



EUROPEAN CENTRAL BANK
EUROSYSTEM

Occasional Papers Series

Béla Szörfi The factors behind output gap
revisions

No 399

Contents

Abstract	2
Non-technical summary	3
1 Introduction	6
2 Data and methodology	11
2.1 Data	11
2.2 Methodology	13
3 Results	18
3.1 Decomposition of output gap revisions	18
3.2 Revisions of potential growth – a panel data assessment	23
4 Conclusions	25
References	27
Annex	29

Abstract

Estimates of potential output and the output gap are widely used in monetary, fiscal and structural policy analysis, but they are unobservable and subject to substantial real-time uncertainty. This paper examines revisions to output gap and potential growth estimates produced by the European Commission, the Eurosystem, the International Monetary Fund (IMF) and the Organisation for Economic Co-operation and Development (OECD) for the euro area and its member countries. Using annual forecast vintages covering up to 20 euro area countries from 2002 to 2025 and a balanced panel of 11 countries from 2007 to 2025, the paper compares the reliability of estimates across institutions, decomposes output gap revisions into their main sources and estimates the impact of real GDP data revisions and forecast errors on potential growth revisions. The results show sizeable differences across institutions: European Commission estimates revise least in the balanced country sample, OECD estimates revise most, and Eurosystem estimates have become markedly more stable over the past decade. Output gap revisions are driven mainly by revisions to real GDP data and potential growth, while nowcast errors play a smaller role. Panel regressions show that both real GDP data revisions and medium-term forecast errors are significantly associated with revisions to potential growth, implying that revised or unexpected GDP developments are to some extent absorbed into estimates of potential growth. The findings highlight the uncertainty surrounding real-time output gap estimates and support the use of complementary indicators of economic slack.

JEL codes: E23, E27, E32, C53, C82

Keywords: potential output, output gap, real-time estimation, data revisions, forecast errors, potential growth, euro area

Non-technical summary

Estimates of potential output and the output gap are important inputs into monetary, fiscal and structural policy analysis. Potential output is commonly understood as the level of economic activity that can be sustained over the medium term without generating inflationary pressures, while the output gap measures the deviation of actual output from this level. These concepts are used, for example, to assess inflationary pressures, the cyclical position of the economy, structural fiscal balances and the stance of macroeconomic policies. However, neither potential output nor the output gap is directly observable. They have to be estimated, and estimates are subject to considerable uncertainty, especially in real time.

This uncertainty matters because real-time estimates are often revised substantially. The stability of potential output and output gap estimates across vintages is one, albeit important, property of such estimates. Their role in signalling the underlying growth of the economy, the state of the business cycle and inflationary pressures, as well as driving macroeconomic forecasts, is vital for economists. However, a policy assessment based on the output gap available at the time may look different when assessed later using revised data and updated estimates, and ex post, the above-mentioned signals might prove to be wrong. Revisions of the output gap can arise for several reasons. First, the underlying macroeconomic data, especially real GDP, are themselves revised by statistical authorities. Second, estimates of potential output are often based not only on historical data but also on forecasts, which may later turn out to be inaccurate. Third, revisions may reflect changes in estimation methods, model parameters or expert judgement. Understanding the relative importance of these sources is important for assessing how much confidence should be placed in real-time estimates of economic slack.

This paper studies revisions to output gap and potential growth estimates produced by four institutions: the European Commission, the Eurosystem, the International Monetary Fund (IMF) and the Organisation for Economic Co-operation and Development (OECD). The analysis uses annual vintages of estimates for the euro area and its member countries. The four institutions use different methodologies to estimate potential output and the output gap. The European Commission applies a production function method and estimates the labour, capital and total factor productivity contributions. The estimates, methodology and codes are public, and everyone can replicate the estimates. The Eurosystem uses various methods for its Member States, but all are organised around the production function. The estimates and the methods are confidential; however, some national central banks publish their own estimates from time to time. Potential output estimates of euro area countries by the IMF are produced by country desks. These are based on different methods. The estimates are published twice a year in the World Economic Outlook, albeit not always. The OECD also uses a production function with labour, capital and labour efficiency as inputs to production. The estimates are published in the OECD Economic Outlook.

The dataset covers up to 20 euro area countries over the period 2002-25, depending on data availability, and a balanced panel of 11 countries over the period 2007-25. The paper compares the reliability of estimates across institutions, where reliability is defined as the extent to which real-time estimates differ from later, ex post estimates. It also decomposes output gap revisions into contributions from revisions to real GDP data, real GDP nowcast errors, revisions to potential growth and revisions to the initial output gap. In addition, it uses panel regressions to assess the extent to which real GDP data revisions and forecast errors are transmitted into revisions of potential growth.

The results show that output gap estimates are often revised, but the size of revisions differs across institutions and over time. For the balanced sample of 11 euro area countries, the absolute value of revisions is the smallest for the European Commission estimates, followed by the Eurosystem and the IMF, while OECD estimates revise the most. Since the global financial crisis, the European Commission, the Eurosystem and the IMF have displayed broadly similar reliability, whereas OECD estimates have remained less stable. The reliability of Eurosystem estimates has improved markedly over the past decade, likely reflecting a more systematic cross-country review of supply-side estimates and the introduction of the Annual Supply Side Review. For the euro area aggregate, the European Commission and the IMF show the lowest revisions according to the revision indicators, while Eurosystem estimates have also become more reliable since 2013. However, the apparent stability of IMF estimates for individual years should be interpreted with caution, as the IMF tends to revise the historical output gap series more extensively than the European Commission and the Eurosystem.

The decomposition of output gap revisions shows that revisions to real GDP data and revisions to potential growth account for a large share of output gap revisions. The role of real GDP data revisions is particularly important. This finding contrasts with some earlier studies, which concluded that statistical data revisions played only a minor role. One reason for the difference is methodological: this paper defines the real-time estimate for a given year as the estimate published in the autumn of that same year, when some of the year's data are already available, rather than as the estimate published in the previous year. This makes it possible to distinguish more clearly between nowcast errors and later statistical data revisions. The paper also reduces the residual role of the initial output gap by tracing cumulative real GDP and potential growth revisions further back in time. The results indicate that data revisions are especially relevant in some countries, such as Belgium, Cyprus, Malta and the Netherlands. In other cases, such as Spain, average revisions can understate the importance of data revisions because large positive and negative revisions offset each other over time.

Nowcast errors in real GDP growth play a smaller role in output gap revisions than data revisions and potential growth revisions. This is likely because, by the time autumn forecast exercises are finalised, information for a substantial part of the current year is already available. By contrast, medium-term forecast errors can have a more important effect on potential growth estimates. If real GDP growth turns out to be weaker than expected, potential growth is often revised down, including for past years.

This can happen because many estimation methods and forecasting practices tend to smooth fluctuations in GDP and often imply that the output gap closes over the projection horizon. As a result, part of an unexpected shortfall in actual GDP may be interpreted ex post as a lower level or growth rate of potential output.

The panel regression results confirm this mechanism. Across institutions and countries, both real GDP data revisions and real GDP forecast errors are statistically significant determinants of potential growth revisions. In the balanced sample, the estimates suggest that around half of real GDP data revisions and more than one-third of real GDP forecast errors are transmitted into revisions of potential growth. In the broader unbalanced sample, the estimated effects are somewhat larger and remain statistically significant. For the European Commission, these results are robust in controlling for revisions to working age population and capital stock data. At the same time, a sizeable portion of potential growth revisions remains unexplained, which may reflect model properties, methodological changes, judgement or the sensitivity of trend-cycle decompositions to the addition of new observations.

The findings have important implications for policy analysis. Output gap and potential output estimates are useful analytical tools, but they should not be interpreted as precise real-time measures of economic slack or supply capacity. Revisions to statistical data cannot be avoided, and they will inevitably affect estimates of both actual and potential output. However, the transmission of forecast errors into historical potential output estimates deserves particular attention, especially when such revisions are interpreted as evidence of structural changes in the economy. Policymakers and researchers should therefore use output gap estimates together with a broader set of indicators, including measures based on observed data that are less frequently revised, such as survey evidence on capacity utilisation or demand as a factor limiting production. Regular expert review, transparency about methods and a careful assessment of the economic plausibility of supply-side narratives can also help mitigate the risks associated with relying on uncertain real-time estimates.

1 Introduction

Potential output and the output gap are central concepts in macroeconomic policy analysis. Potential output is commonly understood as the level of output that can be sustained over the medium term without generating inflationary pressures, while the output gap measures the deviation of actual output from this level.¹ These estimates are used to assess the cyclical position of the economy, the degree of inflationary pressure, the stance of monetary and fiscal policy, and the sustainability of public finances. They also enter a wide range of analytical tools, including Phillips curve models, estimates of the natural rate of interest, Taylor rules and measures of the structural fiscal balance. As a result, revisions to potential output and output gap estimates can materially change the ex post interpretation of past economic conditions and, in some cases, the assessment of policy decisions taken in real time.

Neither potential output nor the output gap is observable. They have to be estimated, and estimates are subject to substantial uncertainty. This uncertainty has several sources. First, different models and institutional approaches can produce different estimates, even when applied to the same data. Second, within any given model, parameters and unobserved components are estimated with uncertainty. Third, the underlying macroeconomic data, most notably real GDP, are themselves revised over time. Fourth, potential output estimates are often based on data samples that include forecasts, and forecast errors can therefore affect not only estimates for the projection horizon but also estimates of potential output and the output gap in recent history. These sources of uncertainty are particularly relevant around turning points and large shocks, such as the global financial crisis and the COVID-19 pandemic, when distinguishing between cyclical and structural developments is especially difficult.

This uncertainty matters for policy. For central banks, the output gap is one of the indicators used to assess demand pressures and the outlook for inflation. Revisions to the output gap can therefore affect the estimated relationship between slack and inflation, including the slope of the Phillips curve, and can influence the interpretation of whether inflation developments are mainly driven by demand, supply or cost-push factors. Potential output estimates also affect estimates of the natural rate of interest and, consequently, assessments of the monetary policy stance. For fiscal policy, output gap estimates are used to distinguish cyclical from structural budgetary developments. If real-time estimates of slack are later revised substantially, estimates of structural balances and fiscal space may also change. More generally, if weak GDP growth is later reclassified as lower potential growth, rather than as a larger negative output gap, the diagnosis of the economy may shift from insufficient demand to weaker supply capacity, with different policy implications.

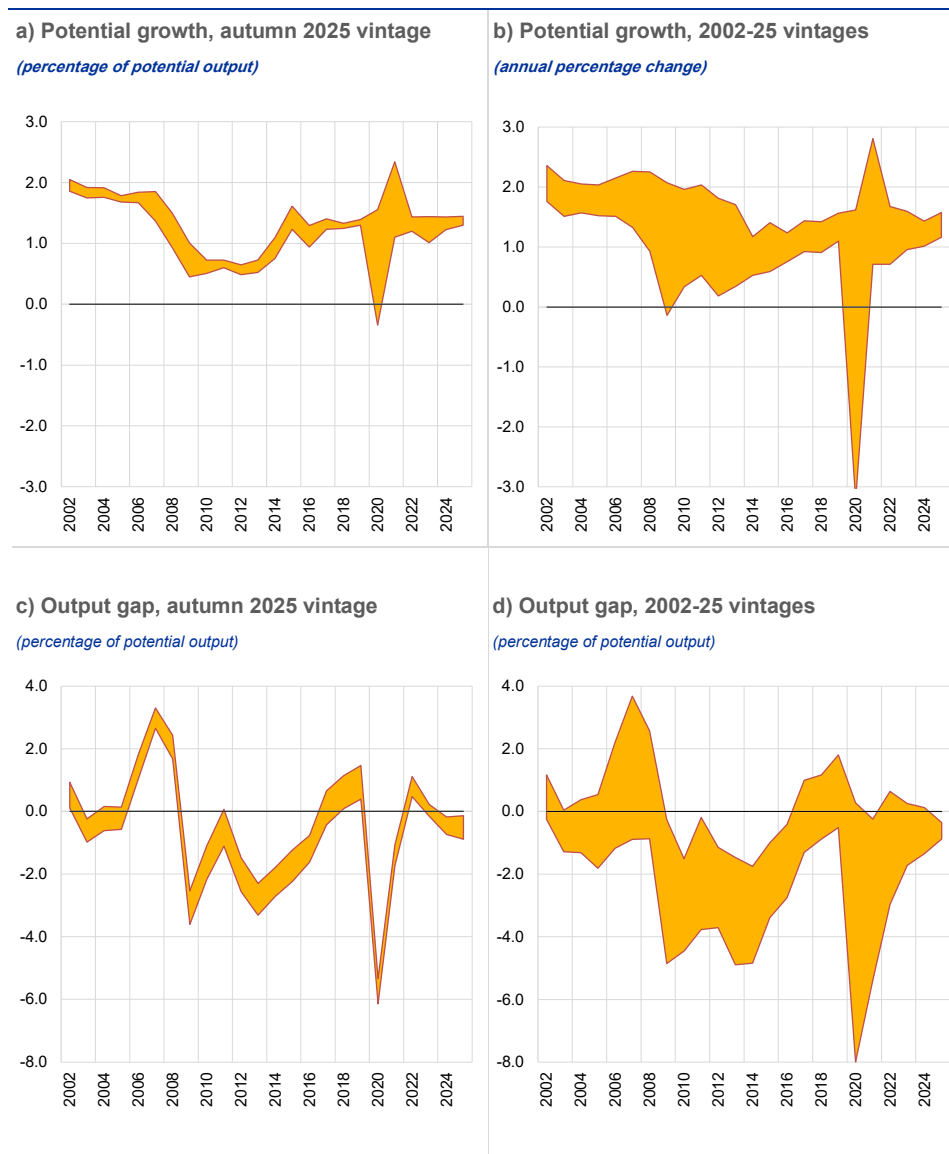
The reliability of potential output and output gap estimates is therefore an important empirical question. In this paper, reliability is defined as the extent to which real-time estimates differ from later, ex post estimates. [Chart 1](#) illustrates this issue for the euro area. The range of estimates across institutions (the European Commission,

¹ See, for example, Andersson et al. (2018).

Eurosystem, International Monetary Fund (IMF) and Organisation for Economic Co-operation and Development (OECD)) in the latest vintage captures uncertainty related to different modelling approaches and judgement. However, the range becomes considerably larger when estimates from different vintages are also considered. This shows that uncertainty is not only a matter of disagreement across institutions at a given point in time; it also reflects the fact that the same institution may revise its assessment of the past as new data, forecasts and judgement become available. Considering both real-time and ex post estimates of the four institutions analysed in this paper, it is difficult to pin down precisely the euro area's potential growth rate or output gap, either in real time or for some historical periods.

Chart 1

Range of potential growth and output gap estimates across institutions, euro area



Sources: European Commission, Eurosystem, IMF and OECD.

The low reliability of real-time output gap estimates is well documented. Orphanides and van Norden (2002) show that policy recommendations based on real-time output

gap estimates can differ substantially from those based on revised estimates, with revisions being particularly large around business cycle turning points. Nelson and Nikolov (2001) and Kangur et al. (2019) question the usefulness of real-time output gap estimates for inflation analysis, while Kangur et al. also argue that output gap revisions may contribute to fiscal policy errors, including excessive deficits and debt accumulation. Coibion, Gorodnichenko and Ulate (2018) show that potential output estimates respond not only to supply shocks but also to demand shocks, even when the latter have only transitory effects on output. This raises the concern that estimates of potential output may partly absorb cyclical developments and that revisions to potential output may sometimes reflect statistical or filtering properties rather than genuine structural changes.

For Europe, Darvas (2015) compares output gap revisions by the European Commission and the IMF for EU countries and documents large revisions in both sets of estimates. He also highlights several possible sources of revisions, including statistical data revisions, forecast errors and methodological changes. However, the relative importance of these sources is not quantified. This distinction is important. If revisions mainly reflect statistical revisions to real GDP, then they are largely unavoidable, although their implications for the interpretation of the cycle and the trend still need to be assessed carefully. If revisions mainly reflect forecast errors, then the use of forecasts to mitigate end point problems in trend-cycle decompositions may itself be an important source of instability. If revisions mainly reflect methodological changes, then users of the estimates should distinguish changes in the economic assessment from changes in the estimation framework.

Hernández de Cos, Lacuesta and Moral-Benito (2016) analyse real-time revisions of European Commission output gap estimates for 15 European countries using vintages between 2002 and 2014. They introduce a decomposition of output gap revisions into statistical data revisions and real GDP forecast errors, although this part of the analysis is conducted only for Spain. They conclude that revisions to output gap levels are primarily due to macroeconomic forecasting errors, while data updates play only a minor role. However, two features of their approach may affect this conclusion. First, averaging revisions over time can understate the importance of a component when positive and negative revisions offset each other. Second, their definition of the real-time estimate for year t as the estimate made in autumn of year $t-1$ blurs the distinction between forecast errors and statistical data revisions, since no official data for year t are yet available in year $t-1$. Ademmer et al. (2019) focus on Germany and use European Commission vintages between 2005 and 2017, together with replications of the Commission methodology, to assess the role of methodological changes. They find that potential output and output gap estimates are subject to significant revisions, especially around recessions, and that short-term forecast errors are an important source of revisions.

This paper contributes to the literature in three ways. First, it uses a broader dataset than previous studies. I analyse annual vintages of potential output, output gap and real GDP estimates produced by four institutions – the European Commission, the Eurosystem, the IMF and the OECD – for the euro area and its member countries. The dataset covers up to 20 euro area countries over the period 2002-25, depending on

data availability, and a balanced panel of 11 countries over the period 2007-25. This makes it possible to compare the reliability of estimates across institutions and countries using a common framework.

Second, the paper decomposes output gap revisions into their main sources for the full sample, rather than for a single country. The decomposition distinguishes between revisions due to real GDP data revisions, real GDP nowcast errors, revisions to potential growth and revisions to the initial output gap. Compared with Hernández de Cos, Lacuesta and Moral-Benito (2016), the paper makes two methodological refinements. The real-time estimate for year t is defined as the estimate published in autumn of year t , when partial information for the year is already available, rather than as the estimate published in autumn of year $t-1$. This allows a clearer distinction between nowcast errors and subsequent statistical data revisions. In addition, the initial output gap revision is pushed back as far as possible by attributing cumulative revisions in real GDP and potential growth to the years before the first available vintage. This reduces the residual role of the initial output gap and provides a more informative decomposition of revisions.

Third, the paper analyses revisions to potential growth directly. In particular, it estimates panel regressions to assess the extent to which real GDP data revisions and real GDP forecast errors are transmitted into revisions of potential growth. This is important because output gap revisions can arise not only from revisions to actual GDP but also from revisions to the estimated path of potential output. If forecast errors are systematically absorbed into potential growth estimates, then estimates of supply capacity may partly reflect unexpected cyclical developments. This has implications for the interpretation of potential output revisions, especially after large shocks.

The results show that output gap estimates are often revised substantially, although the size of revisions differs across institutions. In the balanced sample of 11 euro area countries, European Commission estimates have the smallest absolute revisions over the full sample, while OECD estimates revise the most. Eurosystem estimates have become markedly more reliable over the past decade and are recently close to those of the European Commission. For the euro area aggregate, the European Commission and the IMF show the lowest revisions according to the main revision indicators, while Eurosystem estimates have also become more stable since 2013. However, the apparent stability of IMF estimates for individual years should be interpreted with caution, as the IMF tends to revise the historical output gap series more extensively than the European Commission and the Eurosystem.

The decomposition shows that real GDP data revisions and potential growth revisions account for a large share of output gap revisions. The prominent role of statistical data revisions contrasts with some earlier findings. Data revisions are especially important in countries such as Belgium, Cyprus, Malta and the Netherlands. In other cases, such as Spain, average revisions can understate the importance of data revisions because large positive and negative revisions offset each other over time. Nowcast errors play a smaller role, most likely because autumn forecast exercises already incorporate information for a substantial part of the current year. The panel regressions further show that both real GDP data revisions and real GDP forecast errors are statistically significant determinants of potential growth revisions. In the balanced sample, around

half of real GDP data revisions and more than one-third of real GDP forecast errors are transmitted into revisions of potential growth. These findings suggest that some revised or unexpected GDP developments are absorbed into estimates of the economy's supply potential.

The policy implication is not that output gap and potential output estimates should be disregarded. They remain useful organising concepts for macroeconomic analysis. However, they should be interpreted with caution, especially in real time and around large shocks. Revisions to statistical data are unavoidable, but the transmission of forecast errors into historical potential output estimates deserves particular attention. Policymakers and researchers should therefore complement output gap estimates with a broader set of indicators of economic slack, including indicators based on observed data that are less frequently revised, such as survey measures of capacity utilisation or demand as a factor limiting production. Regular expert review and transparency about methods and judgement can also help assess whether revisions to potential output reflect genuine structural developments or the mechanical properties of estimation methods.

The remainder of the paper is structured as follows. Section 2 describes the data and methodology. Section 3 presents the results, including the decomposition of output gap revisions and the panel regression analysis of potential growth revisions. Section 4 concludes.

2 Data and methodology

2.1 Data

For the analysis I use real-time estimates of potential output and the output gap from four international institutions: the European Commission, the Eurosystem, the IMF and the OECD. Throughout the paper, the real-time estimate for year t is defined as the estimate for year t contained in the last regular forecast or projection vintage of calendar year t . For the European Commission, IMF and OECD this corresponds to the autumn forecast or outlook vintage, while for the Eurosystem it corresponds to the December projection vintage. For simplicity, the paper refers to these as autumn or end-year vintages. The autumn 2025 vintage is used as the final vintage. Revisions are calculated for real-time years up to 2024, since for 2025 no subsequent vintage is yet available to separate nowcast errors from later data revisions.

These institutions apply different methodologies to estimate potential output and the output gap. Havik et al. (2014) and Arévalo et al. (2026) describe the commonly agreed methodology (EU-CAM) of the European Commission. Components of the production function, i.e. trend labour, trend total factor productivity (TFP) and capital, and trends within the labour contribution (trend labour force participation, the non-accelerating wage rate of unemployment (NAWRU), trend hours worked per person), are estimated separately and then aggregated to provide potential output. The NAWRU and trend TFP are estimated with multivariate Kalman-filters, while trend labour force participation rate and trend hours worked per person are estimated using a Hodrick-Prescott filter. Working age population and the capital stock enter the production function without being de-trended. The same method is applied to all EU Member States, with fairly limited country-specific variations. It is worth noting that the European Commission is the most transparent in that the models, codes and estimates are public and can be replicated by the general public. Potential output estimates are published twice a year with the spring and autumn forecasts.

The Eurosystem prepares its potential output estimates in the context of its quarterly macroeconomic projections.² In this paper, I use the last, December projections from each of the four international institutions (European Commission, Eurosystem, IMF, OECD). In the December exercises, Eurosystem potential output estimates are conducted by the national central banks (NCBs) for each Member State and are then discussed and finalised jointly with ECB staff. NCBs use different macromodels and/or satellite models to estimate potential output (see Section 3 of ECB, 2016), often reflecting specific properties of euro area economies or differences in available data. Most NCBs use a production function approach, similar to the method of the European Commission. The euro area aggregate is produced by aggregating the country estimates. The estimates of the Eurosystem are confidential and are not published by the ECB.

² See ECB (2016) and the [ECB website](#).

Potential output estimates of euro area countries by the IMF are produced by country desks. These are based on different methods, similar to the practice of the Eurosystem. Some of the IMF estimates are based on a multivariate filter (see Benes et al., 2010, Blagrove et al., 2015, and Alich et al., 2015). The filter uses three variables (real GDP, consumer price index inflation and the unemployment rate) and employs the economic relationships between the output gap and inflation (the Phillips curve) and between the output gap and the unemployment gap (Okun's law). However, the exact specification the IMF country desks use when estimating potential output is not well documented. The estimates are published twice a year in the World Economic Outlook.

The approach of the OECD to estimate potential output is very similar to that of the European Commission, and it is discussed in detail in Chalaux and Guillemette (2019). The OECD also uses a Cobb-Douglas production function with labour, capital and labour efficiency as inputs to production. The trend unemployment rate used to be estimated with a Kalman filter within a forward-looking Phillips curve; in more recent years, however, the trend unemployment rate has no longer been estimated separately. The OECD estimates trend employment directly, rather than aggregating trend unemployment, trend labour force participation rates and the working age population. Other trend components are estimated with the Hodrick-Prescott filter. Estimates of the OECD are published twice a year with the data and projections of the OECD Economic Outlook.

The different approaches across the four institutions result in different estimates of potential output and the output gap. The range of euro area estimates across the four institutions based on the most recent vintages (autumn 2025) are presented in [Chart 1](#) of Section 1. This chart also illustrates the uncertainty related to the modelling approach. In particular, institutions differ in their assessment of the short-term impact of the COVID-19 pandemic on potential output: the range of potential growth estimates, which is smaller than half a percentage point most of the time, becomes close to 2 percentage points in 2020.

The data used for the analysis in this paper contain annual real-time estimates of potential output and the output gap from 2002 to 2025 (European Commission), 2007 to 2025 (Eurosystem), 2004 to 2025 (IMF), and 2000 to 2025 (OECD). Vintages of real GDP data are also obtained from the forecast databases of the four institutions. For the euro area aggregate, I use the aggregate series published by each institution, where available. Country-level results are based on the vintages listed in [Table 1](#). The balanced country panel is used to compare institutions on a like-for-like basis, while the unbalanced panel exploits the maximum available information but is not used for direct cross-institution comparisons. Using all the available data provides an unbalanced panel. The largest balanced panel available is composed of the data of 11 countries³ and the years between 2007 and 2025.

³ These are Germany, Spain, France, Italy, the Netherlands, Austria, Belgium, Greece, Ireland, Luxembourg and Portugal

Table 1

Availability of data vintages

(year of first available vintage)	European Commission	Eurosystem	IMF	OECD
DE	2002	2007	2004	1999
ES	2002	2007	2004	1999
FR	2002	2007	2004	1999
IT	2002	2007	2004	1999
NL	2002	2007	2004	1999
AT	2002	2007	2004	1999
BE	2002	2007	2004	1999
CY	2004	2007	2004	n/a
EE	2004	2010	2010	2011
FI	2002	2008	2004	1999
GR	2002	2007	2004	1999
IE	2002	2007	2004	2005
LT	2004	2014	2015	2019
LU	2003	2007	2004	2005
LV	2004	2013	2014	2014
MT	2004	2007	2008	2022
PT	2002	2007	2004	1999
SK	2004	2008	2009	2009
SI	2004	2007	2007	2011
HR	2012	2022	2010	2022
EA	2002	2006	2004	1999

Source: ECB Statistical Data Warehouse, based on ECB, European Commission, OECD and IMF data.

2.2 Methodology

2.2.1 Decomposition of output gap revisions

Revisions of the output gap can be decomposed into revisions of potential growth, nowcast errors of real GDP growth, statistical data revisions of real GDP growth, and revisions of the initial output gap estimate. The decomposition is based on the methodology proposed by Hernández de Cos, Lacuesta and Moral-Benito (2016), and I improve that method in two main aspects. First, I define real-time estimates as estimates published in autumn of year t for year t .⁴ Hernández de Cos, Lacuesta and Moral-Benito define real-time estimates as the estimates made in autumn $t-1$; however, in $t-1$, no published data or information is available about year t , and therefore the potential output and output gap estimate relies on forecast, rather than on real-time, data. This makes the decomposition between data revisions and forecast revisions unclear. As a “final” estimate of potential output, the output gap and real

⁴ For example, the real-time estimate of the output gap for year 2013 corresponds to the estimate published in autumn 2013.

GDP, I use the latest available vintages at the time of writing, which were published in autumn 2025. Revisions are defined as the difference between the final and the real-time data for each year of the sample:

$$\text{revision of real GDP level: } rev(y_t) = y_t^F - y_t^{RT}$$

$$\text{revision of the output gap: } rev(\hat{y}_t) = \hat{y}_t^F - \hat{y}_t^{RT}$$

$$\text{revision of potential output level: } rev(\bar{y}_t) = \bar{y}_t^F - \bar{y}_t^{RT}$$

where superscript F denotes the final estimate, i.e. the estimate in the autumn 2025 forecast, and superscript RT denotes the real-time estimate as defined above.

The output gap is decomposed in the following way. The revision of the first observation in a sample, i.e. the initial output gap in $t=0$, can be decomposed as:

$$rev(\hat{y}_0) = \hat{y}_0^F - \hat{y}_0^{RT} = \frac{y_0^F - \bar{y}_0^F}{\bar{y}_0^F} - \frac{y_0^{RT} - \bar{y}_0^{RT}}{\bar{y}_0^{RT}} \approx (\ln y_0^F - \ln \bar{y}_0^F) - (\ln y_0^{RT} - \ln \bar{y}_0^{RT})$$

Similarly, for $t=1$,

$$rev(\hat{y}_1) = \hat{y}_1^F - \hat{y}_1^{RT} = \frac{y_1^F - \bar{y}_1^F}{\bar{y}_1^F} - \frac{y_1^{RT} - \bar{y}_1^{RT}}{\bar{y}_1^{RT}} \approx (\ln y_1^F - \ln \bar{y}_1^F) - (\ln y_1^{RT} - \ln \bar{y}_1^{RT})$$

Adding and subtracting $\ln y_0^F, \ln y_0^{RT}, \ln \bar{y}_0^F, \ln \bar{y}_0^{RT}$ yields:

$$\begin{aligned} rev(\hat{y}_1) = & [(\ln y_1^F - \ln y_0^F) - (\ln y_1^{RT} - \ln y_0^{RT})] - [(\ln \bar{y}_1^F - \ln \bar{y}_0^F) - (\ln \bar{y}_1^{RT} - \ln \bar{y}_0^{RT})] \\ & + (\ln y_0^F - \ln \bar{y}_0^F) - (\ln y_0^{RT} - \ln \bar{y}_0^{RT}) \end{aligned}$$

i.e. the revision of the output gap estimate of $t=1$ is (approximately) equal to the revision of real GDP growth and revision of potential growth of $t=1$, plus the initial revision of the output gap⁵:

$$rev(\hat{y}_1) = [(\Delta \ln y_1^F - \Delta \ln y_1^{RT}) - (\Delta \ln \bar{y}_1^F - \Delta \ln \bar{y}_1^{RT})] + rev(\hat{y}_0)$$

The same logic can be followed for any t until the last but final vintage. Therefore, the revision of the output gap in any year t is the sum of the revision of cumulative real GDP growth, the revision of cumulative potential growth and the revision of the initial output gap.

$$rev(\hat{y}_t) = \sum_{j=1}^t (\Delta \ln y_j^F - \Delta \ln y_j^{RT}) - \sum_{j=1}^t (\Delta \ln \bar{y}_j^F - \Delta \ln \bar{y}_j^{RT}) + rev(\hat{y}_0)$$

The second improvement compared with Hernández de Cos, Lacuesta and Moral-Benito (2016) is that I push back the time of the initial revision of the output gap. In Hernández de Cos, Lacuesta and Mora-Benito (2016), the first vintage of estimates is autumn 2004 and the initial output gap revision is the revision of 2004. However, for instance, the European Commission's estimate of the real-time output gap of 2004 for

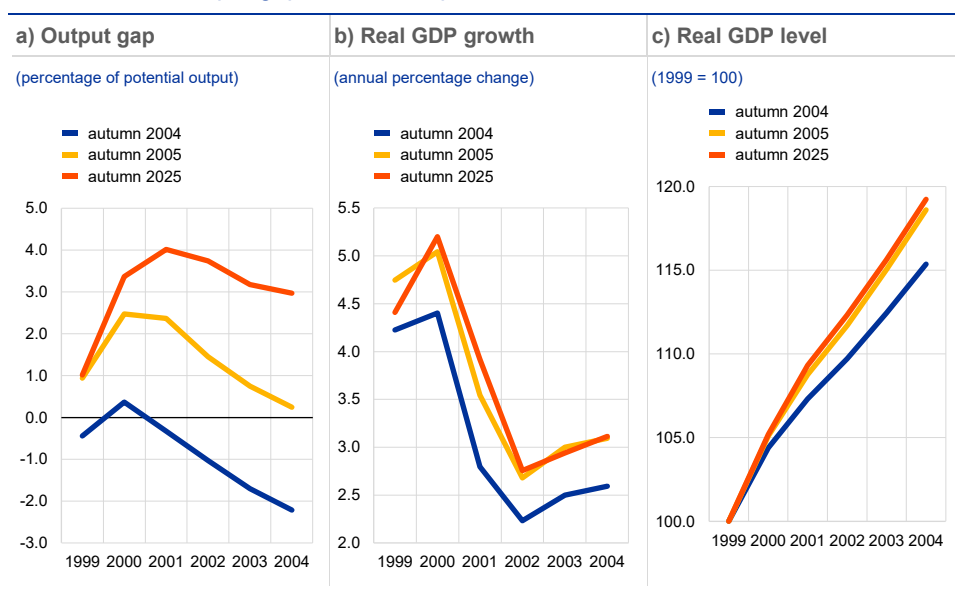
⁵ The decomposition is exact when the output gap is expressed as the log difference between actual and potential output, and approximate when using the standard percentage-of-potential-output definition. Given the size of output gaps in the sample, the approximation error is negligible.

Spain was revised from -2.2% (estimated in 2004) to +3.0% (estimated in 2025) – a total revision of 5.2 percentage points. This would be the size of the initial revision, i.e. $rev(\hat{y}_0)$ in the formula above.⁶ However, as **Chart 2** shows, this revision is largely related to a data revision that affects the real GDP level and growth series not only in 2004, but also in years before that. The whole output gap series is revised, in line with a statistical revision of the real GDP series. In fact, most of the real GDP revision had happened already by 2005, and it was taken on board in the autumn 2005 exercise. In the autumn 2005 forecast, the cumulative growth of real GDP between 1999 and 2004 was revised up by 3.2%, with part of it stemming from a nowcast error (more on that later) but most of it stemming from the statistical revision of historical real GDP data. This suggests that the initial output gap revision of 2004 should be further decomposed into real GDP growth and potential growth revisions, to eliminate the initial output gap revision as much as possible. Therefore, the revisions of the first vintages (autumn 2007 in exercises using balanced samples and autumn 2002 in unbalanced samples) include all of the cumulative revisions in real GDP growth and potential growth between 1999 and 2007 or 2002, depending on the exercise, to diminish the impact from the revision of the initial output gap.

This adjustment is important because otherwise the residual initial output gap revision would mechanically absorb revisions that are in fact attributable to earlier revisions in real GDP and potential growth. Pushing the starting point back to 1999 therefore makes the decomposition more informative and reduces the risk of overstating the unexplained component of output gap revisions.

Chart 2

Real GDP and output gap revisions, Spain



Source: European Commission.

⁶ In Hernández de Cos, Lacuesta and Moral-Benito (2016), only half of this is counted as the initial revision and it therefore appears in the residual, since they define the real-time output gap of 2004 as the estimate made in the autumn 2003 forecast.

The revision of real GDP growth can be further decomposed into a nowcast error and into data revisions. The real-time real GDP growth of year t , as featured in the projections of year t , is really a nowcast, since only two or at most three quarters of macroeconomic data are available at the time of finalising an autumn projection exercise. By the time of the $t+1$ autumn exercise, the full real GDP data of year t are published. Therefore, I consider the real GDP revisions between year t and $t+1$ as forecast errors, and revisions between year $t+1$ and the final vintage, i.e. 2025, are considered as data revisions.⁷

$$\Delta \ln y_t^F - \Delta \ln y_t^{RT} = (\Delta \ln y_t^F - \Delta \ln y_t^{t+1}) + (\Delta \ln y_t^{t+1} - \Delta \ln y_t^{RT})$$

real GDP revision *data revision* *forecast error*

2.2.2 Revisions of potential growth estimates

The methodologies used by the four studied institutions suggest the following possible sources of revisions of potential growth estimates.

Statistical revisions of historical real GDP (and other macroeconomic data) either affect the output gap (as discussed above) or potential output, or most likely both. If not only the level but also the growth rate of real GDP is revised, potential growth will also likely be revised.

Forecast errors of real GDP growth (and other macroeconomic data) can also lead to revisions of real-time and past potential output estimates. This problem is similar to the issue of statistical data revisions: real GDP is forecasted in projection exercises, and potential output is estimated on a series that includes the forecast. The nowcast error is expected to play a limited role, because much information on real GDP of year t is already available in the autumn projection exercise of year t . Forecasts over the medium term might however prove to be wrong, particularly if previously unforeseen events result in a real GDP outcome very different from the forecast. Such events included the outbreak of the global financial crisis in 2008 and the outbreak of the COVID-19 pandemic in 2020. One-year-ahead or two-year-ahead large forecast errors, especially around unexpected events such as the COVID-19 pandemic, can lead to considerable revisions in output gaps and potential output. For instance, if the $t+2$ forecast proves to be wrong, this could lead to a revision of potential output in year t and even in years preceding year t . Ideally, the inclusion of the forecast should eliminate the so-called end point problem, i.e. that potential output and output gap estimates become increasingly uncertain towards the end of the sample. However, given that most tools to estimate potential output smooth out fluctuations in real GDP, forecast errors tend to affect potential growth estimates in earlier years as well.

Certain methods are more sensitive to new data, and potential output and output gap estimates of these are revised more than estimates of other methods when underlying

⁷ This classification is operational. The revision between year t and year $t+1$ vintages is labelled a nowcast error because the year t vintage contains only partial information for year t , whereas the year $t+1$ vintage contains the first full-year estimate. Subsequent revisions are labelled data revisions, although they may include both routine and benchmark statistical revisions.

data, such as real GDP, become available or are revised.⁸ Relatedly, changes in methodology also lead to revisions of potential output and output gap estimates.

In this paper, I study the role of the first two factors: the role of data revisions and forecast errors in potential growth revisions. To do so, I estimate panel regressions using potential growth revisions of 11 euro area countries from data vintages between 2007 and 2025. The dependent variable is the revision of potential output growth for country i , year t and institution j , defined as the difference between the final-vintage estimate and the real-time estimate. In the regression, the revision of potential growth is explained by real GDP data revisions and $t+2$ real GDP forecast errors. Some specifications also include period and cross-section fixed effects to capture the impact of methodological changes, for example. I estimate the following panel regression:

$$rev(\Delta \bar{y}_{t,i}) = \beta_0 + \beta_1(\Delta y_{t,i}^F - \Delta y_{t,i}^{t-2}) + \beta_2(\Delta y_{t,i}^{t+1} - \Delta y_{t,i}^{RT}) + \beta_3 X_{t,i} + \epsilon_{t,i}$$

where the revision of potential growth is explained by the revision of historical real GDP growth and the two-year-ahead forecast error of real GDP. The forecast error is defined as the difference between the final-vintage estimate of real GDP growth in year $t+2$ and the forecast for year $t+2$ contained in the year t vintage. Matrix $X_{t,i}$ contains cross-section and period fixed effects in certain specifications. I estimate the regression for each institution individually, and I also pool the four institutions together. To the extent that methodological changes are common across countries within an institution, period fixed effects absorb part of their impact. However, country-specific methodological changes or judgement may remain in the residual. The regression results should therefore be interpreted as conditional associations rather than strict causal estimates.

One might argue that revisions of other data might affect the revisions of potential output and that these revisions are correlated with real GDP revisions. To check if this indeed causes an endogeneity problem, I include revisions to working age population and capital stock data in the regression using the vintages of the European Commission, where these data are available:

$$rev(\Delta \bar{y}_{t,i}) = \beta_0 + \beta_1(\Delta y_{t,i}^F - \Delta y_{t,i}^{t-2}) + \beta_2(\Delta y_{t,i}^{t+1} - \Delta y_{t,i}^{RT}) + \beta_3 X_{t,i} \\ + \beta_4(\Delta pop_{t,i}^F - \Delta pop_{t,i}^{RT}) + \beta_5(\Delta k_{t,i}^F - \Delta k_{t,i}^{RT}) + \epsilon_{t,i}$$

The reason for focusing on these two variables is that in the Commonly Agreed Methodology of the European Commission and also in general practice, they are usually not smoothed in a production function framework and they directly affect potential output. Their revision may be correlated with real GDP revision if, for instance, all those revisions are related to the revisions of national accounts.

As a robustness check, I estimate the above regression on an extended dataset so that the sample differs across institutions. However, the extension of the sample represents an unbalanced panel, and institutions cannot be compared.

Section 3 presents the results of the decomposition and the regression exercises.

⁸ For instance, Tóth (2021) documents that an unobserved components model built around the production function is less prone to revisions than a Hodrick-Prescott filter.

3 Results

This section presents the empirical results in two steps. First, it compares the size of output gap revisions across institutions and decomposes these revisions into contributions from real GDP data revisions, real GDP nowcast errors, potential growth revisions and revisions to the initial output gap. Second, it examines revisions to potential growth directly, using panel regressions to assess the role of real GDP data revisions and medium-term forecast errors. The results show that output gap revisions are sizeable but differ across institutions. They also show that real GDP data revisions and potential growth revisions account for a large share of output gap revisions, and that both real GDP data revisions and forecast errors are significantly associated with revisions to potential growth.

3.1 Decomposition of output gap revisions

Over the past decade, output gap estimates by the European Commission, the Eurosystem and the IMF have been more stable than in earlier vintages and substantially more stable than OECD estimates. Nevertheless, revisions remain non-negligible, especially for some countries and around major shocks. OECD estimates are much less stable and are revised the most. [Chart 3](#) and [Chart 4](#) show the revisions of output gap estimates of a non-weighted average of the 11 countries studied as well as of the euro area aggregate respectively. Three measures of revisions are presented. The first takes the simple average of the revisions of the output gap, as defined in Section 2 (i.e. the difference between the real-time and final estimates), for each vintage. However, a simple average might mask large revisions with opposite signs, if these cancel each other out. Therefore, the second measure averages the absolute value of the revisions, again for each vintage. Finally, a third measure looks at the correlation between the real-time output gap series and the final output gap series for each vintage and takes the average of those correlations. Lower values based on the first two measures as well as higher correlations indicate more reliable estimates. Overall, the simple average revision captures whether real-time estimates are systematically revised upwards or downwards. The average absolute revision captures the typical size of revisions, irrespective of sign. The correlation between real-time and final output gap series captures whether the real-time estimates track the ex post cyclical pattern, although it does not measure level accuracy.

When looking at individual countries and the non-weighted average of the 11 countries studied over the entire sample of 2007-24 vintages, the European Commission has the smallest absolute revisions (yellow bars in [Chart 3](#)), followed by the Eurosystem and the IMF, while the OECD has the largest revisions. The IMF's small average revision masks larger revisions of opposite signs, as shown by the difference between the average and average absolute revision indicators. In the post-global financial crisis period, the European Commission, the Eurosystem and the IMF display broadly similar reliability, whereas OECD revisions remain larger. For the euro area

aggregate, the European Commission and the IMF have the lowest revisions according to the average and average absolute revision indicators, while Eurosystem estimates have become markedly more stable since 2013. The correlation-based measure varies less across institutions, suggesting that differences in reliability mainly concern the level of the output gap rather than the broad cyclical profile.

Annex 1 shows the three measures for each of the 11 countries. The country-level decompositions in the annex show substantial heterogeneity behind the euro area aggregate results. In several countries, revisions to real GDP data are an important source of output gap revisions, particularly in Belgium, Cyprus, Malta and the Netherlands. In other cases, the average contribution of data revisions is less informative because sizeable positive and negative revisions offset each other over time; Spain is a clear example. The annex charts also confirm that potential growth revisions are an important source of output gap revisions across a broad set of countries, while nowcast errors generally play a smaller role. Finally, the relative importance of the initial output gap revision differs markedly across institutions and countries, consistent with the finding that some institutions revise not only recent estimates but also the historical output gap path.

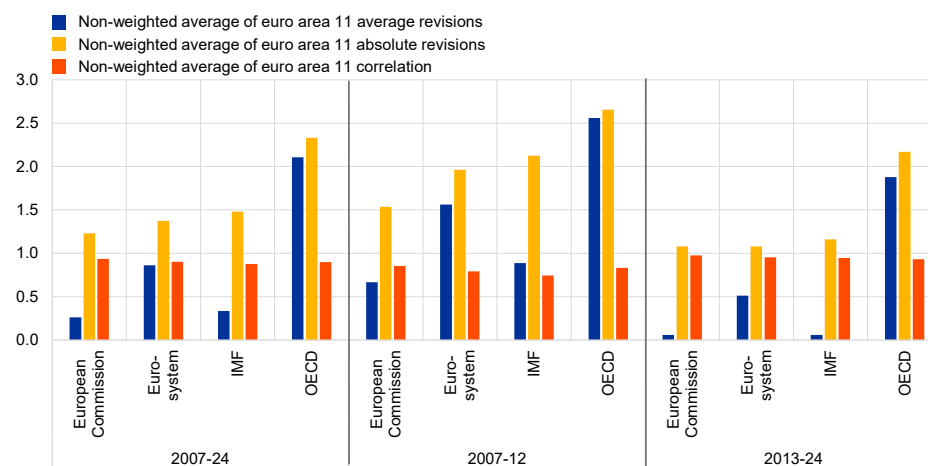
Looking at the output gap estimates of the euro area aggregate, the IMF and the European Commission have the lowest revisions based on the first two indicators when considering the full sample of vintages between 2007 and 2024 and also in the post-global financial crisis period ([Chart 4](#)). The European Commission's estimates were slightly more reliable in the first half of the sample of vintages, i.e. around the time of the global financial crisis, and the IMF has been slightly more reliable since 2013. The reliability of euro area aggregate estimates of the Eurosystem has improved significantly since 2013, most likely due to a more systematic overview of potential output estimates across the Eurosystem and the introduction of the Annual Supply Side Review in 2017⁹. OECD estimates are much less reliable than the estimates of the other three institutions. The differences in the correlation-based measure are also small for the euro area aggregate.

⁹ See Holm-Hadulla et al. (2021).

Chart 3

Output gap revisions, non-weighted average of 11 euro area countries

(percentage points (lhs), correlation (rhs))

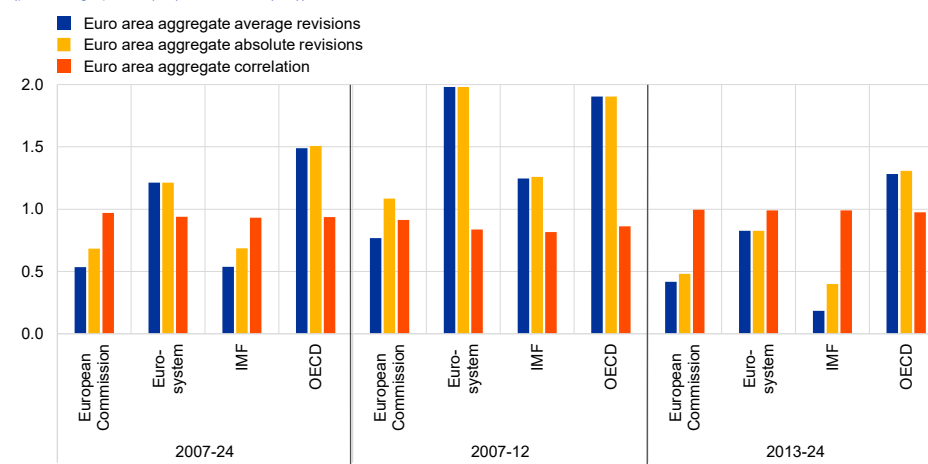


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

Chart 4

Output gap revisions, euro area aggregate

(percentage points (lhs), correlation (rhs))



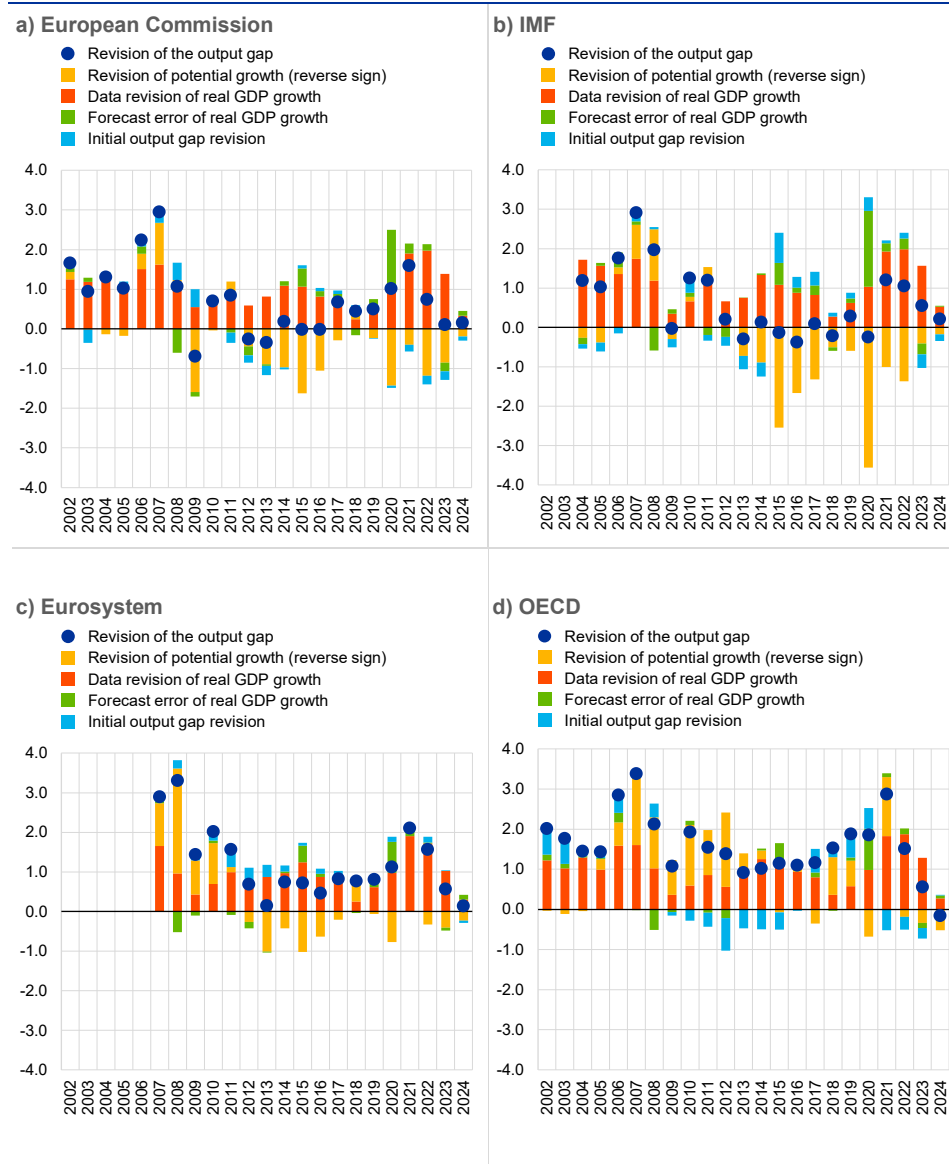
Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

A decomposition of output gap revisions shows that most of the revisions stem from real GDP data revisions and revisions of potential growth. **Chart 5** shows the decomposition for the four institutions, for the largest available set of data vintages. The contribution of potential growth revisions is shown with the reverse sign because, for a given path of actual GDP, an upward revision to potential output lowers the output gap. The prominent role of real GDP data revisions contrasts with some earlier studies. Part of the difference reflects sample coverage: Orphanides and van Norden (2002) study the United States over 1965-97, whereas this paper focuses on euro area countries over more recent vintages. It also reflects methodological choices. Hernández de Cos, Lacuesta and Moral-Benito (2016), for example, average

revisions over time, which can understate the importance of components that change sign, and define the real-time estimate for year t as the estimate made in autumn $t-1$, which tends to classify part of what this paper treats as subsequent data revisions as forecast errors. The nowcast error has a relatively smaller role, most likely because at the time of an autumn forecast, data for around half of the year are already available. The contribution from real GDP revisions, as well as from nowcast errors, are similar across institutions. Since real GDP is an observed variable, the underlying statistical revisions are broadly common across institutions. Differences may nevertheless arise because of different data cut-off dates, database conventions and, more importantly, because institutions may absorb a different share of real GDP revisions into potential output rather than the output gap.

Chart 5

A decomposition of output gap revisions, euro area aggregate



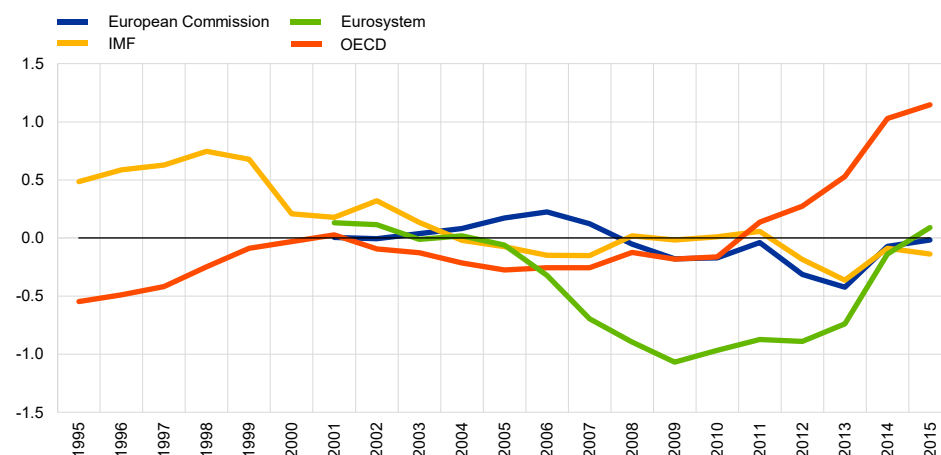
Source: Author's calculations based on European Commission, IMF, Eurosystem and OECD data.

The contributions of potential growth revisions and the revisions of the initial (1999) output gap are remarkably different across institutions. The European Commission and the Eurosystem revised potential growth the least, especially in the post-global financial crisis period, between 2013 and 2024. In their case, real GDP data revisions, nowcast errors and revisions of potential growth nearly fully explain the output gap revisions, and the role of the initial output gap revision is small. Panel b) of [Chart 5](#) reveals that the apparent stability of IMF output gap estimates for individual years masks larger revisions to potential growth and to the historical output gap path, especially after 2012. In addition, the revision of the initial output gap is also larger compared with the European Commission and the Eurosystem. This suggests that when revising potential growth and the output gap, the IMF revises the complete history, including the years before 1999. The same is true for the OECD: not only potential growth revisions are large, but when revising, the entire history of the output gap series tends to be revised. The role of the initial output gap revisions in the case of the IMF therefore warrants caution when interpreting the finding that the real-time output gap estimate of the IMF is revised relatively little: this is true for the particular years, but not for the whole output gap series. This is also illustrated in [Chart 6](#), which shows the revision of the whole output gap series. I picked the autumn 2015 vintage and compared the output gap series to the autumn 2025 vintage. The European Commission and the IMF revised the output gap in 2015 fairly little, and the Eurosystem revised it only a little more. The OECD revised it considerably more than the other institutions. The revision of the 2015 output gap does not affect the series before 2012 in the case of the European Commission and the Eurosystem. Interestingly, the IMF revised the output gap series considerably in years before 2012, and especially from 1995 to 1999. Between the 2015 and the 2025 vintages, the OECD revised up the 1999 output gap by 1 percentage point, which corresponds to the initial revision of the output gap in panel b) of [Chart 5](#) (light blue bar in 2015).

Chart 6

Revisions of euro area output gap series, autumn 2015 vs autumn 2025 vintages

(percentage point difference between the output gap in the autumn 2015 and the autumn 2025 vintages)



Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

3.2 Revisions of potential growth – a panel data assessment

The fairly large revisions of potential growth presented in Section 3.1 deserve some further examination. As described in Section 2, I look at the role of statistical revisions of real GDP and the role of real GDP forecast errors in the revision of potential growth. **Table 2** summarises the results, and the annex includes the detailed results of each regression.

In the balanced sample of 11 countries over 2007-24, both real GDP data revisions and real GDP forecast errors are statistically significant determinants of potential growth revisions. In the specification with both country and period fixed effects, the pooled results suggest that around half of real GDP data revisions and more than one-third of two-year-ahead real GDP forecast errors are reflected in revisions of potential growth. The estimated coefficients differ across institutions but are positive and statistically significant in all cases. For the European Commission, adding revisions to working age population and capital stock leaves the coefficients on real GDP data revisions and forecast errors broadly unchanged. This suggests that the baseline results are not driven by omitted revisions to these two production function inputs.

In the balanced pooled specification with country and period fixed effects, the adjusted R-squared is slightly above 0.5, implying that a sizeable share of potential growth revisions remains unexplained. This residual variation may reflect model properties, judgement, methodological changes not captured by fixed effects or the sensitivity of trend-cycle decompositions to the addition of new observations.

Extending the sample to the unbalanced panel of up to 20 countries over 2002-24 leaves the qualitative conclusions unchanged. The estimated coefficients are generally somewhat larger, especially for data revisions, but both explanatory variables remain statistically significant. Since the unbalanced sample differs in country and vintage coverage across institutions, these estimates should be interpreted as a robustness check rather than as a basis for direct cross-institution comparison.

Across institutions, the estimated association between real GDP data revisions and potential growth revisions is particularly large for the Eurosystem in the balanced sample and for the Eurosystem and OECD in the unbalanced sample. Forecast error coefficients are also sizeable, especially for the Eurosystem and IMF in the balanced sample. These differences should be interpreted cautiously, as they may reflect differences in methodology, judgement, country coverage and sample periods.

Table 2

Impact of real GDP data revisions and forecast errors on potential growth revisions

		Forecast error	Data revision
Balanced sample, 2007-24, 11 countries	All four institutions	0.398***	0.532***
	European Commission	0.219**	0.554***
	European Commission extended	0.393***	0.548***
	Eurosystem	0.532***	0.791***
	IMF	0.582***	0.492***
	OECD	0.361**	0.468***
Unbalanced sample, 2002-24, 20 countries	All four institutions	0.433***	0.697***
	European Commission	0.307***	0.710***
	European Commission extended	0.342***	0.669***
	Eurosystem	0.342***	0.811***
	IMF	0.582***	0.492***
	OECD	0.390***	0.818***

Source: Author's calculations.

Notes: The table reports coefficients from regressions of potential growth revisions on two-year-ahead real GDP forecast errors and real GDP data revisions. All specifications include country and period fixed effects. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels respectively. The table reports regression results with both period and country fixed effects.

Overall, the results point to two main conclusions. First, output gap revisions are not driven by a single source: real GDP data revisions, potential growth revisions and, for some institutions, revisions to the historical output gap path all matter. Second, revisions to potential growth are systematically related to both revised historical GDP data and forecast errors. This suggests that estimates of supply potential partly absorb information from revised or unexpected developments in actual GDP, reinforcing the need to interpret real-time output gap estimates with caution.

4 Conclusions

This paper studies revisions to potential growth and output gap estimates produced by the European Commission, the Eurosystem, the IMF and the OECD for the euro area and its member countries. Using annual vintages covering up to 20 euro area countries over the period 2002-25 and a balanced panel of 11 countries over the period 2007-25, the paper compares the reliability of real-time estimates across institutions and decomposes output gap revisions into contributions from real GDP data revisions, real GDP nowcast errors, potential growth revisions and revisions to the initial output gap. It also assesses, using panel regressions, the extent to which real GDP data revisions and forecast errors are associated with revisions to potential growth.

The results confirm that output gap and potential growth estimates are subject to sizeable real-time uncertainty. In the balanced country sample, European Commission estimates revise least on average over the full sample, while OECD estimates revise most. Eurosystem estimates have become markedly more stable over the past decade and are recently close to those of the European Commission. For the euro area aggregate, the European Commission and the IMF show relatively small revisions according to the main revision indicators, while Eurosystem estimates have also become more reliable since 2013. However, the apparent stability of IMF estimates for individual years should be interpreted with caution, as it partly masks larger revisions to potential growth and to the historical output gap path.

The decomposition shows that output gap revisions are not driven by a single source. Revisions to real GDP data and revisions to potential growth account for a large share of output gap revisions, while nowcast errors generally play a smaller role. The importance of statistical real GDP revisions contrasts with some earlier findings and is particularly visible in several euro area countries. Since revisions to observed real GDP data are largely outside the control of users and producers of output gap estimates, they represent an unavoidable source of uncertainty. Nevertheless, they still require careful interpretation, because a revision to real GDP can be reflected either in the output gap, in potential output or in both.

The analysis also shows that real GDP forecast errors are significantly associated with revisions to potential growth. In the balanced panel, around half of real GDP data revisions and more than one-third of two-year-ahead real GDP forecast errors are reflected in revised potential growth estimates. One possible explanation is that many estimation approaches, and some projection practices, tend to imply a closing of the output gap over the forecast horizon. If actual GDP subsequently turns out weaker than expected, maintaining a closed output gap at the end of the projection horizon may require an implausibly strong rebound in actual GDP unless potential output is revised down. As a result, part of the unexpected weakness in GDP may be attributed ex post to lower potential growth, including for past years. This mechanism can be useful if the shock genuinely reflects a change in supply capacity, but it can be

misleading if a largely cyclical or temporary development is interpreted as a structural deterioration.

These findings have several implications for policy analysis. First, potential output and output gap estimates should be treated as useful but uncertain analytical tools, rather than as precise real-time measures of supply capacity or economic slack. Policy assessments that rely on these estimates – including assessments of inflationary pressures, the monetary policy stance, structural fiscal balances or the natural rate of interest – should explicitly acknowledge this uncertainty. Second, while statistical data revisions cannot be avoided, the transmission of forecast errors into historical potential output estimates should be carefully scrutinised. In particular, revisions to potential output following large forecast errors should be assessed against a coherent economic narrative and should not be interpreted mechanically as evidence of structural change.

Third, policymakers should complement model-based output gap estimates with a broader set of indicators of slack and supply constraints. These may include survey-based measures of capacity utilisation, labour shortages, demand as a factor limiting production, unemployment and vacancy indicators, wage developments and other sectoral evidence. Such indicators are not substitutes for potential output estimates, but they can provide useful cross-checks, especially around turning points and large shocks. Tools such as the European Commission's plausibility tool (Hristov, Racibovski and Vandermeulen, 2017) and the Eurosystem's regular assessment of headline output gap estimates against a range of alternative estimates¹⁰ are useful examples of this approach.

¹⁰ See pages 27-28 of Holm-Hadulla et al. (2021).

References

- Andersson, M., Szörfi, B., Tóth, M. and Zorell, N. (2018), "[Potential output in the post-crisis period](#)", *Economic Bulletin*, Issue 7, ECB, November.
- Ademmer M., Boysen-Hogrefe J., Carstensen K., Hauber P., Jannsen N., Kooths S., Rossian T., and Stolzenburg U., (2019) "[Estimating potential output and the output gap – An analysis of the EU approach and suggestions for improvement](#)", *Kieler Beiträge zur Wirtschaftspolitik*, 19Alichì, A. (2015), "[A New Methodology for Estimating the Output Gap in the United States](#)", *IMF Working Papers*, Volume 2015: Issue 144
- Arévalo, P., Crucitti, F., D'Auria, F., Döhring, B., Maier, C., Mc Morrow, K., Planas, C., Rossi, A. and Thum-Thysen, A. (2026), "[The EU's Commonly Agreed Production Function Methodology for Estimating Potential Output \(EUCAM\)](#)", *Discussion Papers*, No 256, European Commission, July.
- Benes, J., Clinton, K., Garcia-Saltos, R., Johnson, M., Laxton, D., Manchev, P. and Matheson, T. (2010), "[Estimating Potential Output with a Multivariate Filter](#)", *IMF Working Papers*, No WP/10/285, International Monetary Fund, December.
- Blagrove, P., Garcia-Saltos, R., Laxton, D. and Zhang, M. (2015) "[A Simple Multivariate Filter for Estimating Potential Output](#)," *IMF Working Paper* WP/15/79.
- Chaloux, T. and Guillemette, Y. (2019), "[The OECD potential output estimation methodology](#)", *OECD Economics Department Working Papers*, No 1563, Organisation for Economic Co-operation and Development, August.
- Coibion, O., Gorodnichenko, Y. and Ulate, M. (2018), "[The Cyclical Sensitivity in Estimates of Potential Output](#)", *Brookings Papers on Economic Activity*, fall, pp. 343-434.
- Darvas, Z. (2015), "[Mind the gap \(and its revision\)!](#)", *Bruegel blog*, Bruegel, 20 May.
- European Central Bank (2016), "[A guide to the Eurosystem/ECB staff macroeconomic projection exercises](#)", July.
- Havik, K., Mc Morrow, K., Orlandi, F., Planas, C., Raciborski, R., Röger, W., Rossi, A., Thum-Thysen, A. and Vandermeulen, V. (2014), "[The Production Function Methodology for Calculating Potential Growth Rates and Output Gaps](#)", *Economic Papers*, No 535, European Commission, November.
- Hernández de Cos, P., Lacuesta, A. and Moral-Benito, E. (2016), "[An exploration of real-time revisions of output gap estimates across European countries](#)", *Occasional Papers*, No 1605, Banco de España, July.
- Holm-Hadulla, F., Musso, A., Rodriguez Palenzuela, D. and Vlassopoulos, T. (2021), "[Evolution of the ECB's analytical framework](#)", *Occasional Paper Series*, No 277, ECB, September.

- Hristov, A., Raciborski, R. and V. Vandermeulen (2017), “[Assessment of the Plausibility of the Output Gap Estimates](#)”, European Commission Economic Brief 023
- Kangur, A., Kirabaeva, K., Natal, J.M. and Voigts, S. (2019), “[How Informative Are Real Time Output Gap Estimates in Europe?](#)”, *IMF Working Papers*, No WP/19/200, International Monetary Fund, September.
- Nelson, E. and Nikolov, K. (2001), “[UK inflation in the 1970s and 1980s: the role of output gap mismeasurement](#)”, *Bank of England Staff Working Paper series* 148, Bank of England.
- Orphanides, A. and van Norden, S. (2002), “[The Unreliability of Output-Gap Estimates in Real Time](#)”, *The Review of Economics and Statistics*, Vol. 84, No 4, pp. 569-583.
- Tóth, M. (2021), “[A multivariate unobserved components model to estimate potential output in the euro area: a production function based approach](#)”, *Working Paper Series*, No 2523, ECB, February.

Annex

Table 3
Regression results, data of all four institutions

Balanced panel, 11 countries, 2007-24

		(1)	(2)	(3)	(4)
Constant	coefficient	-0.049	-0.042	0.170	0.189
	std. error	0.139	0.114	0.152	0.122
	t-statistic	-0.353	-0.368	1.123	1.556
	probability	0.724	0.713	0.262	0.120
Forecast error	coefficient	0.221	0.216	0.395	0.398
	std. error	0.035	0.029	0.068	0.057
	t-statistic	6.222	7.414	5.778	7.050
	probability	0.000	0.000	0.000	0.000
Data revisions	coefficient	0.575	0.559	0.552	0.532
	std. error	0.061	0.055	0.061	0.054
	t-statistic	9.420	10.074	9.010	9.844
	probability	0.000	0.000	0.000	0.000
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.160	0.447	0.244	0.543
Number of observations		704	704	704	704

Source: Author's calculations.

Table 4

Regression results, data of the European Commission

Balanced panel, 11 countries, 2007-24

		(1)	(2)	(3)	(4)
Constant	coefficient	0.472	0.531	0.532	0.531
	std. error	0.198	0.166	0.223	0.166
	t-statistic	2.379	3.196	2.390	3.196
	probability	0.018	0.002	0.018	0.002
Forecast error	coefficient	0.193	0.219	0.242	0.219
	std. error	0.051	0.043	0.103	0.043
	t-statistic	3.759	5.092	2.354	5.092
	probability	0.000	0.000	0.020	0.000
Data revisions	coefficient	0.598	0.554	0.593	0.554
	std. error	0.088	0.082	0.091	0.082
	t-statistic	6.790	6.799	6.549	6.799
	probability	0.000	0.000	0.000	0.000
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.261	0.495	0.307	0.495
Number of observations		176	176	176	176

Source: Author's calculations.

Table 5

Regression results, data of the European Commission

Balanced panel, 11 countries, 2007-24, extended set of controls

		(1)	(2)	(3)	(4)
Constant	coefficient	0.491	0.503	0.530	0.687
	std. error	0.203	0.172	0.225	0.184
	t-statistic	2.422	2.926	2.354	3.731
	probability	0.017	0.004	0.020	0.000
Forecast error	coefficient	0.187	0.217	0.235	0.393
	std. error	0.053	0.043	0.109	0.087
	t-statistic	3.564	4.986	2.167	4.514
	probability	0.001	0.000	0.032	0.000
Data revisions	coefficient	0.595	0.579	0.591	0.548
	std. error	0.089	0.083	0.091	0.081
	t-statistic	6.684	7.016	6.472	6.720
	probability	0.000	0.000	0.000	0.000
Population revisions	coefficient	-0.002	-0.272	0.045	-0.260
	std. error	0.159	0.179	0.165	0.182
	t-statistic	-0.013	-1.521	0.275	-1.429
	probability	0.990	0.130	0.783	0.155
Capital stock revisions	coefficient	0.029	0.037	-0.002	-0.012
	std. error	0.047	0.046	0.049	0.047
	t-statistic	0.618	0.802	-0.037	-0.258
	probability	0.538	0.424	0.971	0.797
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.254	0.498	0.299	0.578
Number of observations		176	176	176	176

Source: Author's calculations.

Table 6

Regression results, data of the Eurosystem

Balanced panel, 11 countries, 2007-24

		(1)	(2)	(3)	(4)
Constant	coefficient	-0.522	-0.634	-0.161	-0.337
	std. error	0.229	0.218	0.230	0.220
	t-statistic	-2.282	-2.908	-0.699	-1.531
	probability	0.024	0.004	0.486	0.128
Forecast error	coefficient	0.297	0.269	0.604	0.532
	std. error	0.058	0.055	0.100	0.097
	t-statistic	5.117	4.874	6.067	5.468
	probability	0.000	0.000	0.000	0.000
Data revisions	coefficient	0.682	0.783	0.674	0.791
	std. error	0.103	0.108	0.099	0.105
	t-statistic	6.643	7.230	6.812	7.545
	probability	0.000	0.000	0.000	0.000
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.284	0.373	0.419	0.507
Number of observations		176	176	176	176

Source: Author's calculations.

Table 7

Regression results, data of the IMF

Balanced panel, 11 countries, 2007-24

		(1)	(2)	(3)	(4)
Constant	coefficient	0.731	0.886	0.834	1.348
	std. error	0.282	0.228	0.321	0.254
	t-statistic	2.594	3.891	2.596	5.301
	probability	0.010	0.000	0.010	0.000
Forecast error	coefficient	0.118	0.191	0.209	0.582
	std. error	0.081	0.066	0.162	0.132
	t-statistic	1.463	2.919	1.291	4.399
	probability	0.145	0.004	0.198	0.000
Data revisions	coefficient	0.930	0.584	0.935	0.492
	std. error	0.031	0.099	0.031	0.097
	t-statistic	30.172	5.889	30.381	5.059
	probability	0.000	0.000	0.000	0.000
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.732	0.827	0.740	0.846
Number of observations		176	176	176	176

Source: Author's calculations.

Table 8

Regression results, data of the OECD

Balanced panel, 11 countries, 2007-24

		(1)	(2)	(3)	(4)
Constant	coefficient	-1.184	-1.153	-0.622	-0.903
	std. error	0.317	0.265	0.351	0.299
	t-statistic	-3.738	-4.350	-1.772	-3.025
	probability	0.000	0.000	0.078	0.003
Forecast error	coefficient	0.268	0.174	0.736	0.361
	std. error	0.081	0.067	0.159	0.140
	t-statistic	3.331	2.578	4.617	2.580
	probability	0.001	0.011	0.000	0.011
Data revisions	coefficient	0.702	0.520	0.654	0.468
	std. error	0.140	0.129	0.144	0.135
	t-statistic	5.033	4.046	4.549	3.470
	probability	0.000	0.000	0.000	0.001
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.172	0.435	0.215	0.459
Number of observations		176	176	176	176

Source: Author's calculations.

Table 9

Regression results, data of all four institutions

Unbalanced panel, 20 countries, 2002-24

		(1)	(2)	(3)	(4)
Constant	coefficient	0.065	0.040	0.210	0.236
	std. error	0.109	0.092	0.116	0.095
	t-statistic	0.598	0.430	1.814	2.478
	probability	0.550	0.667	0.070	0.013
Forecast error	coefficient	0.232	0.245	0.362	0.433
	std. error	0.030	0.026	0.053	0.045
	t-statistic	7.640	9.513	6.791	9.539
	probability	0.000	0.000	0.000	0.000
Data revisions	coefficient	0.876	0.738	0.877	0.697
	std. error	0.012	0.039	0.011	0.037
	t-statistic	74.505	18.899	76.827	18.667
	probability	0.000	0.000	0.000	0.000
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.812	0.868	0.826	0.885
Number of observations		1318	1318	1318	1318

Source: Author's calculations.

Table 10

Regression results, data of the European Commission

Unbalanced panel, 20 countries, 2002-24

		(1)	(2)	(3)	(4)
Constant	coefficient	0.519	0.468	0.575	0.468
	std. error	0.162	0.148	0.164	0.148
	t-statistic	3.208	3.155	3.497	3.155
	probability	0.001	0.002	0.001	0.002
Forecast error	coefficient	0.277	0.307	0.331	0.307
	std. error	0.041	0.038	0.069	0.038
	t-statistic	6.685	8.050	4.818	8.050
	probability	0.000	0.000	0.000	0.000
Data revisions	coefficient	0.909	0.710	0.905	0.710
	std. error	0.017	0.059	0.016	0.059
	t-statistic	52.721	12.089	54.918	12.089
	probability	0.000	0.000	0.000	0.000
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.880	0.901	0.892	0.901
Number of observations		398	398	398	398

Source: Author's calculations.

Table 11**Regression results, data of the European Commission****Unbalanced panel, 20 countries, 2002-24, extended set of controls**

		(1)	(2)	(3)	(4)
Constant	coefficient	0.441	0.457	0.460	0.547
	std. error	0.162	0.149	0.168	0.153
	t-statistic	2.727	3.056	2.745	3.584
	probability	0.007	0.002	0.006	0.000
Forecast error	coefficient	0.209	0.240	0.224	0.342
	std. error	0.046	0.040	0.085	0.076
	t-statistic	4.547	6.030	2.637	4.517
	probability	0.000	0.000	0.009	0.000
Data revisions	coefficient	0.910	0.680	0.906	0.669
	std. error	0.024	0.055	0.024	0.055
	t-statistic	37.445	12.410	37.897	12.250
	probability	0.000	0.000	0.000	0.000
Population revisions	coefficient	-0.051	-0.269	-0.039	-0.265
	std. error	0.083	0.101	0.080	0.099
	t-statistic	-0.618	-2.652	-0.490	-2.668
	probability	0.537	0.008	0.624	0.008
Capital stock revisions	coefficient	0.002	-0.029	-0.006	-0.033
	std. error	0.014	0.024	0.014	0.024
	t-statistic	0.151	-1.196	-0.413	-1.371
	probability	0.880	0.233	0.680	0.171
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.908	0.934	0.917	0.941
Number of observations		349	349	349	349

Source: Author's calculations.

Table 12

Regression results, data of the Eurosystem

Balanced panel, 11 countries, 2007-24

		(1)	(2)	(3)	(4)
Constant	coefficient	-0.331	-0.348	-0.169	-0.219
	std. error	0.181	0.163	0.191	0.170
	t-statistic	-1.830	-2.128	-0.881	-1.283
	probability	0.068	0.034	0.379	0.201
Forecast error	coefficient	0.241	0.228	0.376	0.342
	std. error	0.050	0.046	0.087	0.082
	t-statistic	4.772	4.934	4.312	4.190
	probability	0.000	0.000	0.000	0.000
Data revisions	coefficient	0.859	0.851	0.861	0.811
	std. error	0.019	0.069	0.018	0.064
	t-statistic	46.407	12.407	49.085	12.598
	probability	0.000	0.000	0.000	0.000
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.885	0.907	0.899	0.923
Number of observations		287	287	287	287

Source: Author's calculations.

Table 13

Regression results, data of the IMF

Balanced panel, 11 countries, 2007-24

		(1)	(2)	(3)	(4)
Constant	coefficient	0.731	0.886	0.834	1.348
	std. error	0.282	0.228	0.321	0.254
	t-statistic	2.594	3.891	2.596	5.301
	probability	0.010	0.000	0.010	0.000
Forecast error	coefficient	0.118	0.191	0.209	0.582
	std. error	0.081	0.066	0.162	0.132
	t-statistic	1.463	2.919	1.291	4.399
	probability	0.145	0.004	0.198	0.000
Data revisions	coefficient	0.930	0.584	0.935	0.492
	std. error	0.031	0.099	0.031	0.097
	t-statistic	30.172	5.889	30.381	5.059
	probability	0.000	0.000	0.000	0.000
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.732	0.827	0.740	0.846
Number of observations		337	337	337	337

Source: Author's calculations.

Table 14

Regression results, data of the OECD

Balanced panel, 11 countries, 2007-24

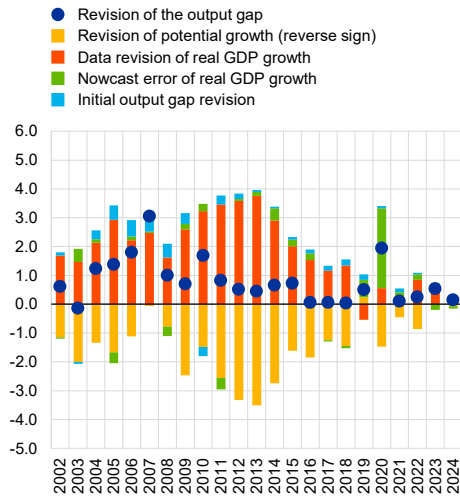
		(1)	(2)	(3)	(4)
Constant	coefficient	-1.038	-1.032	-0.739	-0.866
	std. error	0.212	0.201	0.235	0.219
	t-statistic	-4.892	-5.121	-3.152	-3.954
	probability	0.000	0.000	0.002	0.000
Forecast error	coefficient	0.267	0.216	0.549	0.390
	std. error	0.064	0.058	0.123	0.114
	t-statistic	4.169	3.720	4.476	3.434
	probability	0.000	0.000	0.000	0.001
Data revisions	coefficient	0.767	0.841	0.764	0.818
	std. error	0.024	0.088	0.024	0.088
	t-statistic	32.003	9.599	32.126	9.340
	probability	0.000	0.000	0.000	0.000
Cross-country fixed effects		no	yes	no	yes
Period fixed effects		no	no	yes	yes
Adjusted R-squared		0.781	0.824	0.791	0.837
Number of observations		296	296	296	296

Source: Author's calculations.

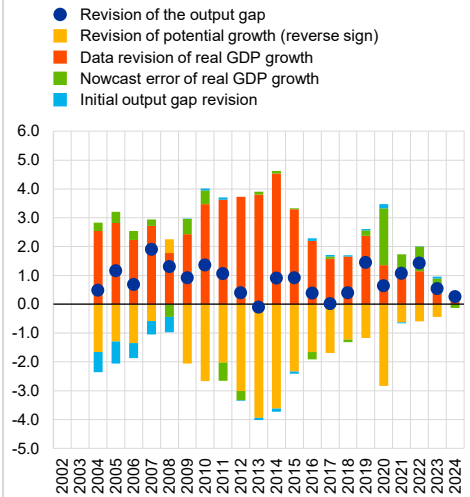
Chart 7

A decomposition of the revisions of the output gap, Belgium

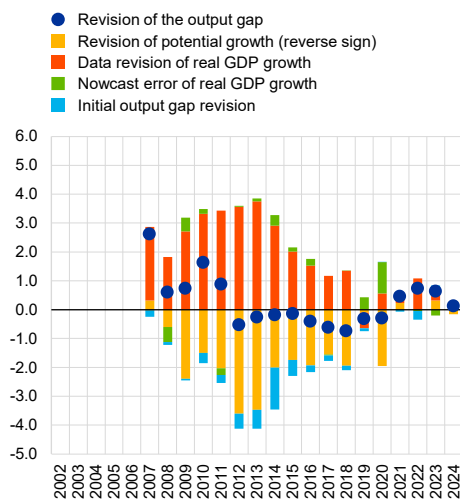
a) European Commission



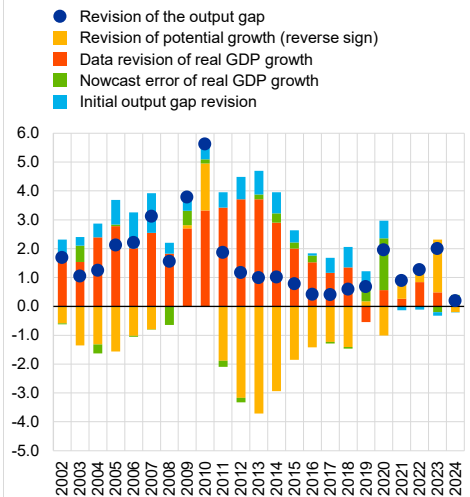
b) IMF



c) Eurosystem



d) OECD

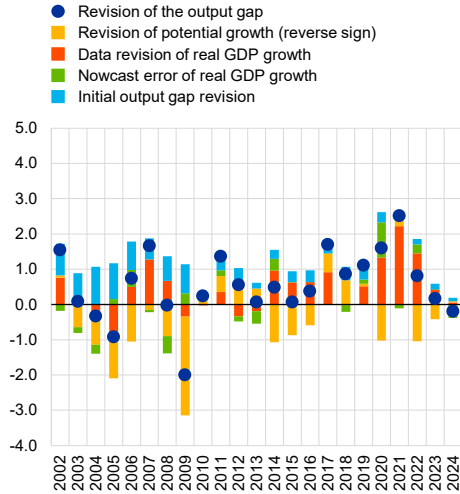


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

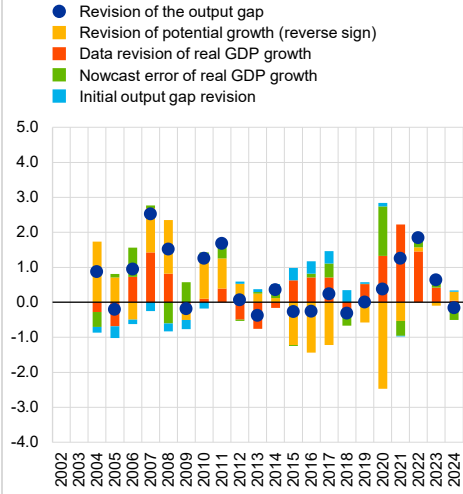
Chart 8

A decomposition of the revisions of the output gap, Germany

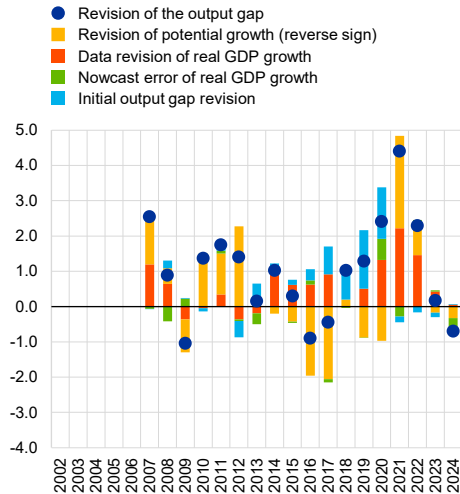
a) European Commission



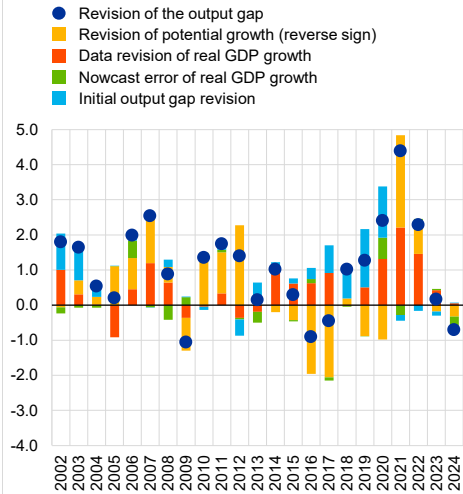
b) IMF



c) Eurosystem



d) OECD

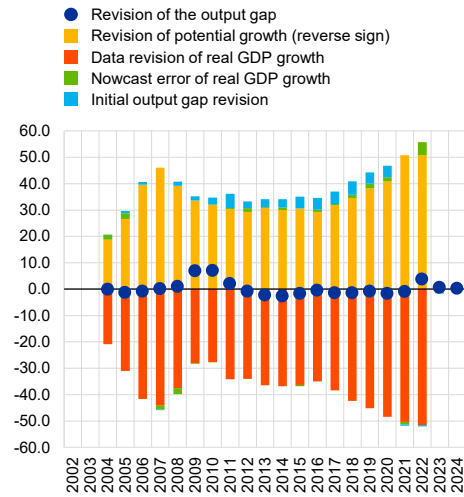


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

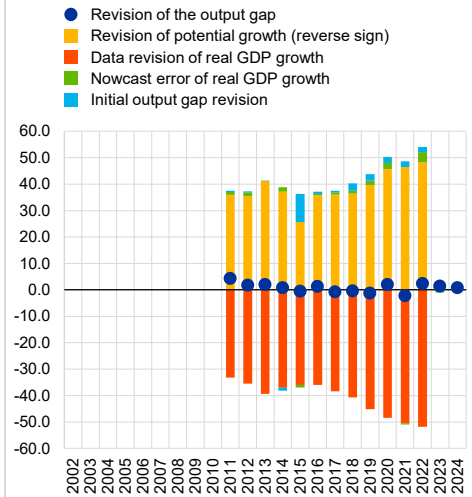
Chart 9

A decomposition of the revisions of the output gap, Estonia

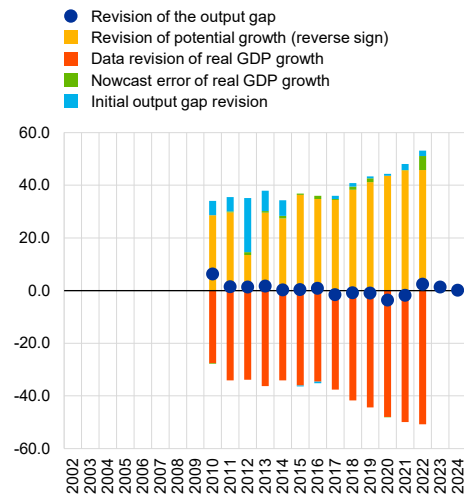
a) European Commission



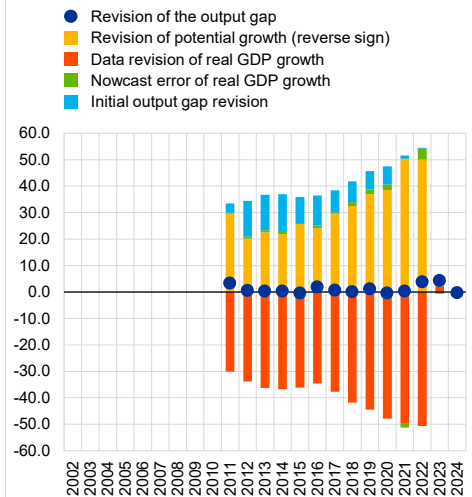
b) IMF



c) Eurosystem



d) OECD

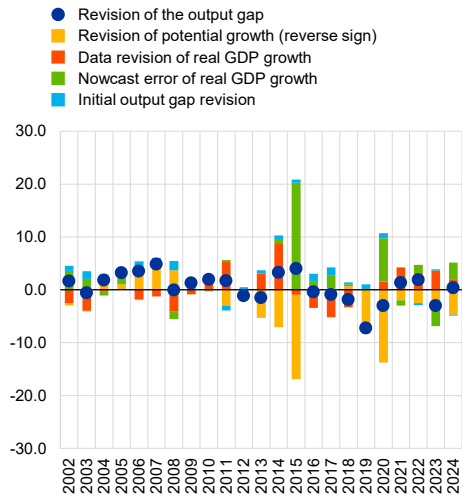


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

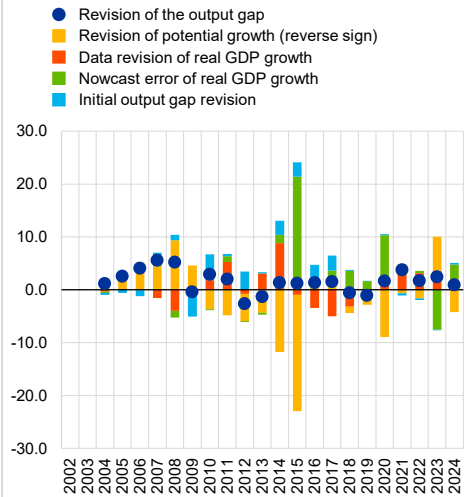
Chart 10

A decomposition of the revisions of the output gap, Ireland

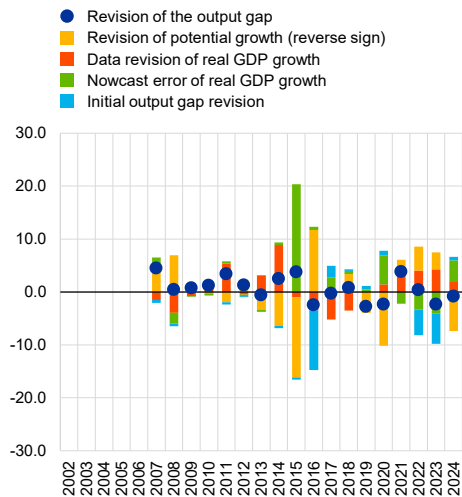
a) European Commission



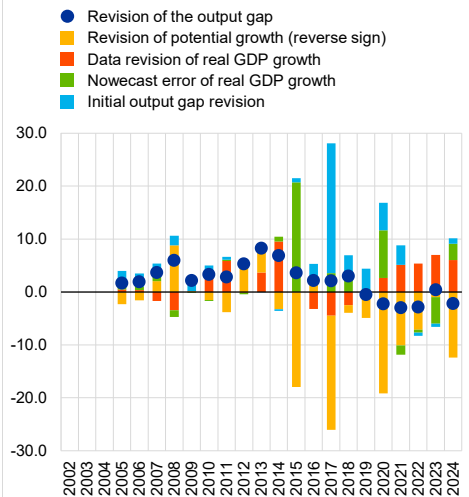
b) IMF



c) Eurosystem



d) OECD

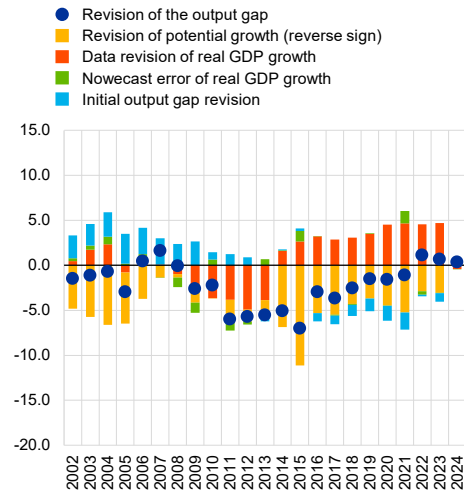


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

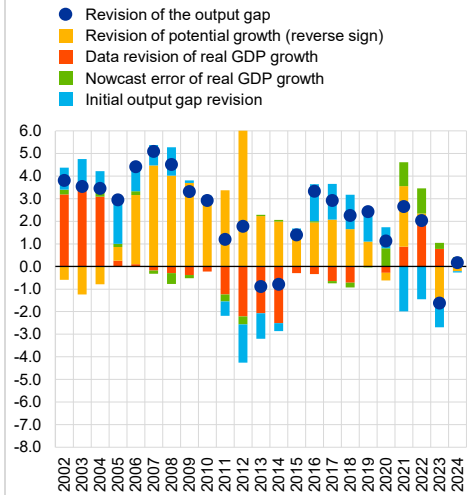
Chart 11

A decomposition of the revisions of the output gap, Greece

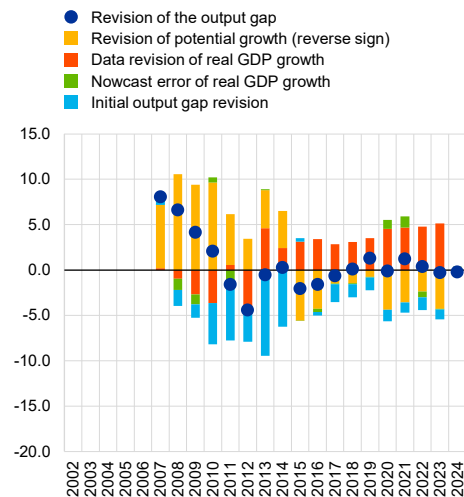
a) European Commission



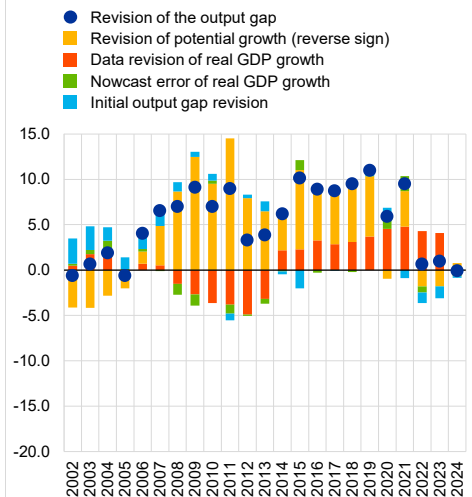
b) IMF



c) Eurosystem



d) OECD

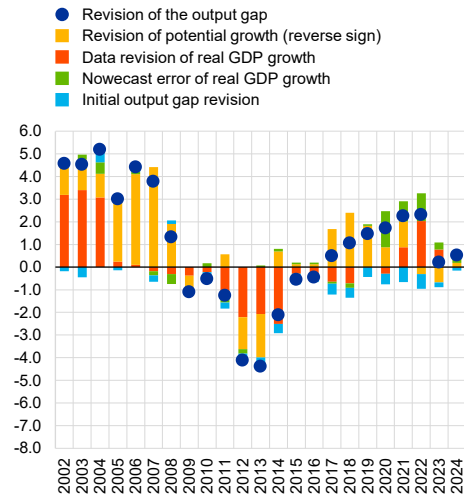


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

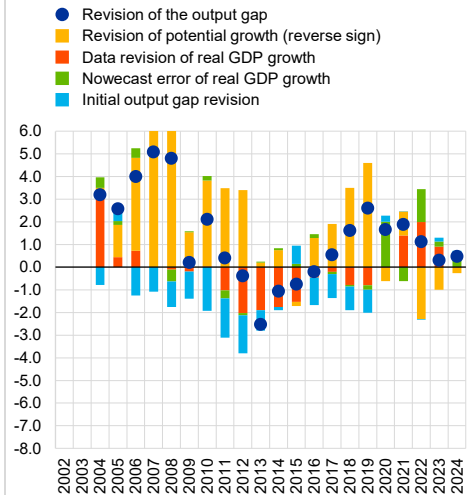
Chart 12

A decomposition of the revisions of the output gap, Spain

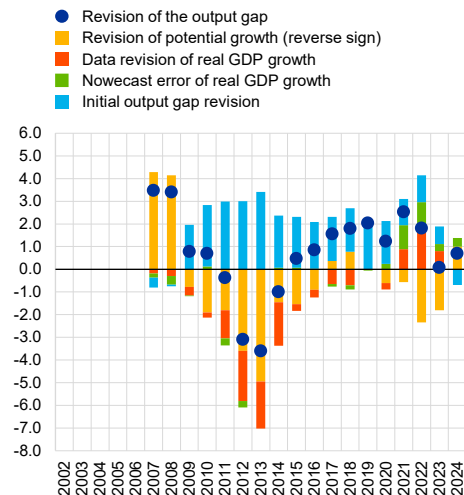
a) European Commission



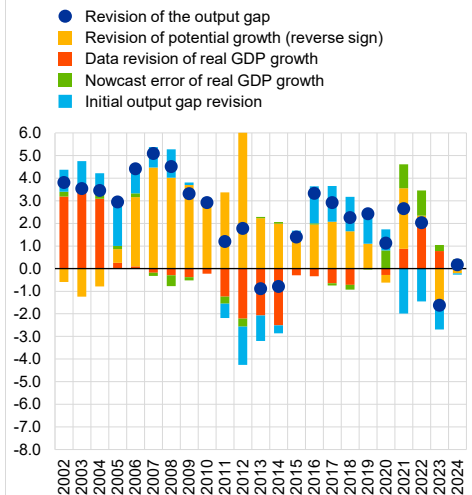
b) IMF



c) Eurosystem



d) OECD

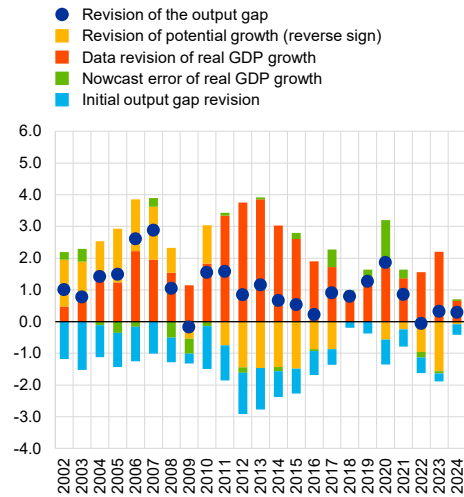


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

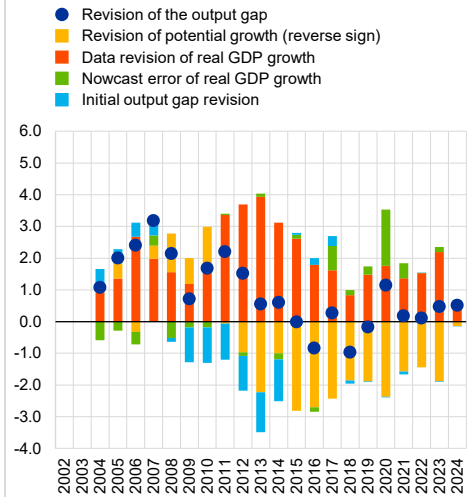
Chart 13

A decomposition of the revisions of the output gap, France

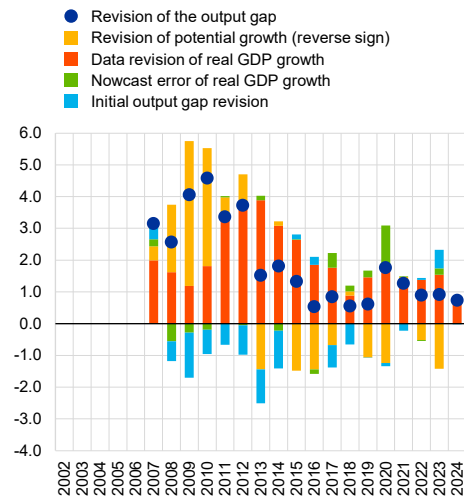
a) European Commission



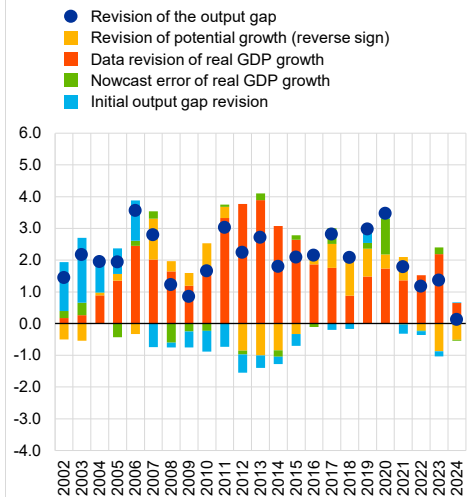
b) IMF



c) Eurosystem



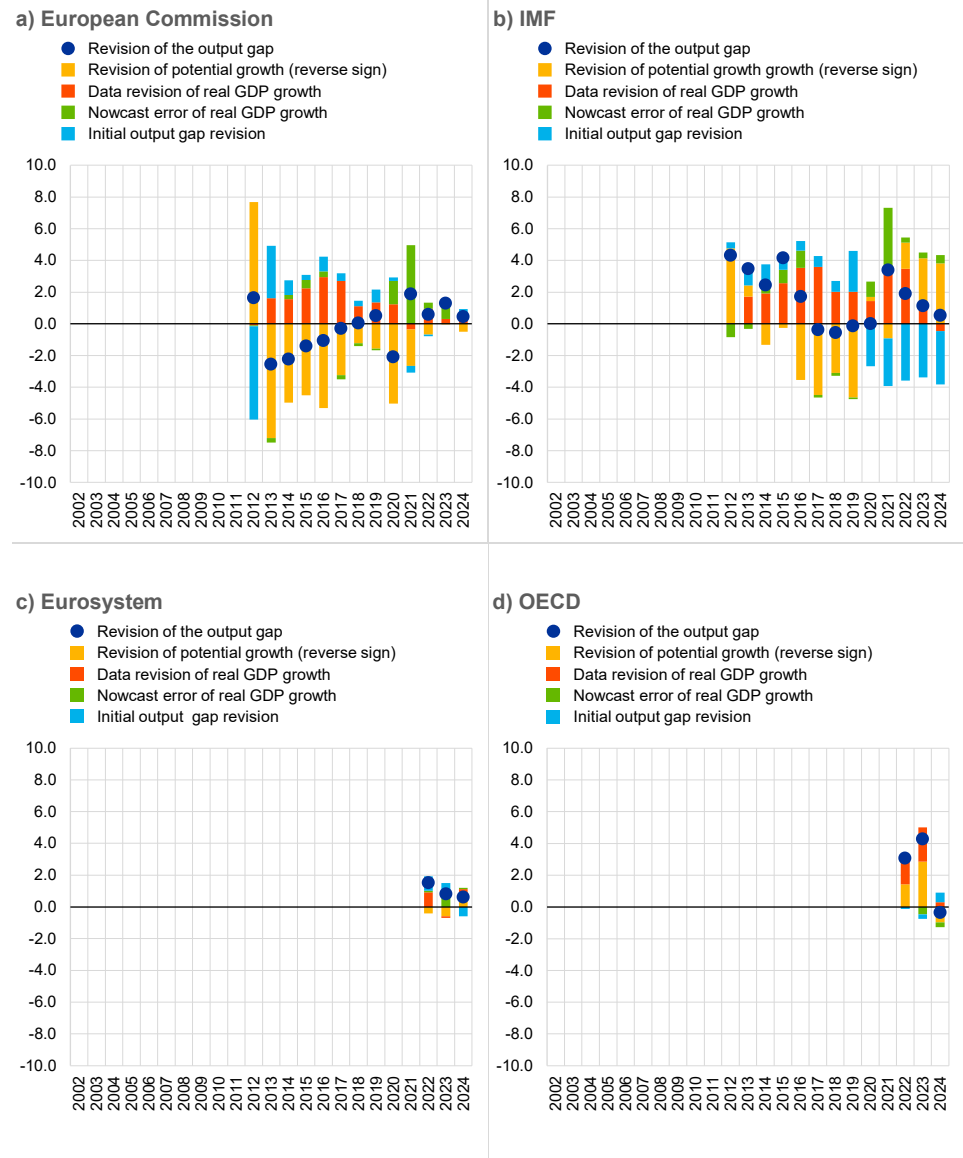
d) OECD



Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

Chart 14

A decomposition of the revisions of the output gap, Croatia

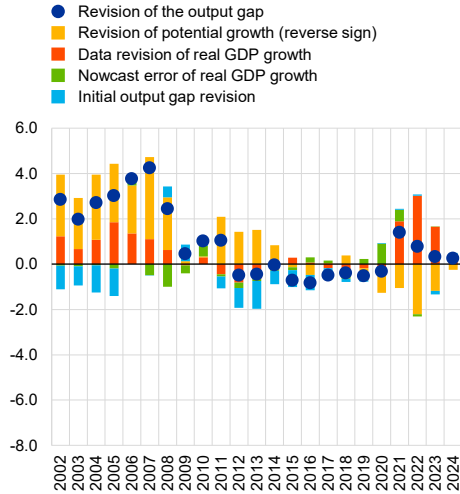


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

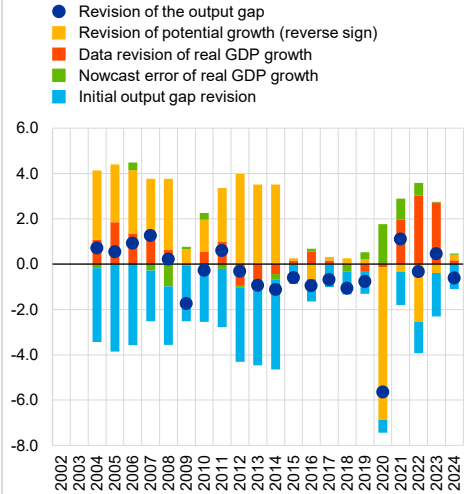
Chart 15

A decomposition of the revisions of the output gap, Italy

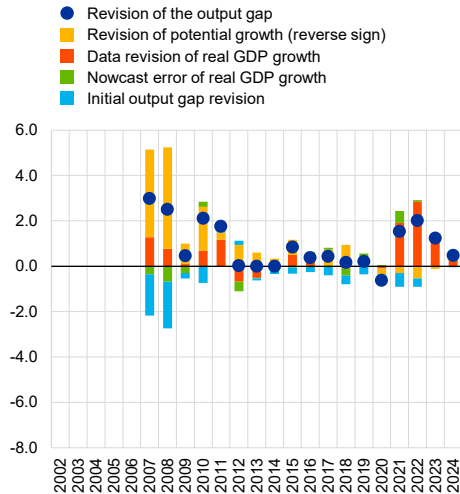
a) European Commission



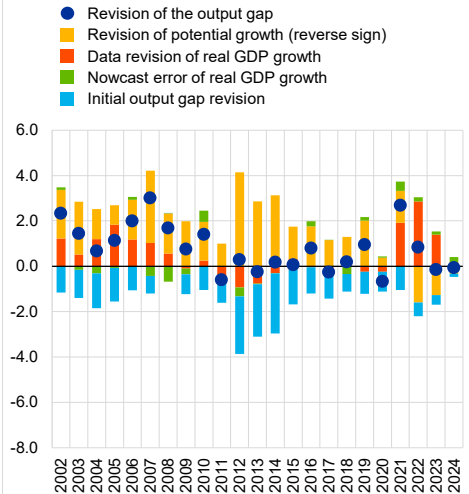
b) IMF



c) Eurosystem



d) OECD

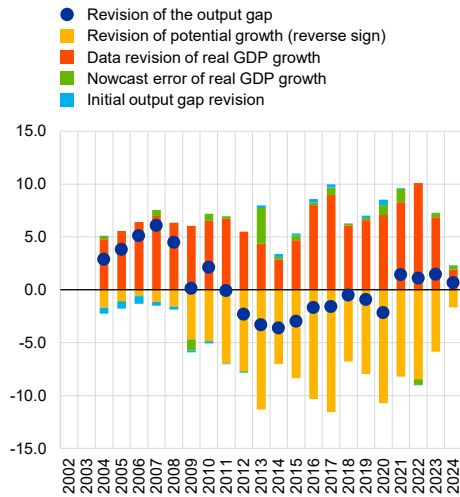


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

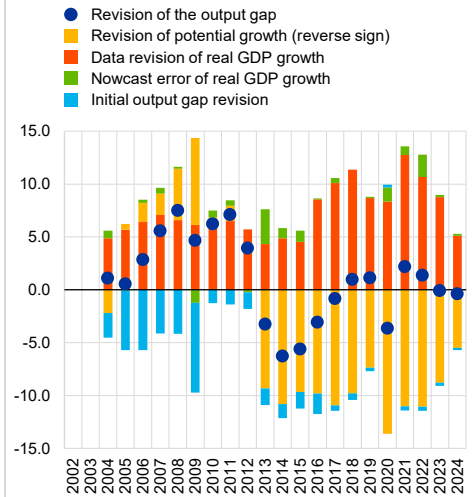
Chart 16

A decomposition of the revisions of the output gap, Cyprus

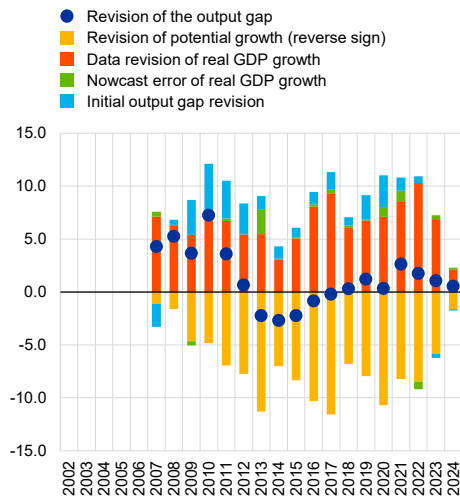
a) European Commission



b) IMF



c) Eurosystem



d) OECD

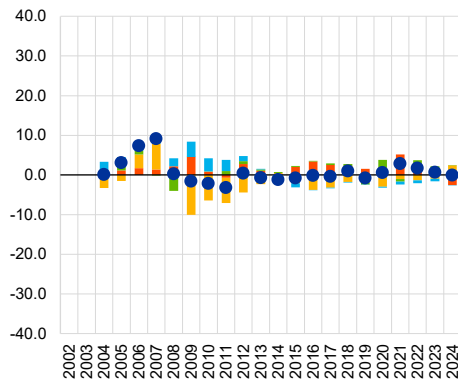
Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

Chart 17

A decomposition of the revisions of the output gap, Latvia

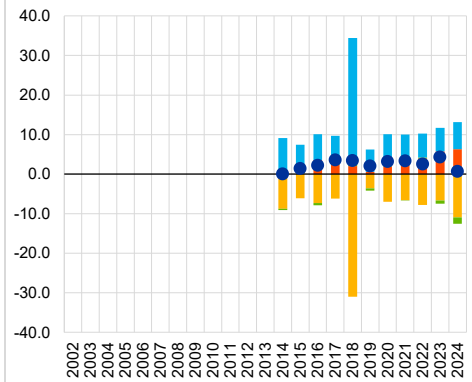
a) European Commission

- Revision of the output gap
- Revision of potential growth (reverse sign)
- Data revision of real GDP growth
- Nowcast error of real GDP growth
- Initial output gap revision



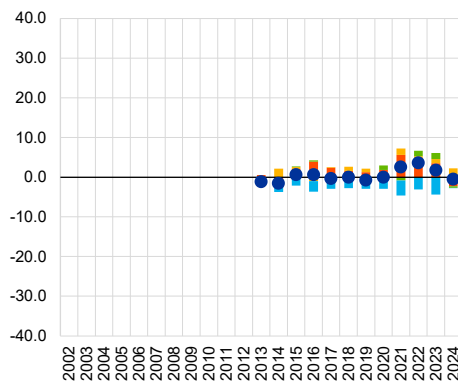
b) IMF

- Revision of the output gap
- Revision of potential growth (reverse sign)
- Data revision of real GDP growth
- Nowcast error of real GDP growth
- Initial output gap revision



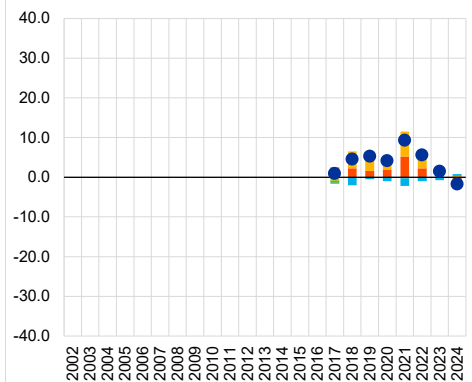
c) Eurosystem

- Revision of the output gap
- Revision of potential growth (reverse sign)
- Data revision of real GDP growth
- Nowcast error of real GDP growth
- Initial output gap revision



d) OECD

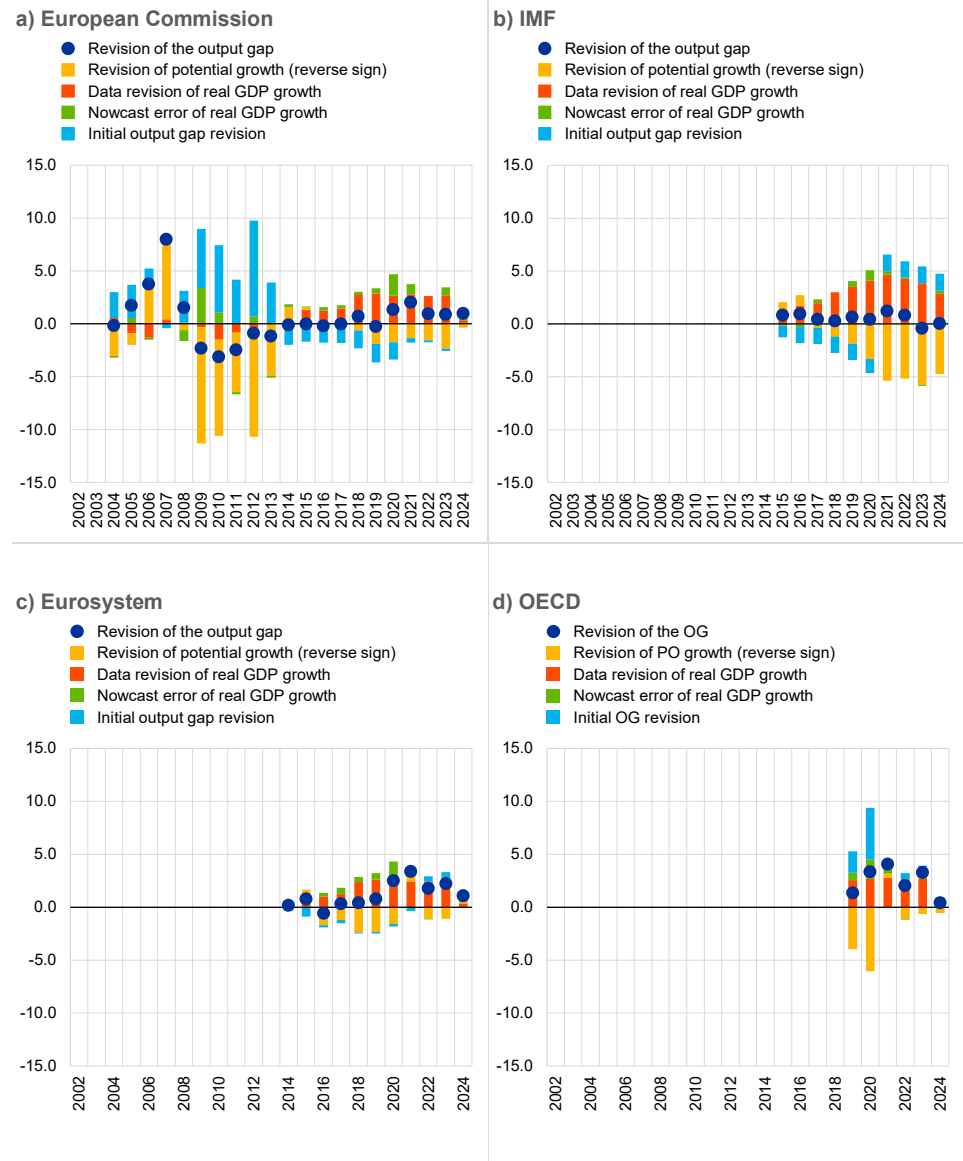
- Revision of the output gap
- Revision of potential growth (reverse sign)
- Data revision of real GDP growth
- Nowcast error of real GDP growth
- Initial output gap revision



Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

Chart 18

A decomposition of the revisions of the output gap, Lithuania

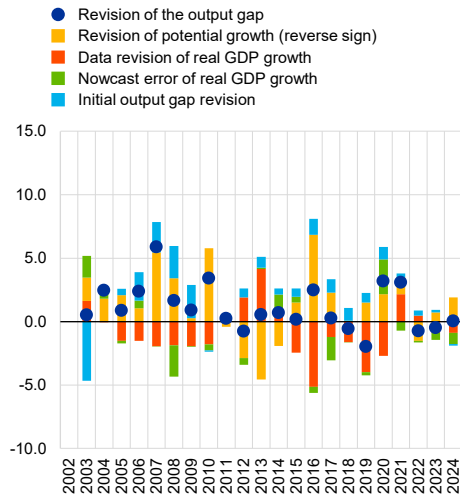


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

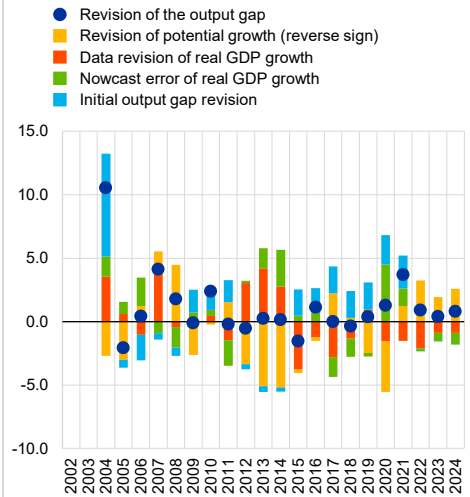
Chart 19

A decomposition of the revisions of the output gap, Luxembourg

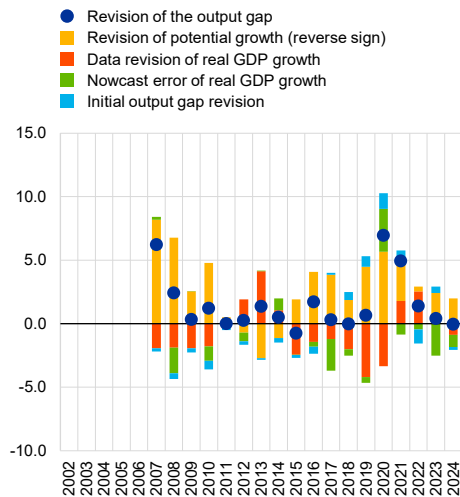
a) European Commission



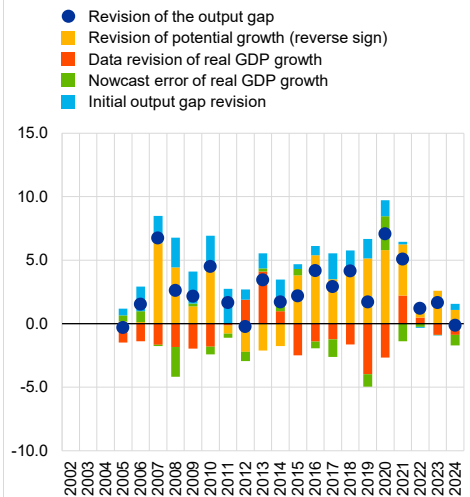
b) IMF



c) Eurosystem



d) OECD

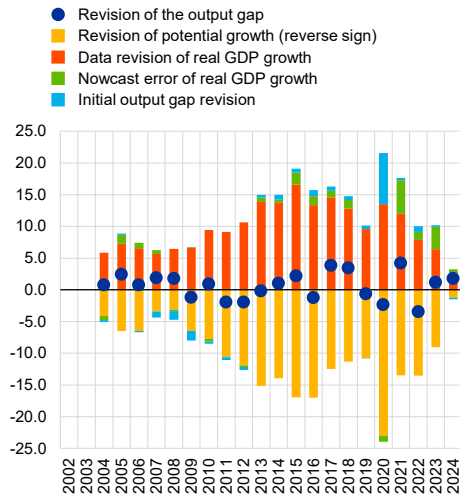


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

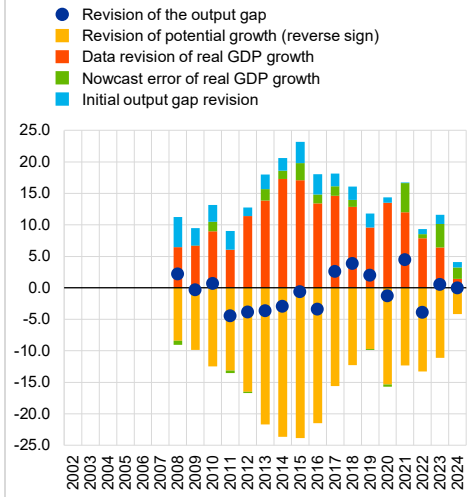
Chart 20

A decomposition of the revisions of the output gap, Malta

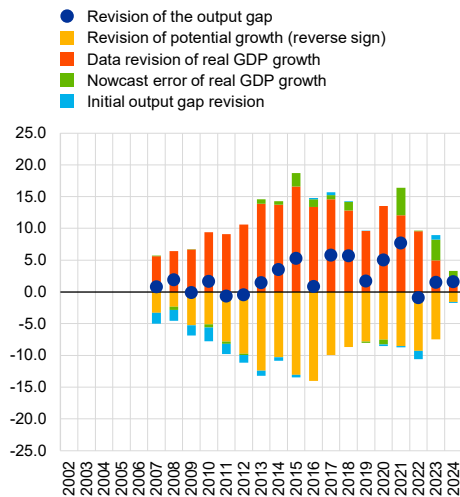
a) European Commission



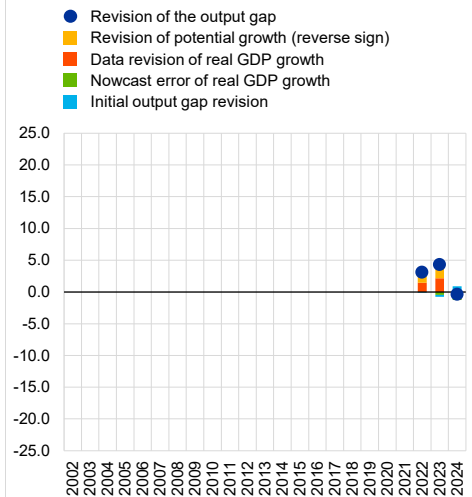
b) IMF



c) Eurosystem



d) OECD

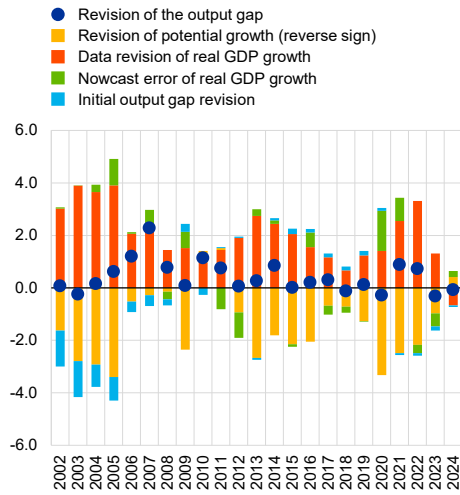


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

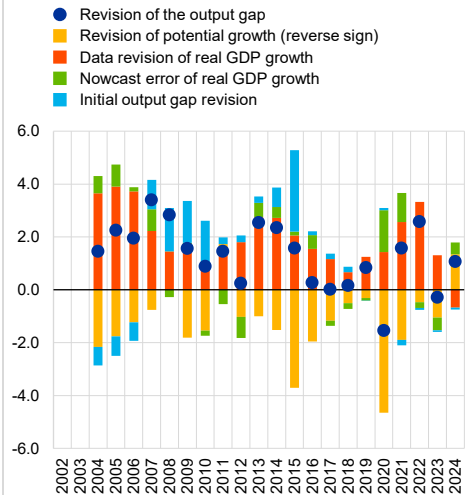
Chart 21

A decomposition of the revisions of the output gap, The Netherlands

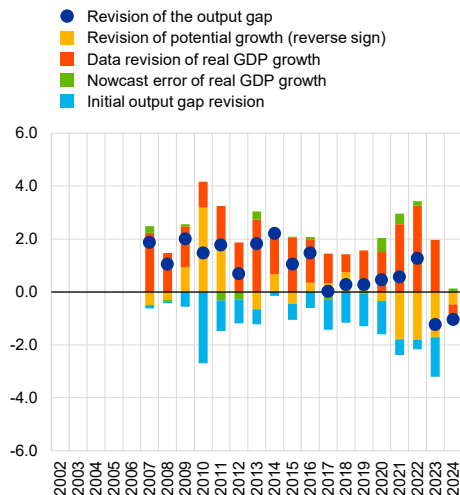
a) European Commission



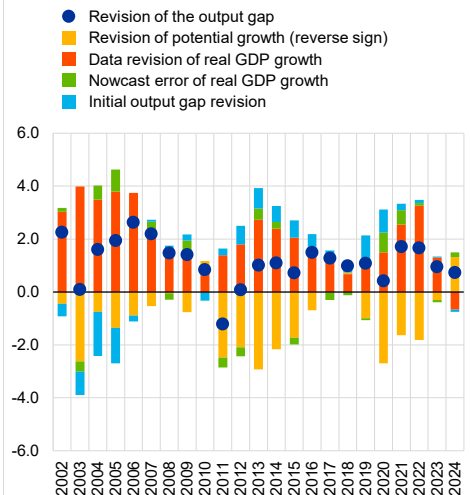
b) IMF



c) Eurosystem



d) OECD

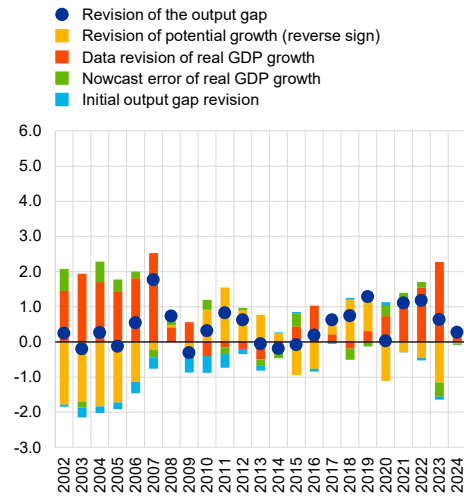


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

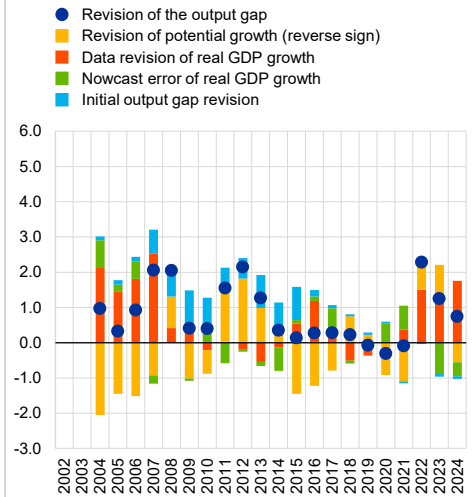
Chart 22

A decomposition of the revisions of the output gap, Austria

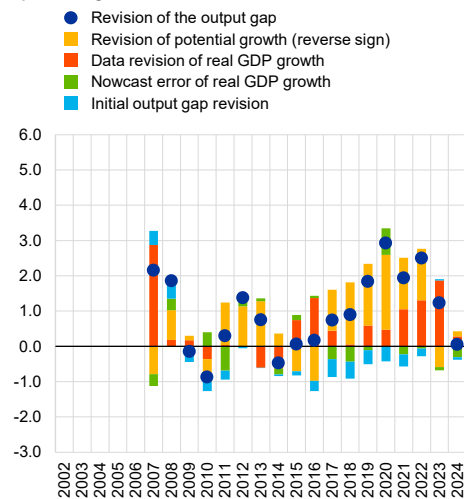
a) European Commission



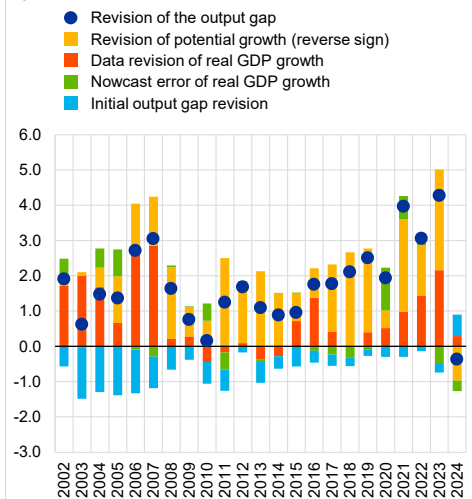
b) IMF



c) Eurosystem



d) OECD

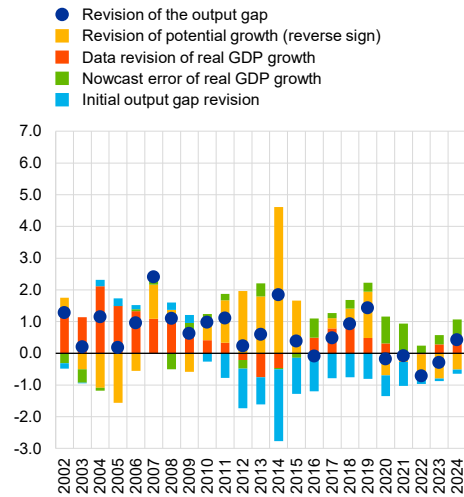


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

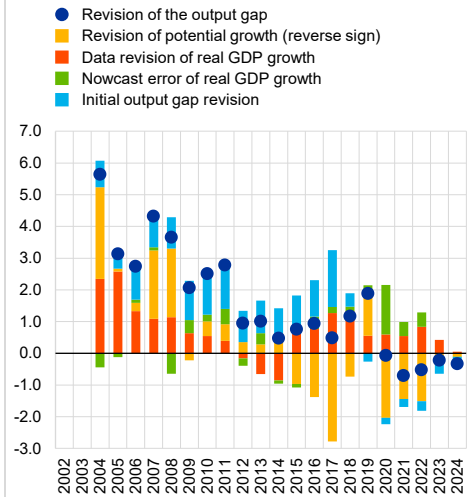
Chart 23

A decomposition of the revisions of the output gap, Portugal

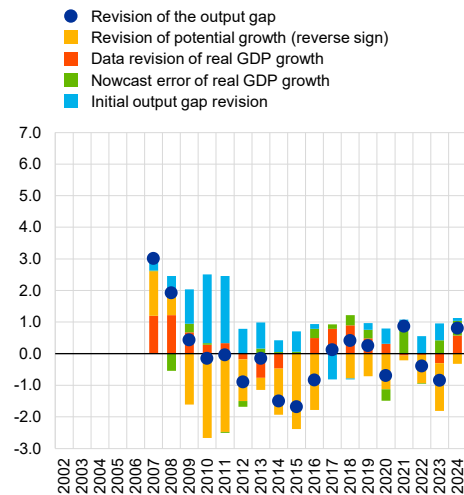
a) European Commission



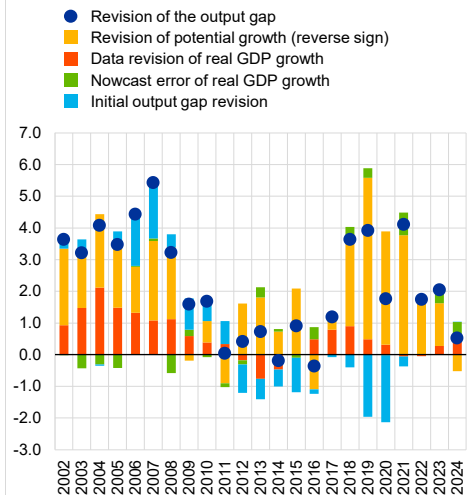
b) IMF



c) Eurosystem



d) OECD

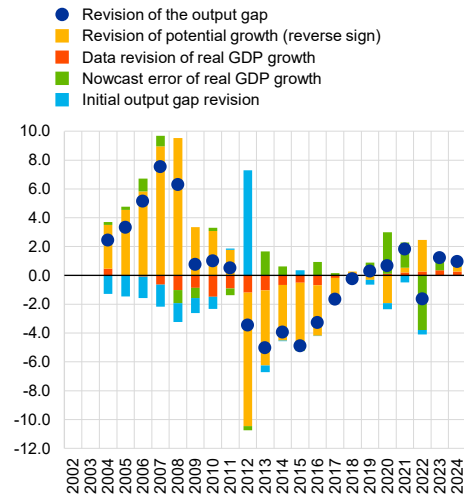


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

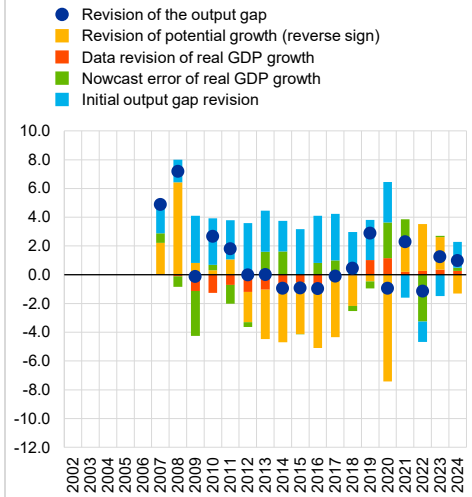
Chart 24

A decomposition of the revisions of the output gap, Slovenia

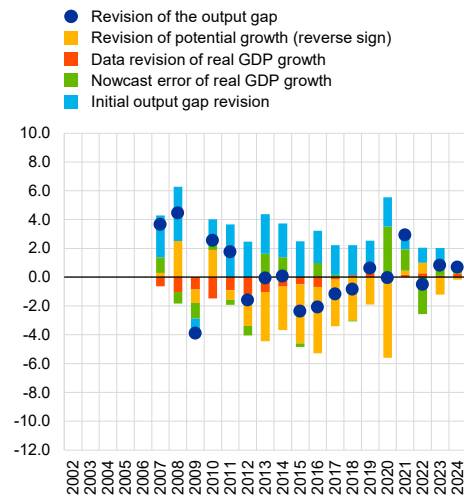
a) European Commission



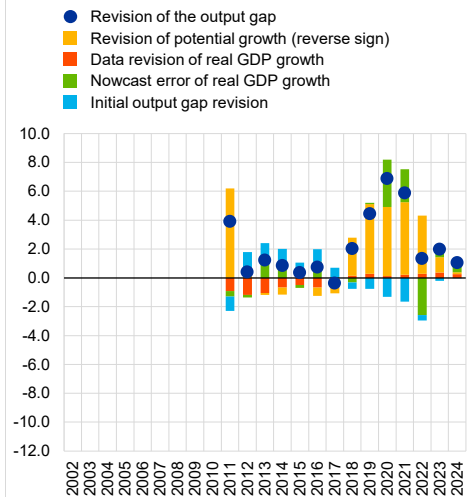
b) IMF



c) Eurosystem



d) OECD

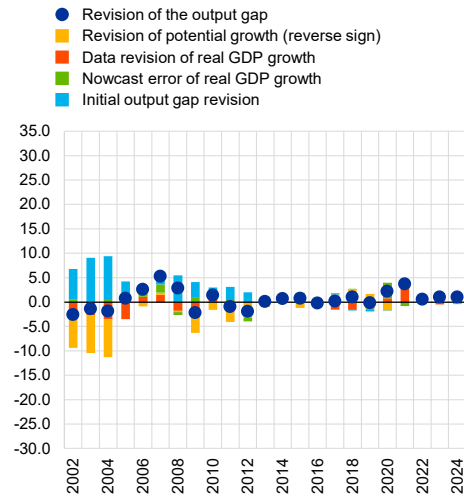


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

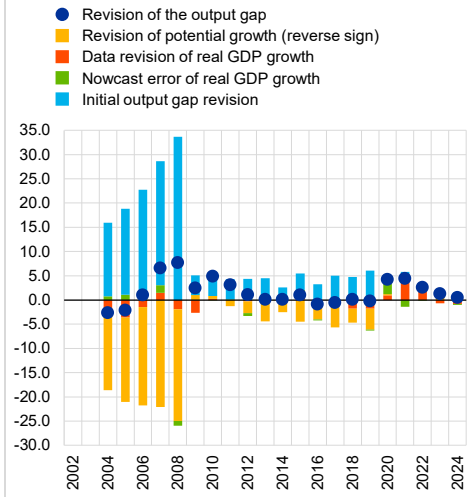
Chart 25

A decomposition of the revisions of the output gap, Slovakia

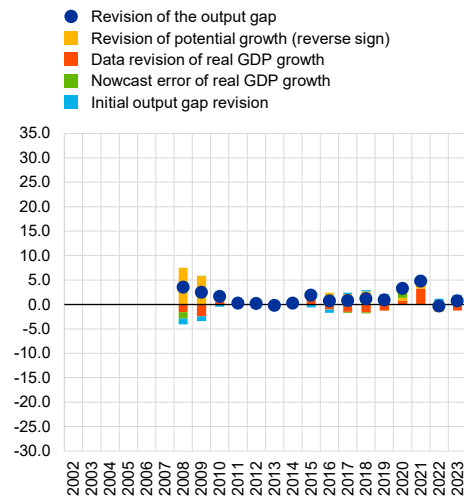
a) European Commission



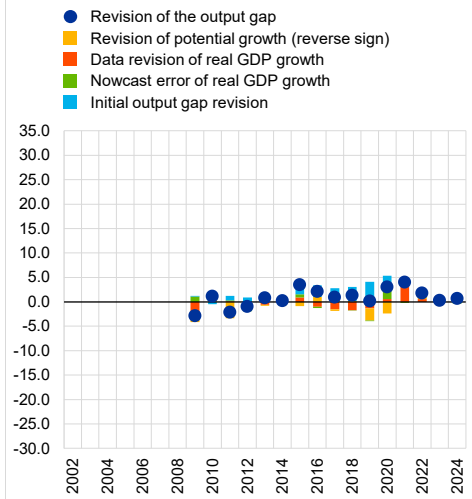
b) IMF



c) Eurosystem



d) OECD

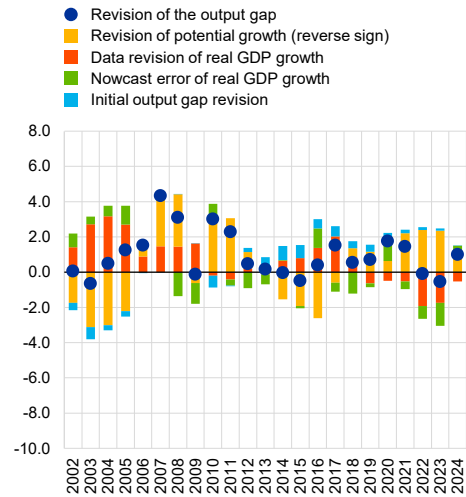


Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

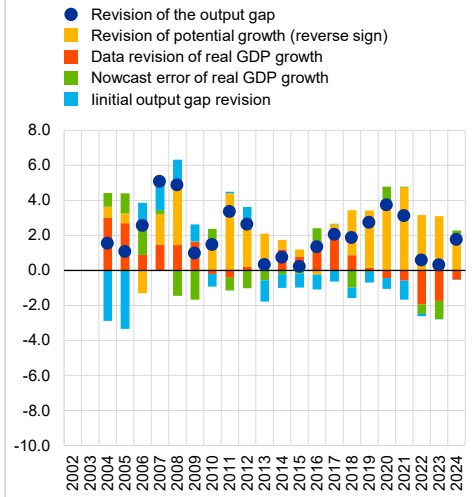
Chart 26

A decomposition of the revisions of the output gap, Finland

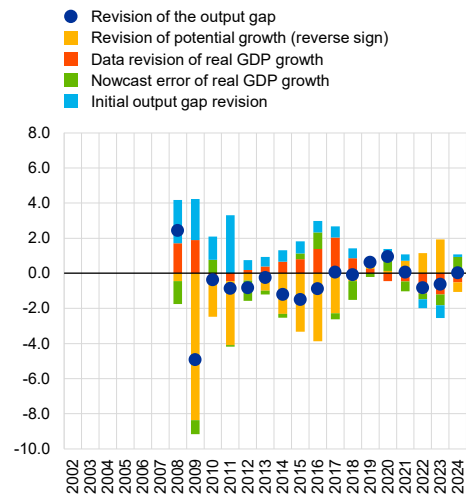
a) European Commission



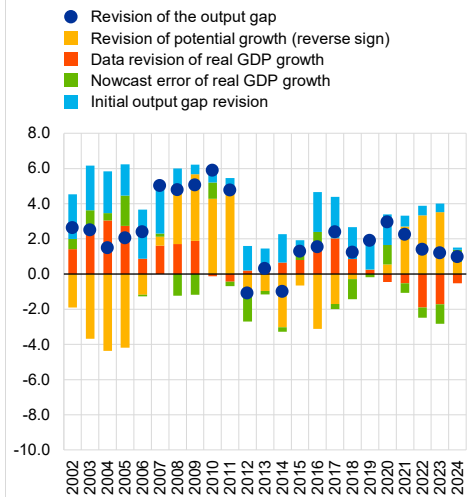
b) IMF



c) Eurosystem



d) OECD



Source: Author's calculations based on European Commission, Eurosystem, IMF and OECD data.

Acknowledgements

I would like to thank João Sousa, Paloma Lopez-Garcia, Bettina Landau, Christoph Planas, members of the ESCB Working Group on Forecasting, members of the EPC Output Gap Working Group and various ECB staff members for their useful comments and suggestions. I am also grateful to Ana Seco Justo for technical assistance. Any errors are my own.

Bela Szörfi

European Central Bank, Frankfurt am Main, Germany; email: bela.szorfi@ecb.europa.eu

© European Central Bank, 2026

Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website www.ecb.europa.eu

All rights reserved. Any reproduction, publication and reprint in the form of a different publication, whether printed or produced electronically, in whole or in part, is permitted only with the explicit written authorisation of the ECB or the authors.

This paper can be downloaded without charge from the [ECB website](http://www.ecb.europa.eu), from the [Social Science Research Network electronic library](http://www.ssrn.com) or from [RePEc: Research Papers in Economics](http://www.repec.org). Information on all of the papers published in the ECB Occasional Paper Series can be found on the ECB's website.

PDF ISBN 978-92-899-7916-0, ISSN 1725-6534, doi:10.2866/5503104, QB-01-26-163-EN-N