	2.06	2.80	-0.97	1.79	2.34
LU	-2.00	2.10	2.46	-1.63	1.90	2.17	-1.64	1.89	2.14	-1.29	1.97	2.29	-1.57	1.83	2.09	-1.27	1.93	2.25	-1.55	1.79	2.05
MT	-0.75	0.75	0.76	-0.67	1.27	1.69	-0.63	1.24	1.63	0.11	1.69	2.90	-0.48	1.19	1.58	0.05	1.67	2.84	-0.51	1.19	1.56
NL	-0.38	1.53	1.76	-0.11	1.45	1.96	-0.18	1.38	1.88	-0.17	1.62	2.15	-0.39	1.49	1.95	-0.32	1.71	2.23	-0.53	1.58	2.05
AT	-0.56	0.67	0.77	-0.38	0.78	0.94	-0.43	0.79	0.93	0.03	1.13	2.01	-0.36	0.80	0.93	0.02	1.10	1.96	-0.35	0.77	0.91
PT	0.43	1.16	1.46	0.98	1.46	2.09	0.80	1.40	2.00	0.74	1.67	2.34	0.51	1.48	2.04	0.62	1.70	2.34	0.39	1.52	2.06
SI	-0.81	0.96	1.18	0.49	2.06	3.35	0.37	1.86	3.14	0.54	2.20	3.50	0.11	1.87	3.03	0.38	2.22	3.46	-0.03	1.91	3.01
SK	-0.55	0.91	0.92	0.17	0.99	1.68	0.21	0.93	1.59	0.16	1.26	1.92	-0.07	1.08	1.69	0.13	1.22	1.88	-0.10	1.06	1.65
FI	-1.14	1.34	1.59	-0.31	1.46	1.98	-0.27	1.38	1.89	-0.22	1.53	2.03	-0.41	1.42	1.89	-0.18	1.50	1.99	-0.36	1.39	1.85
EA	**-0.19**	**0.79**	**0.92**	**0.13**	**0.82**	**1.29**	**0.09**	**0.77**	**1.22**	**0.28**	**1.01**	**1.76**	**0.01**	**0.77**	**1.20**	**0.26**	**0.98**	**1.73**	**0.00**	**0.75**	**1.18**
BG	1.70	1.70	1.70	0.68	2.29	2.98	0.34	2.17	2.81	0.64	2.13	2.81	0.36	1.95	2.62	0.56	2.05	2.74	0.29	1.88	2.55
CZ	-1.95	1.95	2.21	-0.98	1.72	2.03	-0.85	1.55	1.90	-0.46	1.67	2.16	-0.79	1.46	1.81	-0.45	1.60	2.11	-0.76	1.40	1.77
DK	-0.62	1.12	1.55	-0.92	1.56	1.96	-1.11	1.69	2.09	-1.29	1.85	2.37	-1.38	1.90	2.42	-1.35	1.89	2.39	-1.44	1.94	2.44
HU	0.95	2.13	2.23	-0.57	1.60	2.74	-0.51	1.43	2.57	0.07	1.69	2.88	-0.32	1.40	2.46	0.18	1.72	2.86	-0.18	1.45	2.45
PL	-0.85	0.97	1.29	0.48	1.57	2.63	0.32	1.48	2.49	0.61	1.83	2.86	0.26	1.55	2.45	0.57	1.75	2.79	0.23	1.48	2.39
RO	0.00	0.00	0.00	0.36	1.07	1.68	0.31	1.05	1.59	0.25	1.47	2.17	-0.06	1.24	1.85	0.33	1.47	2.14	0.04	1.25	1.83
SE	-1.04	1.34	1.47	-0.80	1.38	1.60	-0.70	1.26	1.52	-0.62	1.36	1.63	-0.78	1.29	1.55	-0.56	1.34	1.61	-0.71	1.27	1.52
EU	**-0.10**	**0.83**	**0.97**	**0.11**	**0.87**	**1.32**	**0.08**	**0.80**	**1.25**	**0.23**	**1.04**	**1.73**	**-0.02**	**0.83**	**1.26**	**0.22**	**1.00**	**1.69**	**-0.03**	**0.80**	**1.23**
Ave.	-0.56	1.29	1.50	-0.10	1.61	2.24	-0.11	1.51	2.14	0.10	1.78	2.58	-0.22	1.54	2.15	0.07	1.76	2.55	-0.25	1.54	2.14
StD.	0.97	0.57	0.65	0.89	0.64	0.95	0.79	0.58	0.89	0.72	0.55	0.79	0.72	0.55	0.85	0.71	0.53	0.77	0.71	0.53	0.82

Source: EC, Eurostat, own calculations.

Table I.4. **Forecast error drivers, gross domestic product, year-ahead**

	Baseline		Nonlinear		Uncertainty		Crises		Crises & Uncertainty		Crises & Uncertainty & Non-linearity	
	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23
Structural balance	-0.28**	0.01	-0.26**	-0.09**	-0.32***	0.00	-0.41***	-0.02	-0.42***	-0.02	-0.44***	-0.34***
Global (excl EU) growth	1.85***	1.06***	1.81***	1.11***	1.54***	0.97***	1.27***	0.81***	0.93**	0.83***	0.92**	0.93***
NEER	0.03	-0.12***	0.03	-0.12***	-0.04	-0.11***	-0.02	-0.04	-0.02	-0.04	-0.02	-0.05
Oil	-0.01	0.02***	-0.01	0.02***	0.00	0.02***	-0.02***	-0.01	-0.01	-0.01	-0.01	-0.01
Long-term int. rates	-0.60***	-0.58***	-0.57***	-0.58***	-0.59***	-0.54***	-0.37***	-0.38***	-0.39***	-0.39***	-0.41***	-0.39***
Short-term int. rates	0.00	0.13	-0.09	0.14	-0.17	0.07	-0.47***	-0.35***	-0.48***	-0.37***	-0.42***	-0.38***
Structural balance sq.			0.05	0.00**							-0.04	0.00***
Uncertainty (st/sed)					0.95***	0.51***			0.31	0.32***	0.33*	0.37***
Year = 2009							4.90***	5.02***	5.08***	4.46***	5.24***	4.61***
Year = 2010							1.68**	0.99	0.84	0.72	0.81	0.69
Year = 2020								2.49*		1.88		2.27
Year = 2021								-1.01		-0.88		6.60***
Year = 2022								-2.30***		-2.56***		-2.33***
Constant	0.21	0.04	0.16	0.04	0.53***	0.21*	-0.18	-0.02	0.04	0.14	0.08	0.09
# observations	222	374	222	374	214	366	222	374	214	366	214	366
# countries	27	27	27	27	27	27	27	27	27	27	27	27
R-square	0.59	0.58	0.60	0.59	0.66	0.61	0.75	0.71	0.76	0.71	0.76	0.74
R-square adjusted	0.56	0.60	0.56	0.61	0.63	0.61	0.74	0.71	0.75	0.72	0.75	0.74

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

Source: own calculations.

Table I.5. **Forecast error drivers, inflation, year-ahead**

	Baseline		Nonlinear		Uncertainty		Crises		Crises & Uncertainty		Crises & Uncertainty & Non-linearity	
	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23	00-17	00-23
Structural balance	0.20***	0.04***	0.20***	0.04	0.19***	0.04***	0.15**	0.06***	0.16***	0.06***	0.16***	0.14**
Global (excl EU) growth	0.29***	-0.25***	0.29***	-0.24***	0.23***	-0.20***	0.28	0.14	0.30	0.15	0.33	0.13
NEER	-0.11***	-0.22***	-0.11***	-0.22***	-0.12***	-0.22***	-0.11***	-0.09***	-0.12***	-0.09***	-0.12***	-0.09**
Oil	0.03***	0.06***	0.03***	0.06***	0.03***	0.06***	0.03***	0.02***	0.03***	0.03***	0.03***	0.02***
Long-term int. rates	0.05	0.15*	0.05	0.15*	0.10**	0.17**	0.08	0.06	0.10*	0.08	0.09*	0.08
Short-term int. rates	-0.08	0.39***	-0.06	0.40***	-0.12*	0.39***	-0.19***	0.06	-0.19***	0.05	-0.17**	0.05
Structural balance sq.			-0.01	0.00							-0.01	0.00
Uncertainty (st/sed)					0.09	-0.17			0.09	0.03	0.09	0.02
Year = 2009							0.88	1.05*	0.33	0.81	0.22	0.74
Year = 2010							0.40	-0.34	0.21	-0.51	0.27	-0.50
Year = 2020								-1.46		-1.62		-1.75
Year = 2021								-3.43**		-3.47**		-5.29***
Year = 2022								-6.23***		-6.26***		-6.33***
Constant	0.33***	-0.25**	0.33***	-0.25**	0.33***	-0.33***	0.27***	0.17*	0.32***	0.19*	0.31**	0.21*
# observations	222	374	222	374	214	366	222	374	214	366	214	366
# countries	27	27	27	27	27	27	27	27	27	27	27	27
R-square	0.47	0.46	0.47	0.45	0.49	0.46	0.49	0.72	0.51	0.72	0.51	0.72
R-square adjusted	0.43	0.42	0.42	0.42	0.46	0.43	0.48	0.71	0.48	0.71	0.48	0.71

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

Source: own calculations.

Table I.6. **Forecast error drivers, GDP, current year, 2013-2023**

	Baseline		Nonlinear		Uncertainty		Crises		Crises & Uncertainty		Crises & Uncertainty & Non-linearity	
	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23
Structural balance	0.01	-0.32***	0.01	-0.40***	-0.04	-0.05	-0.11*	-0.29***	-0.22***	-0.32***	-0.20***	-0.32***
Global (excl EU) growth	0.36**	-0.13	0.41**	-0.19	0.35*	1.14***	0.09	0.04	0.14	0.20	0.15	0.21
NEER	0.15*	0.16	0.14*	0.14	0.12	0.35**	0.29***	0.16	0.24***	0.14	0.23***	0.14
Oil	0.00	0.04**	0.00	0.04***	0.00	-0.18***	0.00	-0.03*	-0.01	-0.03*	-0.01	-0.03*
Long-term int. rates	-0.35**	0.31	-0.33**	0.33	-0.35**	-1.26***	-0.53***	0.26	-0.49***	0.21	-0.47***	0.21
Short-term int. rates	0.42*	0.50	0.42*	0.44	0.44*	0.20	-0.29	-0.03	-0.18	-0.03	-0.17	-0.03
Structural balance sq.			0.06**	-0.07**							0.03	0.00
Uncertainty (st/sed)					0.10	-0.14			0.39***	0.32**	0.38***	0.32**
Year = 2009							1.40***		1.18***		1.06**	
Year = 2010							-1.39***		-1.55***		-1.53***	
Year = 2020							-1.72***	-1.95***	-2.20***	-2.39***	-2.29***	-2.39***
Year = 2021							-2.21***	-2.54***	-2.60***	-2.87***	-2.66***	-2.87***
Year = 2022							-2.29***	-1.10**	-2.40***	-1.53***	-2.39***	-1.53***
Constant	-0.29***	-0.68***	-0.40***	-0.60***	-0.30***	1.00***	0.12	-0.28**	0.18*	-0.07	0.15	-0.07
# observations	402	255	402	255	393	95	402	255	393	252	393	252
# countries	27	26	27	26	27	24	27	26	27	26	27	26
R-square	0.03	0.08	0.03	0.12	0.04	0.40	0.28	0.26	0.34	0.28	0.33	0.28
R-square adjusted	-0.04	-0.03	-0.03	-0.01	-0.05	0.24	0.22	0.19	0.27	0.20	0.27	0.20

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

Source: own calculations.

Table I.7. **Forecast error drivers, GDP, year ahead, 2013-2023**

	Baseline		Nonlinear		Uncertainty		Crises		Crises & Uncertainty		Crises & Uncertainty & Non-linearity	
	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23
Structural balance	0.01	0.00***	-0.09**	-0.07*	0.00	-0.59***	-0.02***	0.01***	-0.02***	0.01***	-0.34***	-0.24**
Global (excl EU) growth	1.06***	1.19***	1.11***	1.23***	0.97***	1.11***	0.81***	0.56*	0.83***	0.77**	0.93***	0.89***
NEER	-0.12***	-0.23***	-0.12***	-0.23***	-0.11***	-0.12**	-0.04***	-0.09	-0.04***	-0.07	-0.05***	-0.08
Oil	0.02***	0.00**	0.02***	-0.01***	0.02***	0.10***	-0.01	-0.01*	-0.01	-0.01*	-0.01	-0.01*
Long-term int. rates	-0.58***	0.05	-0.58***	0.06	-0.54***	-0.63***	-0.38***	-0.02	-0.39***	-0.10	-0.39***	-0.11
Short-term int. rates	0.13*	-0.10	0.14*	-0.09	0.07*	-0.57***	-0.35***	-0.16	-0.37***	-0.12	-0.38***	-0.11
Structural balance sq.			0.00**	0.00*							0.00***	0.00***
Uncertainty (st/sed)					0.51***	0.09			0.32***	0.29*	0.37***	0.36**
Year = 2009							5.02***		4.46***		4.61***	
Year = 2010							0.99***		0.72***		0.69***	
Year = 2020							2.49*	4.14**	1.88***	2.57***	2.27***	2.54***
Year = 2021							-1.01***	-2.16***	-0.88***	-2.29***	6.60***	3.87***
Year = 2022							-2.30***	-0.47***	-2.56***	-1.44***	-2.33***	-1.47***
Constant	0.04***	-0.66***	0.04***	-0.65***	0.21*	2.41***	-0.02***	-0.41**	0.14***	-0.12***	0.09***	-0.11***
# observations	374***	252***	374***	252***	366***	71***	374	252**	366	249	366	249
# countries	27	26	27	26	27	24	27	26	27	26	27	26
R-square	0.58	0.66	0.59	0.66	0.61	0.85	0.71	0.67	0.71	0.68	0.74	0.69
R-square adjusted	0.60	0.66	0.61	0.66	0.61	0.88	0.71	0.67	0.72	0.68	0.74	0.68

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

Source: own calculations.

Table I.8. **Forecast error drivers, inflation, current year, 2013-2023**

	Baseline		Nonlinear		Uncertainty		Crises		Crises & Uncertainty		Crises & Uncertainty & Non-linearity	
	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23
Structural balance	0.13***	0.08	0.13***	0.02	0.16***	0.09	0.07*	0.08	0.07*	0.09*	0.06	0.06
Global (excl EU) growth	0.18*	-0.13	0.17	-0.16	0.17*	0.19	0.06	-0.20	0.07	-0.26*	0.07	-0.28*
NEER	-0.17***	-0.10	-0.17***	-0.11	-0.16***	-0.01	-0.07	0.00	-0.07	0.01	-0.07	0.01
Oil	0.00	0.02***	0.00	0.02**	0.00	-0.05**	0.00	0.02	0.00	0.02	0.00	0.02*
Long-term int. rates	0.29***	0.67***	0.29***	0.69***	0.31***	-0.16	0.13	0.35*	0.17*	0.40**	0.16*	0.39*
Short-term int. rates	1.13***	2.17***	1.14***	2.20***	1.07***	0.65***	0.75***	1.49***	0.75***	1.47***	0.75***	1.48***
Structural balance sq.			-0.02	-0.04**							-0.02	-0.02
Uncertainty (st/sed)					-0.14**	-0.19			-0.01	-0.09	0.00	-0.09
Year = 2009							0.18		0.11		0.17	
Year = 2010							-0.41		-0.51*		-0.53**	
Year = 2020							-0.43**	-0.39*	-0.43**	-0.24	-0.38*	-0.15
Year = 2021							-1.12***	-0.79***	-1.11***	-0.67**	-1.07***	-0.61**
Year = 2022							-2.05***	-1.66***	-2.00***	-1.50***	-2.02***	-1.50***
Constant	-0.20***	-0.21***	-0.16***	-0.15*	-0.21***	0.07	0.06	0.10	0.05	0.04	0.07	0.06
# observations	402	255	402	255	393	95	402	255	393	252	393	252
# countries	27	26	27	26	27	24	27	26	27	26	27	26
R-square	0.27	0.45	0.27	0.46	0.28	0.30	0.44	0.53	0.45	0.53	0.45	0.53
R-square adjusted	0.21	0.39	0.21	0.41	0.23	0.02	0.41	0.52	0.42	0.53	0.42	0.53

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

Source: own calculations.

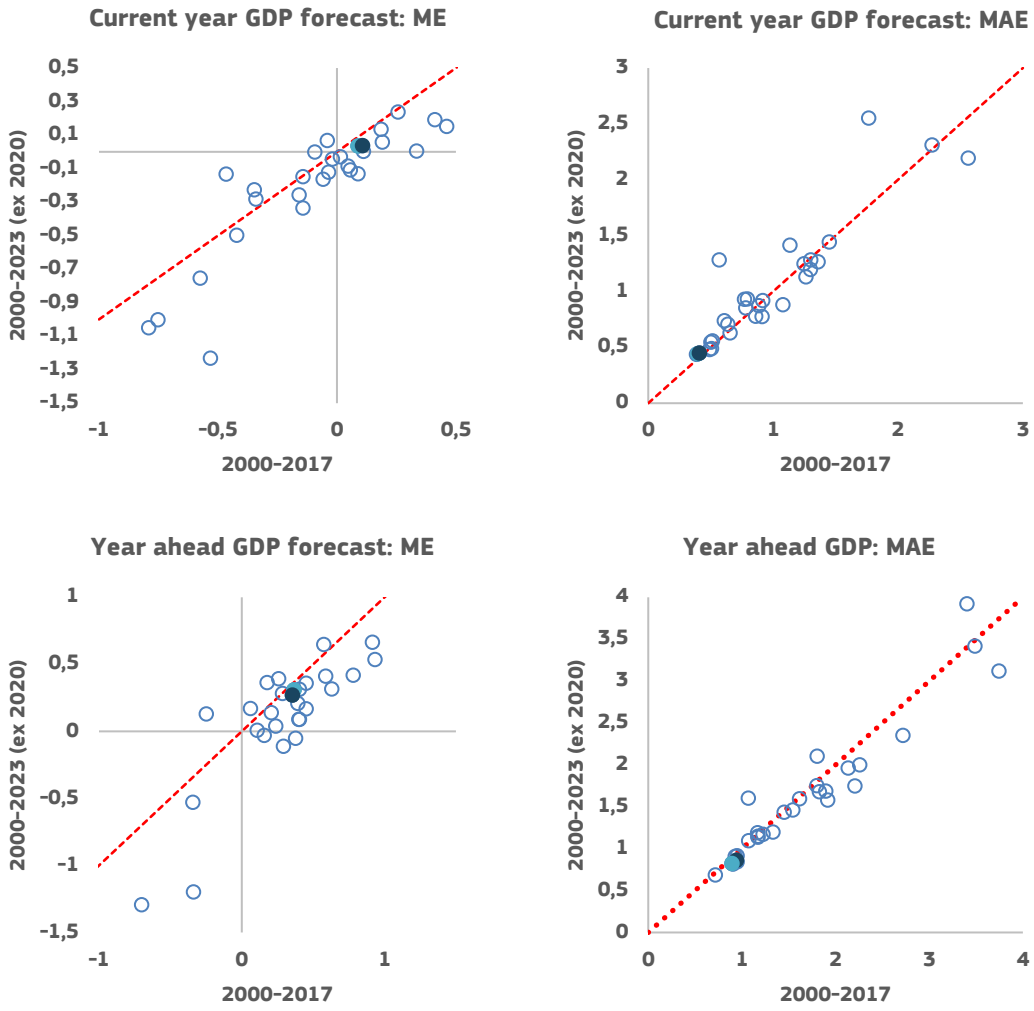
Table I.9. **Forecast error drivers, inflation, year ahead, 2013-2023**

	Baseline		Nonlinear		Uncertainty		Crises		Crises & Uncertainty		Crises & Uncertainty & Non-linearity	
	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23	00-23	13-23
Structural balance	0.04***	0.03***	0.04	0.03	0.04***	0.14	0.06***	0.03	0.06***	0.03	0.14**	0.08
Global (excl EU) growth	-0.25***	-0.16**	-0.24***	-0.16**	-0.20***	-0.07	0.14	-0.31	0.15	-0.36	0.13	-0.38
NEER	-0.22***	-0.19***	-0.22***	-0.19***	-0.22***	-0.15***	-0.09***	0.00	-0.09***	0.00	-0.09**	0.00
Oil	0.06***	0.04***	0.06***	0.04***	0.06***	0.05***	0.02***	0.02***	0.03***	0.02***	0.02***	0.02***
Long-term int. rates	0.15*	0.80***	0.15*	0.80***	0.17**	0.04	0.06	0.33**	0.08	0.36***	0.08	0.36***
Short-term int. rates	0.39***	1.11***	0.40***	1.11***	0.39***	-0.07	0.06	0.74***	0.05	0.74***	0.05	0.74***
Structural balance sq.			0.00	0.00							0.00	0.00
Uncertainty (st/sed)					-0.17	0.34			0.03	-0.05	0.02	-0.07
Year = 2009							1.05*		0.81		0.74	
Year = 2010							-0.34		-0.51		-0.50	
Year = 2020							-1.46	1.86	-1.62	2.17	-1.75	2.17
Year = 2021							-3.43**	-2.53*	-3.47**	-2.57*	-5.29***	-3.61
Year = 2022							-6.23***	-4.37***	-6.26***	-4.16***	-6.33***	-4.16***
Constant	-0.25**	-0.65***	-0.25**	-0.65***	-0.33***	0.23	0.17*	0.06	0.19*	0.02	0.21*	0.01
# observations	374	252	374	252	366	71	374	252	366	249	366	249
# countries	27	26	27	26	27	24	27	26	27	26	27	26
R-square	0.46	0.69	0.45	0.69	0.46	0.65	0.72	0.79	0.72	0.79	0.72	0.79
R-square adjusted	0.42	0.69	0.42	0.69	0.43	0.52	0.71	0.78	0.71	0.78	0.71	0.78

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

Source: own calculations.

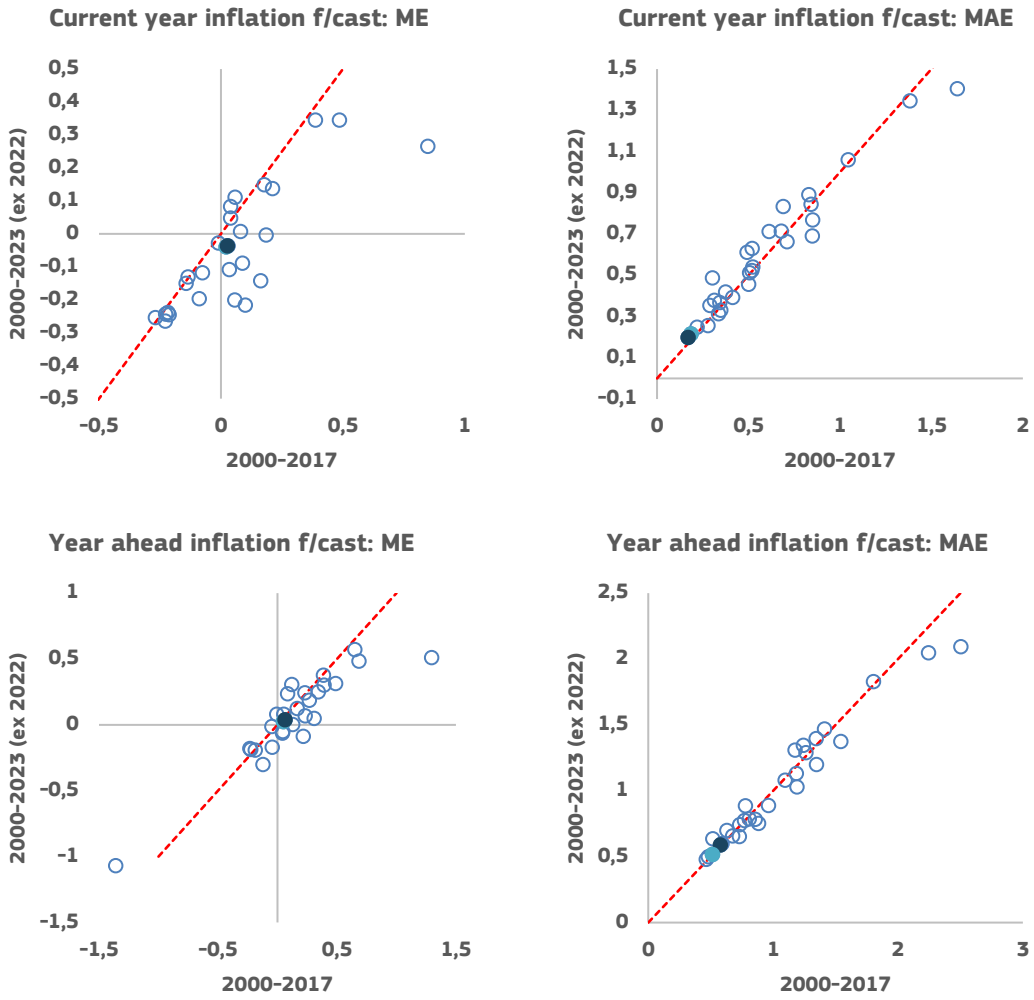
Graph I.1. **Bias and accuracy across countries, compared to reference period: GDP**



Note: Scatterplot visualisations of results of Table I.1. ME stands for Mean (forecast) error, and MAE for Mean absolute (forecast) error. Filled dots correspond to the EA/EU. Red dashed line depicts the 45-degree line.

Source: own calculations.

Graph I.2. **Bias and accuracy across countries, compared to reference period: Inflation**

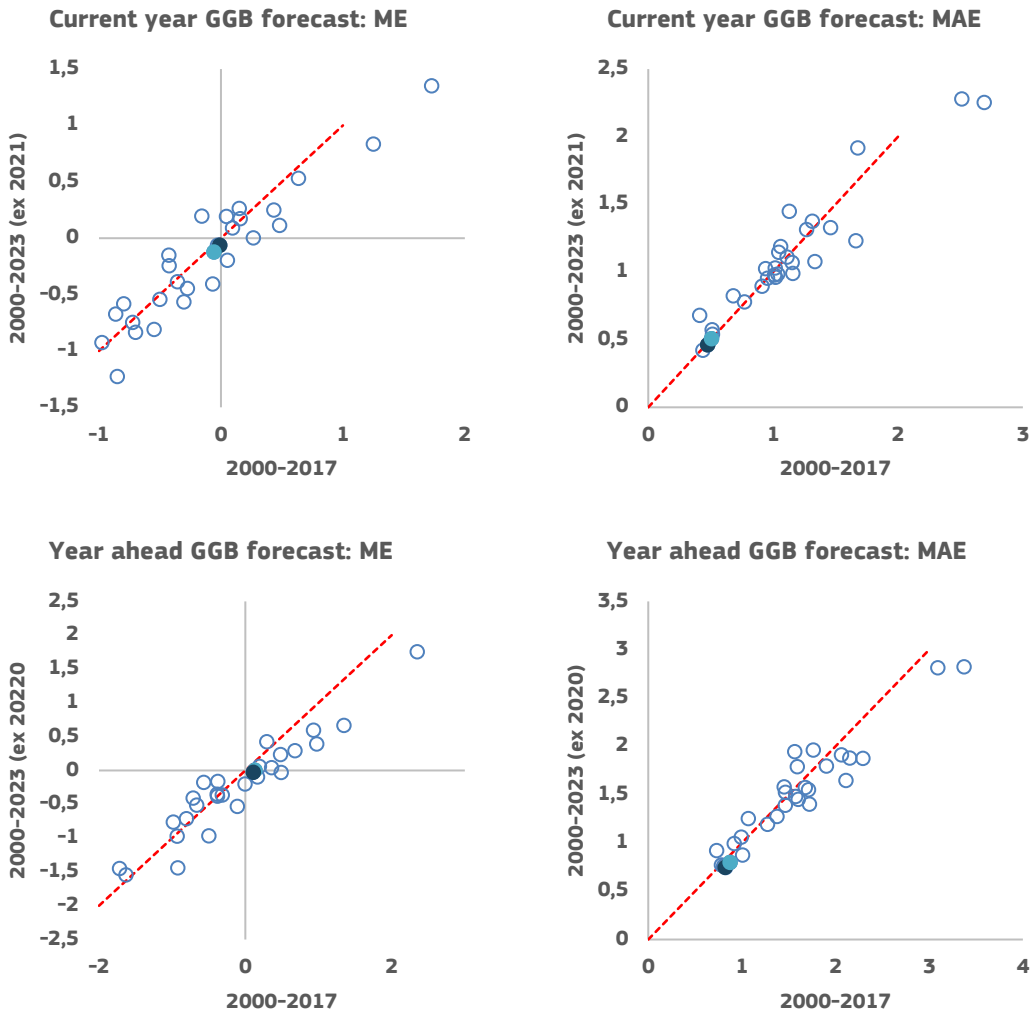


Note: Scatterplot visualisations of results of

Table I.2. ME stands for Mean (forecast) error, and MAE for Mean absolute (forecast) error. Filled dots correspond to the EA/EU. Red dashed line depicts the 45-degree line.

Source: own calculations.

Graph I.3. **Bias and accuracy across countries, compared to reference period: GGB**

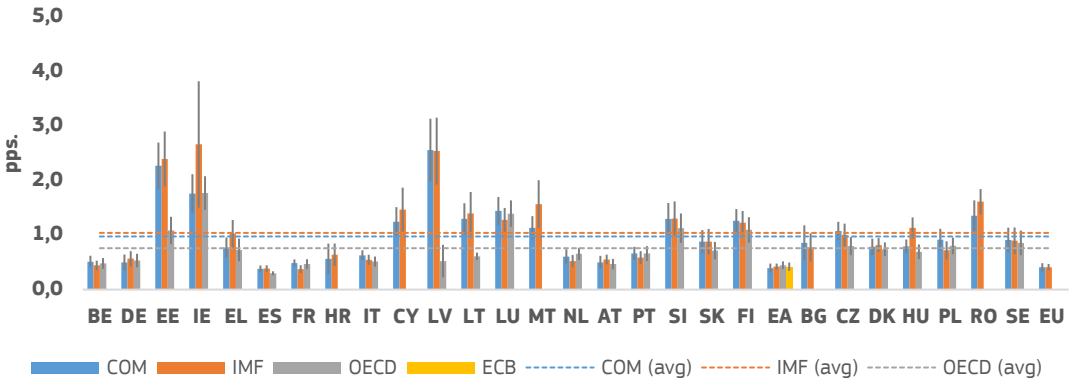


Note: Scatterplot visualisations of results of Table I.3. ME stands for Mean (forecast) error, and MAE for Mean absolute (forecast) error. Filled dots correspond to the EA/EU. Red dashed line depicts the 45-degree line.

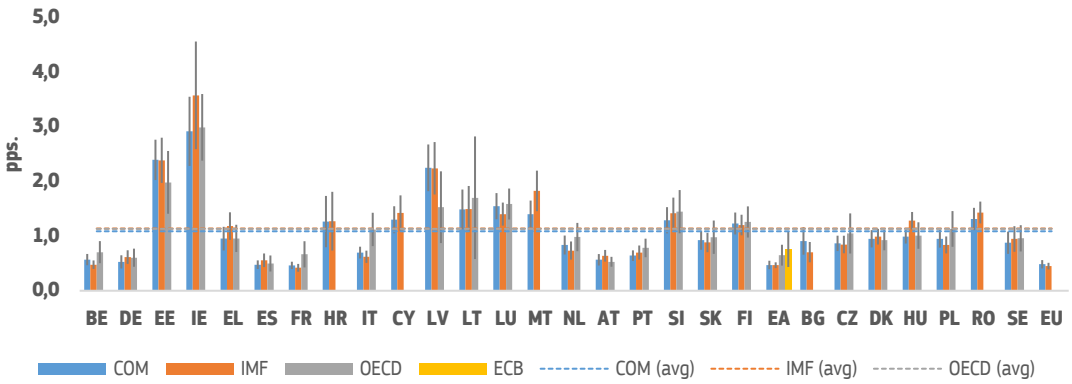
Source: own calculations.

Graph I.4. **Mean absolute GDP forecast errors, current year**

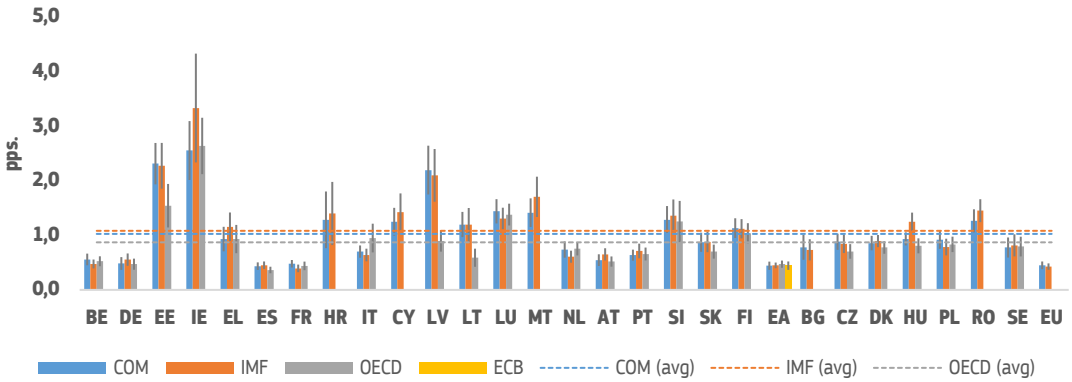
Period: 2000-2017



Period: 2000-2023



Period: 2000-2023 (ex 2020)

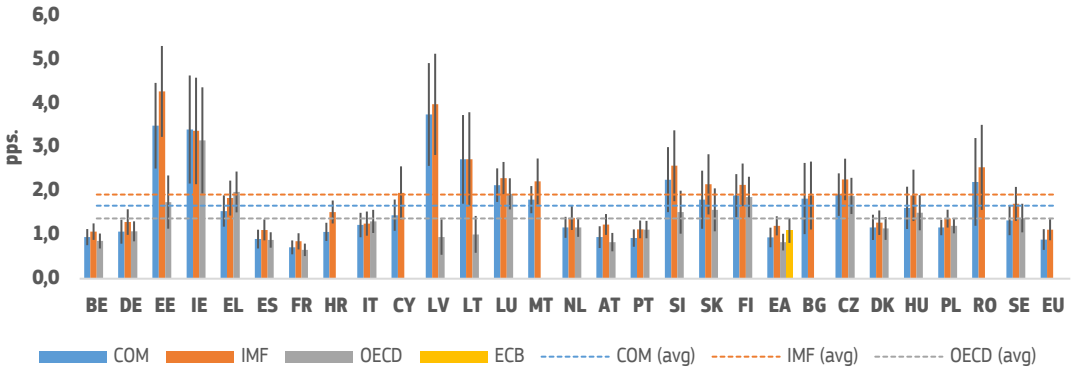


Notes: Error bars depict +/- one standard error of the mean absolute forecast error. Dashed lines depict averages across countries / regions.

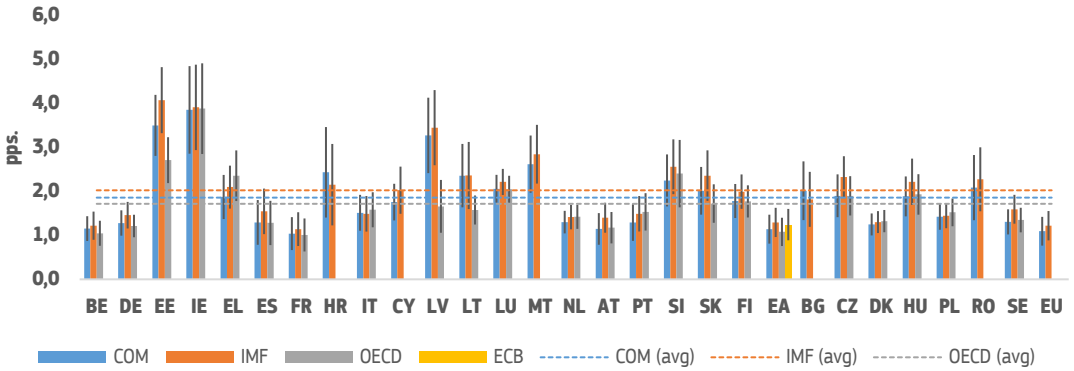
Source: EC, IMF, OECD, own calculations.

Graph I.5. **Mean absolute GDP forecast errors, year ahead**

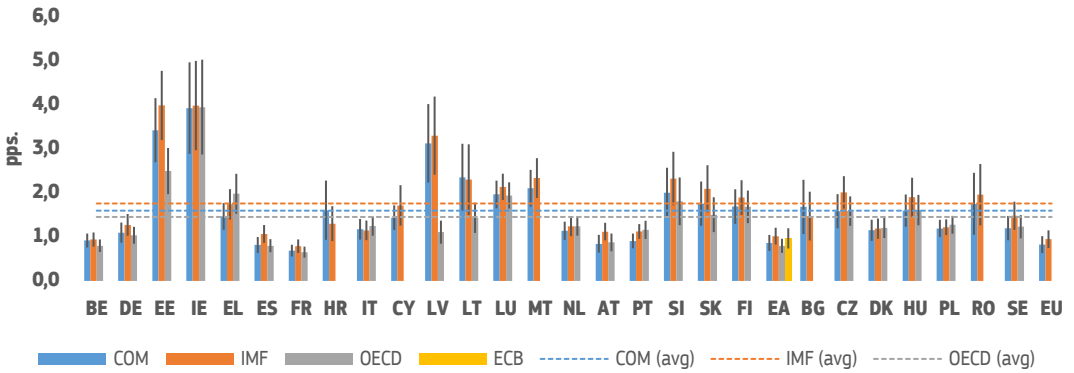
Period: 2000-2017



Period: 2000-2023



Period: 2000-2023 (ex 2020)



Notes: Error bars depict +/- one standard error of the mean absolute forecast error. Dashed lines depict averages across countries / regions.

Source: EC, IMF, OECD, own calculations.

ANNEX II - GM MODEL-BASED FORECAST ERROR DECOMPOSITIONS

II - 1. SCOPE

The analysis covers the period from Spring Forecast (SF) 2017 to SF 2024. Each year's relevant variables are forecasted 5 times: from the T-2 Autumn Forecast (AF) to the last AF before data release. Our dataset features 5 years (2019-2023) for which the path of the Forecast Error (FE) is full, and 2 years for which it is incomplete (2017-2018). We produce, for each year, the decomposition of the forecast error at each forecast round into 9 main components: Supply, Labour and goods market, Private demand, Fiscal, External drivers, Exchange rate, Energy, Monetary policy, and others. We consider 3 main variables for the EA: the growth of real GDP, consumption inflation and government deficit.

The aim of the exercise is to decompose the FE into various drivers, to identify patterns or systematic errors, and to illustrate how recent events have impacted the forecast process, through the lens of the GM model.

II - 2. METHODOLOGY

Since the goal is to assess the drivers of European Economic Forecast errors, and not the performance of the model, we use the same model specification across all forecast rounds. Specifically, we use the last version of the model, where parameters and shock processes have been estimated with the latest vintage available (SF 2024).

For each year, we compare the shock decomposition of the realised paths of our variables of interest (using SF T+1 vintage) to the shock decomposition obtained using vintages from previous forecast rounds. This yields 5 forecast errors and their decomposition for each year, from AF T-2 to AF T.

We use the model, in combination with the Kalman filter, as a smoothing tool to recover the series of shocks that best explain variations in the observed variables, given the structure of the model. Naturally, modelling choices influence the inferred series of shocks, and the interpretation of forecast errors is shaped by the underlying structural assumptions. However, since the shock decomposition of the forecast error reflects differences in shock decompositions and the model structure remains constant (including both its equations and estimated or calibrated parameters), the forecast error shock decompositions reveal how the model interprets innovations in data, forecasts, or external assumptions.

In mathematical terms, the Kalman filter can be represented as follows:

State Transition Equation

$$\boldsymbol{s_t = As_{t-1} + B\varepsilon_t}$$

Observation Equation

$$\boldsymbol{y_t = Cs_t}$$

Where:

- $\boldsymbol{s_t}$ is the state vector at time t, representing the latent variables of the DSGE model.
- $\boldsymbol{A}$ is the state transition matrix that governs the dynamics of the states.
- $\boldsymbol{B}$ is a matrix that maps the stochastic shocks ($\boldsymbol{\varepsilon_t}$) to the state variables.
- $\boldsymbol{\varepsilon_t}$ is a vector of exogenous shocks.

- $\boldsymbol{y_t}$ is a vector of observed variables at time t, such as output, inflation, and interest rates.
- **C** is the observation matrix that maps the states $\boldsymbol{s_t}$ to the observed variables $\boldsymbol{y_t}$.

Through the Kalman filter and smoothing algorithms, the observables have a moving average (MA) representation as a function of shocks and initial conditions. In the exercise we perform, matrices ***A***, ***B***, and ***C*** are constant, while $\boldsymbol{y_t}$ represents the information set we consider at each forecast round. Thus, each forecast round implies a different vintage for both $\boldsymbol{s_t}$ and $\boldsymbol{\varepsilon_t}$. The FE decomposition is the difference in the MA representation of the observables into shocks. In other words, it is the MA representation of the delta of the shocks retrieved by the Kalman filter using forecast data or ex-post realised data. Since the model structure (matrices ***A***, ***B***, and ***C***) is invariant, this MA representation in differences factors out the model effect, at least to a large extent. For example, differences in discount factor shocks will incorporate information on the forecast error in private consumption. Hence, in the FE shock decomposition of GDP or inflation, domestic demand shocks will convey information about the FE of domestic demand components.

It is also worth emphasising that $\boldsymbol{y_t}$ incorporates all available information at the time of the forecast round into the model: we observe all real GDP components and their deflators, employment, hours, wages, fiscal, and trade variables. In this sense, the exercise leverages full information, with the Kalman filter reconstructing the sequence of shocks conditional on the complete information set. For instance, domestic demand shocks in the FE decomposition incorporate information on the forecast errors of consumption and investment. Given the model's structural nature and the full-information approach, it is not entirely accurate to attribute a specific shock exclusively to a change in an external assumption or a forecasted variable.

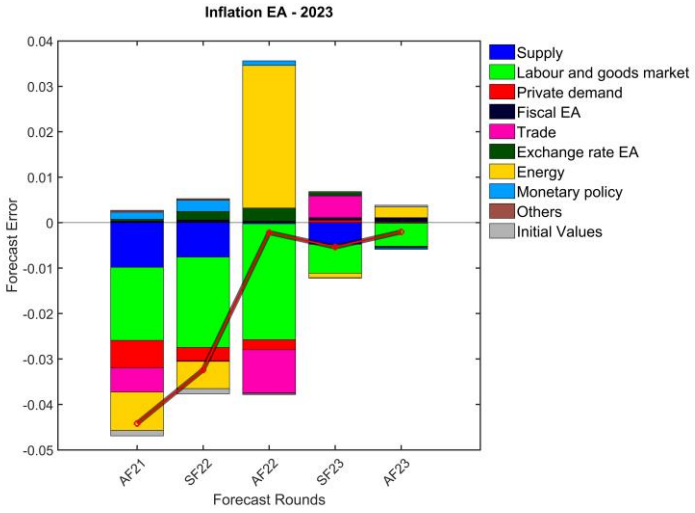
For example, in the model, the central bank's interest rate follows a Taylor rule, responding to inflation gap to target and GDP growth deviations from long run growth. Monetary policy shocks, therefore, represent deviations of the assumed or realised policy rate trajectory from the level prescribed by this rule. Consequently, monetary policy shocks in the decompositions may stem from revisions in observed variables that influence the model-implied policy rate (directly or indirectly) or adjustments to the assumed path of the policy rate itself.

II – 3. ILLUSTRATED EXAMPLES

II – 3.1. Forecast Error for a Given Year

Graph II.1 below displays the forecast error of consumption inflation in 2023. It is computed as the realised value of inflation minus the forecast value in each forecast round. A **negative value** thus represents an **underprediction** of inflation, while a **positive value** represents an **overprediction**. We can see that during AF 2021 and SF 2022, there was a large underprediction of inflation, mainly explained by labor and goods markets factor, but also by energy prices. In AF 2022, the energy prices hike was assumed to be persistent, while it was ultimately temporary. The result is a large overprediction of the impact of energy prices in AF 2022 on inflation for 2023. For SF and AF 2023, the forecast was much better and converged to the realised value.

Graph II.1. **Inflation Forecast Error Decomposition – 2023**



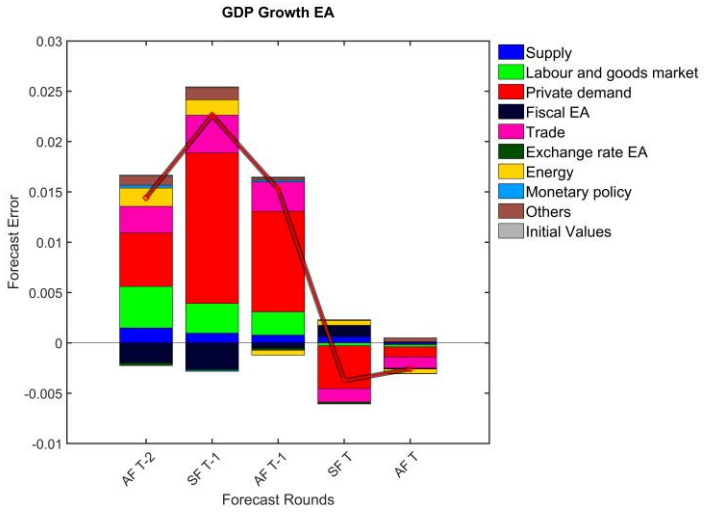
Source: EC, Eurostat, own calculations.

It is important to note two things. First, the absolute value of the FE doesn't tell the full story. The size of bars gives an indication of how wrong assumptions about future shocks were at the time of the forecast. For instance, the FE in AF 2022 was small, but only thanks to two main compensating assumptions on the dynamics of labor and goods markets and energy prices. We can obtain such a result given that we use full information in the Kalman Filter, as described in the methodology section. This includes variables beyond external assumptions, such as labor market variables. It is also interesting to see that, most of the time, the size of these bars is decreasing, together with the FE itself.

II - 3.2. Mean Forecast Error

Graph II.2 below displays the mean FE of real GDP growth and its contributing factors for each forecast horizon. As it is average, it gives more weight to the outliers and the Covid period is clearly visible. To overcome this issue, we also provide mean contribution of each factor in the next section, such that the size of the FE does not bias the mean.

Graph II.2. **GDP Mean Forecast Error Decomposition**



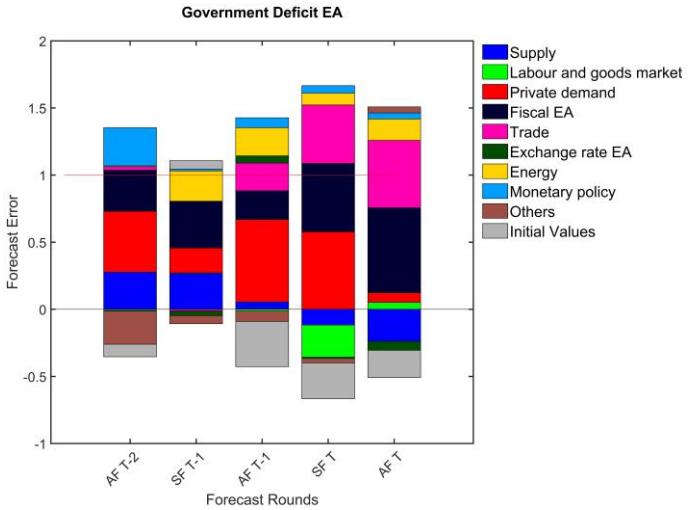
Source: EC, Eurostat, own calculations.

We can see that, on average, a sizable part of the FE of real GDP growth can be attributed to private demand factors. Interestingly, real GDP growth tends to be over-predicted from 10 to 6 quarters ahead, but the FE turns positive for the last two forecast rounds. Labor and goods markets variables are also an important contributor to this FE when the forecast horizon is large, but their importance dies out quickly as we get closer to the data release date.

II – 3.3. Contribution to the Forecast Error

Graph II.3 below displays the mean contribution of each factor to the FE of the change in government deficit, for each forecast round. Each bar is normalised, such that the sum of all the components is always one. If a factor is represented with a positive bar, it means that it went in the same direction as the FE. For instance, we see that assumptions about fiscal and private demand components always contribute to the FE, while some other factors can sometimes compensate and tend to lower the FE.

Graph II.3. **Contribution to Government Deficit Forecast Error Decomposition**



Source: EC, Eurostat, own calculations.

Note that a small bar does not necessarily mean that the contribution of this factor is always small. Since it is an average over all forecast years in our sample, it could be that there is positive and negative contributions that compensate over the various years. Thus, this exercise highlights systematic factors for which the contribution is consistently positive or negative. It is also worth noting that, contrary to the two previous sections, the size of bars should not be interpreted as the re-scaling blurs the picture.

II - 4. ADDITIONAL FIGURES

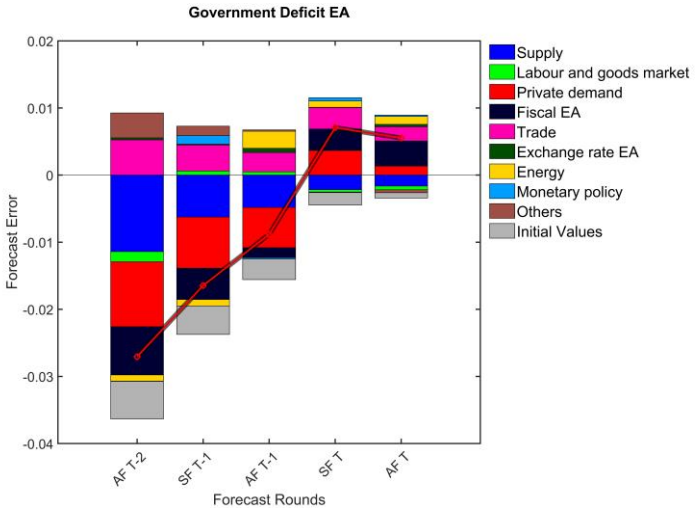
In this section, we present and briefly comment on figures not previously discussed in the main text or elsewhere in this appendix. To maintain conciseness, we do not include year-by-year decompositions for each variable. Since average contributions were already discussed for the three variables under study and the decomposition of the mean forecast error was discussed in the previous section, we are left with two figures: the mean forecast error for inflation and for the government deficit.

As shown in Graph II.4 and

Graph II.5, the mean forecast error tends to decline over time, indicating that forecasters continuously learn about the state of the economy and adjust their projections toward actual outcomes. This trend is particularly pronounced for inflation, where the average learning curve over the period studied appears almost linear.

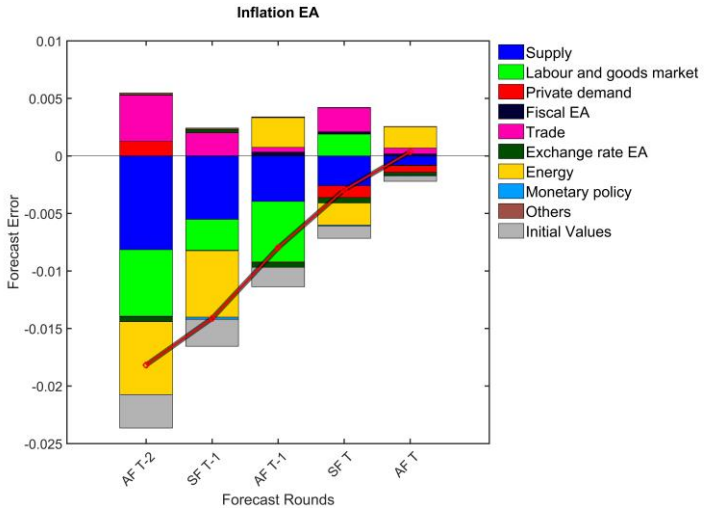
Regarding the main drivers of forecast errors, the dominant factors for inflation were energy prices, labor and goods market conditions, and supply-side elements. Expectations about the global environment also contributed, leading on average to an overestimation of inflation during the period. While fiscal factors played only a marginal role in explaining inflation forecast errors, they had a more substantial impact on government deficit forecasts. Specifically, fiscal assumptions tended to result in underpredictions of the deficit when the forecast was made more than a year ahead of the data release, with the sign reversing as the release date approached. A similar pattern holds for private demand factors.

Graph II.4. **Government Deficit Mean Forecast Error Decomposition**



Source: EC, Eurostat, own calculations.

Graph II.5. **Inflation Mean Forecast Error Decomposition**



Source: EC, Eurostat, own calculations.

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