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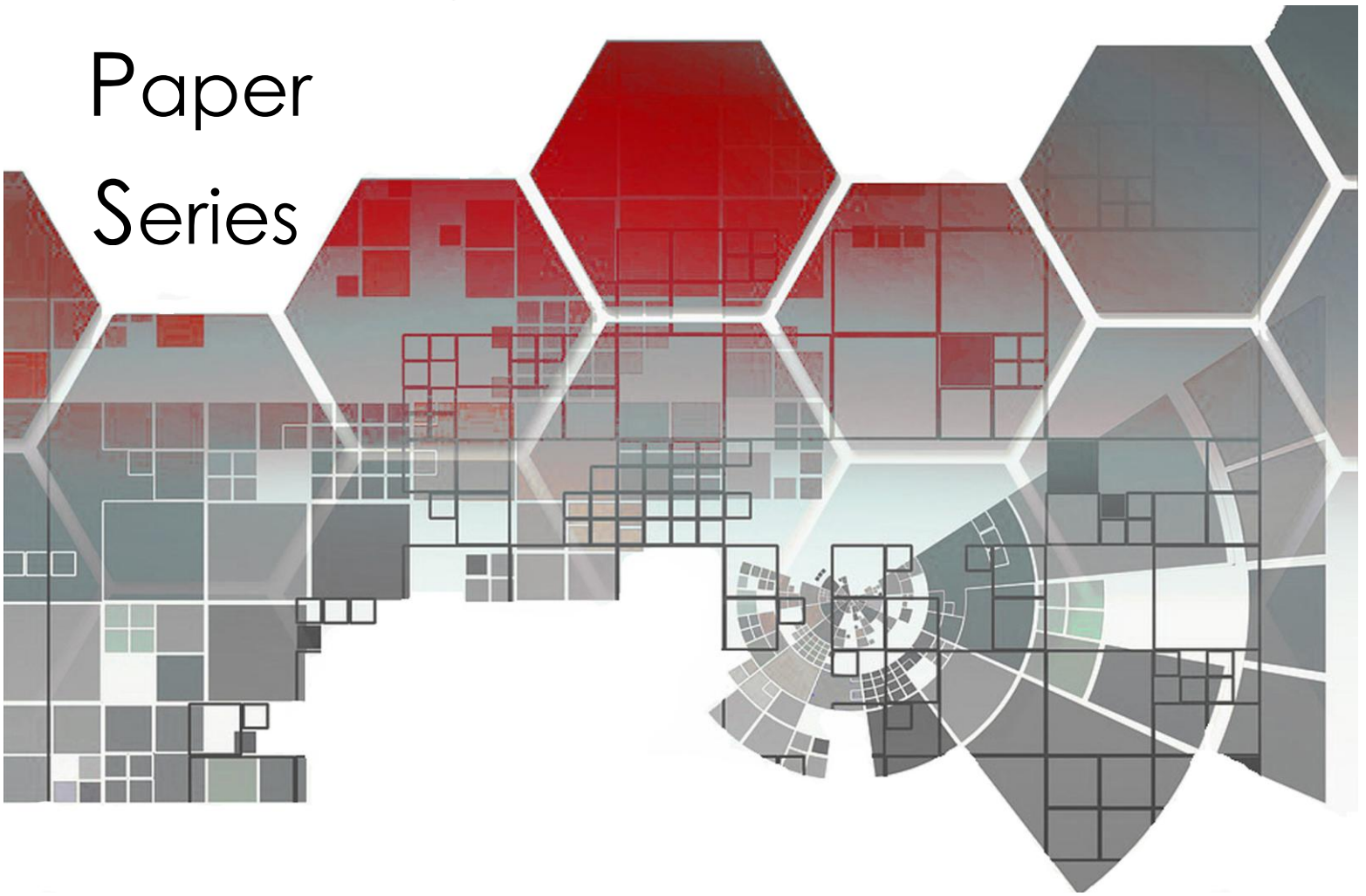

Izabela Sobiech Pellegrini

Revising potential: major revisions to EUCAM growth projections and their underlying drivers

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Abstract

This paper analyzes revisions to potential GDP estimates for EU member states using the European Commission's commonly agreed methodology (EUCAM) between autumn 2019 and autumn 2024. The unprecedented series of shocks—including the COVID-19 pandemic, Russia's invasion of Ukraine, energy and inflation crises, and large-scale migration flows—has severely tested the stability of these estimates. Comparing the pre- and post-pandemic projections reveals that while revisions for 2020 were minimal (average 0% for EU27), they accumulate substantially over time, indicating permanent effects. By spring 2024, eighteen Member States experienced downward revisions while eight of them saw upward adjustments, with some Central and Eastern European countries facing 10-30% reductions in ten-year projections of potential GDP. Using Poland as a detailed case study, we demonstrate that the methodology exhibits counterintuitive properties: increases in employment and capital lead to lower potential growth projections through negative effects on the trend of total factor productivity (TFP), while decreases in hours worked have the opposite effect. This sensitivity to the end-point observations creates procyclical bias in estimates. Comparison with Canadian experience suggests alternative approaches to incorporating migration shocks. Findings highlight fundamental challenges in production function approaches during periods of structural change and raise questions about their appropriateness for policy guidance.

Key words: potential output, output gaps, total factor productivity, production function methodology

JEL classification: E27, E32, E60, O4

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Introduction

Accurate estimation of potential output is fundamental to sound macroeconomic policy yet remains one of the most challenging tasks facing fiscal and monetary authorities. Researchers across academia, central banks, and major international institutions have developed a range of methodologies designed to provide robust estimates of potential output. The European Commission's commonly agreed methodology (EUCAM) provides standardized estimates of potential GDP for all EU Member States (MS), serving as a cornerstone for fiscal surveillance in the new economic governance framework. However, the unprecedented sequence of shocks experienced since 2019—including the COVID-19 pandemic, Russia's invasion of Ukraine, subsequent energy and inflation crises, and large-scale migration flows—has severely tested the stability and reliability of these estimates. Some of the issues raised in this paper are not new — already before the pandemic economists have been highlighting significant and persistent downward revisions of potential output and overly optimistic output gap estimates, even a decade after the global financial crisis.

This paper examines the magnitude and sources of potential output revisions across EU member states between autumn 2019 and autumn 2024, with particular focus on Poland as an illustrative case study. Our decomposition analysis for Poland reveals a fundamental flaw in how EUCAM responds to data revisions: the methodology exhibits extreme sensitivity to end-point observations through the total factor productivity channel. This sensitivity produces counterintuitive results where upward revisions to employment and capital data paradoxically lead to lower potential growth projections, while downward revisions to hours worked increase them. These findings raise important questions about the procyclicality of current estimation methods and their potential to distort policy decisions by attributing long-run effects to temporary shocks.

This paper is structured as follows: section 1 provides an overview of the existing methodologies for potential output and output gap estimation methodologies. Special attention is given to the EUCAM, which was developed by the European Commission jointly with experts from Member States. The magnitude of revisions obtained with this methodology in recent years is presented in section 2. Section 3 focuses on Poland as an example of a country which faced a positive migration shock in the last years and experienced downward revisions of potential GDP projections in EUCAM. Section 4 sets the results in a broader context and provides the concluding remarks.

1. Potential GDP estimation – different academic approaches

Potential gross domestic product is a supply-side measure of the aggregate economy that aims to answer the question: how much output the economy can produce under conditions of full employment (Okun, 1962). It is a measure of productive capacity of an economy, considering also other socially desired aspects of macroeconomic equilibria – price stability and free markets. Therefore, potential output describes the maximum level of production, employing all available means of production which at the same time does not generate inflationary pressure. It is sometimes referred to as a measure of sustainable growth (Havik et al., 2014).

(Álvarez & Gómez-Loscos, 2018) and (Chen & Gornicka, 2020) provide an overview over the existent estimation methods, which can be broadly grouped into two categories:

- Univariate statistical filters – such as Hodrick-Prescott, Hamilton, Beveridge-Nelson filters – applied directly to the real GDP series to extract potential output as the trend component.
- Multivariate approaches: Okun's law, production function approach, Blanchard-Quah, joint estimation of inflation and output gap (based on Phillips curve models), RBC and DSGE models. In these approaches trend extractions are linked to economic theory.

Potential GDP estimation in practice

Potential output estimates and the output gap are of particular interest for monetary and fiscal authorities. Firstly, these measures help to assess the cyclical position of the economy in real time and to make decisions on stabilization policies, either monetary or fiscal, if necessary. Secondly, the real-time stability of fiscal policy is assessed based measures of cyclically adjusted government budget balance. Moreover, structural policies also rely on potential GDP estimates, which help to identify the impact of e.g. demographic changes.

For these reasons both international institutions (International Monetary Fund – IMF, the Organisation for Economic Co-operation and Development – OECD, EC) and national monetary and fiscal authorities provide estimates of potential GDP and the output gap.[2] The production function approach is the predominant method applied, however some institutions allow for adjustments based on expert judgement or on estimates obtained from other methods. Central banks (e.g. Federal Reserve Bank – FED, European Central Bank – ECB, Bank of Canada) usually use a judgmental mixture of purely statistical and structural procedures (such as unobserved components models). The EC's methodology (which is described in detail below) is very standardized, country-specific modifications are only possible after a formal request from a given MS and detailed technical evaluation of the consequences both for the given MS and for all others.

The level of aggregation of the data can differ – for example, in the United States the Congressional Budget Office (CBO) estimates potential output based on trends of factors of production in five main sectors of the economy.[3] Country-level potential GDP is the sum of sectoral trends. Factors of production differ across sectors, for each factor of production the CBO estimates of trend growth rates are based on data from the two most recent business cycles (as dated by the National Bureau of Economic Research) (Coibion et al., 2018). (Błażej et al., 2025) recently developed a similar bottom-up approach to estimating the output gap in Poland[4]. Other institutions usually focus on country-level data.

(EUIFIs, 2020) and (Williams, 2017) provide overviews of existing methodologies and challenges related to potential output and the output gap from the perspective of fiscal and monetary authorities. (González-Torres Fernandez et al., 2023) provide the context of additional challenges related to this topic in times of more frequent temporary supply shocks.

EUCAM – methodology description

The EUCAM is described in detail in (Blondeau et al., 2021) and (Havik et al., 2014). It is a production function approach, based on the Cobb-Douglas aggregate production function with

[2] For a description of the OECD methodology see (Chalaux & Guillemette, 2019), the IMF uses country-specific methodologies, e.g. (International Monetary Fund, 2022) for Poland.
[3] Nonfarm business, agriculture and forestry, households, nonprofit organizations serving households, and government.
[4] The approach can, however, be only applied to historical data, the authors do not propose any out-of-sample projection methodology.

constant returns to scale and a common elasticity of labor of 0.65 for all Member States (see Equation (1)). The factors of production are labor (measured in total hours worked[5]), the capital stock and total factor productivity (Solow residual). Trends are extracted separately for each factor of production and methodologies differ depending on the variable and on forecasting horizon (2 years ahead, 3 to 5 years ahead, 6 to 10 years ahead). The forecast horizons are referred to as T+2, T+5 and T+10 respectively, where T is the last year for which a full set of annual data is available (in line with European Commission's economic forecasts)[6].

$$Y_t = TFP \cdot L^{\alpha} \cdot K^{1-\alpha} \qquad (1)$$

The trend estimations and projections are annual and based almost entirely on annual data, with few exceptions where higher frequency data is used. The main data source is the AMECO database. As a general rule, capital and population data are not detrended – they are treated as the entire stock describing the full capacity of the economy each year. These two series are rather smooth. As for the remaining factors over the T+2 horizon the following methodologies are applied:

- TFP – trend obtained by Kalman filter ($POTTFP_t$), using capacity utilization data as an observed indicator of the cyclical position of the economy.
- NAWRU rate – Kalman filtering, using the LFS harmonized unemployment rate as an observed indicator of the cyclical position of the economy. Additionally, a Phillips curve is included as another observation equation with a labor cost indicator as the observed indicator of the cyclical position of the labor market in the economy. The Phillips curve can be either forward-looking or backward-looking, and the choice is made by matching country data. The Kalman filter projections are capped by the T+10 country-specific NAWRU anchor.[7]
- Hours worked per worker – extended by 5 years with a forecast from an autoregressive process and afterwards the trend is extracted using a standard HP filter ($\lambda = 10$) – renders $hperehp_t$
- Participation rate – same procedure as above for hours worked per worker – renders $parts_t$

The estimate of potential GDP ($YPOT_t$) is then obtained as:

$$YPOT_t = POTTFP_t \cdot LP_t^{\alpha} \cdot K_t^{1-\alpha} \qquad (2)$$

where the potential labor input (LP_t) is further decomposed into:

$$LP_t = hperehp_t \cdot popw_t \cdot \frac{parts_t}{100} \cdot \left(1 - \frac{nawru_t}{100}\right) \qquad (3)$$

In principle, the EUCAM applies to all Member States, however country-specific adjustments are allowed in economically justified cases (for example, unavailability of specific time series, short samples, etc.). The number of lags in autoregressive processes is also country-specific, and data driven (subject to lag selection criteria).

[5] $L_t = hpere_t \cdot empl_t$, where $hpere_t$ denotes average annual hours worked per worker.
[6] In the spring forecasts T is the previous calendar year, in the autumn forecasts –the current year, see for example https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/economic-forecasts/autumn-2024-economic-forecast-gradual-rebound-adverse-environment_en, accessed on 21.11.2024.
[7] The T+10 NAWRU anchor is estimated in panel regression using structural labor market indicators jointly for all MS. For more details see (Hristov, Planas, et al., 2017).

A few adjustments of the methodology have been made in 2020 and 2021 in response to the COVID-19 crisis in order to assure stability of potential output estimates. They consisted of the inclusion of dummy variables for the year 2020 (and 2021) to reflect labor hoarding in the Phillips curve equation and of smoothing hours worked per worker.[8] The aim of the adjustments was to keep potential GDP estimates as stable as possible relative to the AF2019 baseline. In 2024 these adjustments are still used for some countries.

After the Russian aggression on Ukraine in 2022 and increased migration flows from the affected regions towards EU countries additional adjustments to the methodology were introduced. Due to the initial lack of official data, estimated numbers of refugees needed to be added to population statistics and their participation rates had to be separately computed in order to exclude them from long-run trends. Since then, the EC provides data and forecasts for the number of working age refugees in each country, and their breakdown into employed, unemployed and inactive. Horizontal assumptions are used in the projections of the geographical distribution of refugees across EU countries and the evolution of refugee-specific unemployment rates[9].

Projections for the T+3 to T+5 horizon are based on specific trend extrapolation and the assumed linear output gap closure in three years (by 1/3 of the initial gap each year). The following system of equations is solved:

$$YPOT_t = \exp(srk_t) \cdot LP_t^{\alpha} \cdot K_t^{1-\alpha}$$

$$K_t = IQ_t + (1 - \delta_t) \cdot K_{t-1}$$

$$IQ_t = \left(\frac{IYPOT_t}{100}\right) \cdot YPOT_t$$

$$Y_t = YPOT_t \cdot \left(1 + \frac{YGAP_t}{100}\right) \qquad (4)$$

where:

IQ_t- investment (gross fixed capital formation at constant 2015 prices)

$IYPOT_t$- share of investment in potential GDP (%)

δ_t- depreciation rate of capital (based on historical data, kept constant in the forecast)

Working-age population data is extended using average growth rates implied by the most recent EUROPOP projection of Eurostat and the NAWRU rate is assumed to stabilize after one year:

$$nawru_{T+3} = nawru_{T+2} + \frac{1}{2} \cdot (nawru_{T+2} - nawru_{T+1})$$

[8] In many EU countries governments introduced and/or extended to a large-scale job retention schemes /short-time schemes to retain employment and know-how in firms. Such schemes generated a large drop in hours worked which is supposed to be transitory and should not affect estimates of potential output in the following years. The 2020 hours worked value was replaced by its average from the adjacent years so that the HP-filtered trend series remains stable.

[9] EC provides projections of the total number of active temporary protection registrations which are updated in each vintage of the forecast. The geographical distribution of the people is assumed to remain unchanged, reflecting their current distribution. For more details on the current assumptions see (Directorate-General for Economic and Financial Affairs, 2024)

$$nawru_{T+5} = nawru_{T+4} = nawru_{T+3} \qquad (5)$$

The forecast of actual GDP and its components is created by applying the mechanical gap closure rule to each variable. In other words, the TFP gap, unemployment rate gap, etc. are assumed to close by 1/3 of the initial gap each year from T+3 to T+5. All vintages of EC's potential output estimates over the T+5 horizon are publicly available at https://circabc.europa.eu/.[10]

As for the T+6 to T+10 extension of potential output estimates, they are based mostly on simple extrapolation of trends:

- TFP – projection from the same Kalman filter as in the T+2 and T+5 horizons,
- Capital formation – as in Equation (4),
- NAWRU rate – gradual and smoothed convergence towards the T+10 NAWRU anchor, however the total change from T+6 to T+10 is capped in the range between -5.0 and 1.0 percentage point.
- Trend participation rates – converge to Ageing Working Group projections (from the latest Ageing Report) in growth rates,
- Hours worked per worker – gradual stabilization after T+5.

The T+10 methodology is currently under review by the Potential Output Working Group. Estimation results are not publicly available.

EC uses two tools to analyze the revision magnitude and plausibility of output gap estimates between two adjacent forecast vintages[11]. The first analysis focuses on T+1 and T+2 potential output growth estimates. The difference in estimates between two neighboring forecasts (for example, AF2021 and SF2021) is decomposed into 1) the impact of historical data and short-term forecast revisions, 2) large (horizontal) methodological changes and 3) changes made by the EC (parametrization, for example update of NAWRU anchor, number of lags in equations). In general, since 2019 the average revision of potential output growth was lower than 0.5 p.p. and it was almost entirely caused by the outturn data and short-term forecast revisions. Apart from SF2020 there have been no other large methodological changes. In SF2020 there were new elements applied: a new NAWRU anchor estimation method, adaptations in hours worked (smoothing), the CUBS series (estimate for 2020) and the Philips curve equation ("labour hoarding" dummy for 2020 and 2021 for chosen MS)[12]. Such a revision analysis is not available for all vintages, in particular, SF2021 and both vintages from 2022 are missing. While this tool can be useful to see sources of revisions between the autumn and spring vintage which have the same horizon, it is not possible to evaluate how revisions accumulate over time, as the T+1 and T+2 dates are not constant.

The plausibility tool helps assess the level of potential output estimated for each country for the year T, based on a comparison of the output gap resulting from the EUCAM production function (PF) approach with $\widehat{OG}_{it}$ projections from a panel regression, in which the EUCAM output gaps until the year T are regressed on cyclical indicators. Two sets of confidence bounds are created for each country for the year T: 90% and 68%, using quantiles of the normal distribution and the root-mean-square errors (RMSE):

[10] The path is Continue as visitor -> European Commission -> Economic and Financial Affairs -> Output Gaps -> Library (accessed on 25.11.2024). The library also includes the EUCAM package which allows for replication of the results in MS Excel and provides all source codes.
[11] The results of both analyses are publicly available at circabc.europa.eu.
[12] See footnote 8 for more information about the temporary methodological adaptations.

$$RMSE_i = \sqrt{\frac{1}{T_i}\sum_t \left(OG_{it} - \widehat{OG}_{it}\right)^2} \qquad (6)$$

Where OG_{it} denotes the output gap for country *i* in year *t*, resulting from EUCAM PF approach. If the PF output gap lies outside the RMSE90, the result is automatically flagged as potentially counterintuitive and necessitating immediate further investigation. Results out of the RMSE68 bound are flagged as borderline cases (for more details see Hristov, Raciborski, et al., 2017). In AF2019 only DE was flagged as possibly counterintuitive. No plausibility assessment was published in 2020 and 2021. The note accompanying the SF2021 edition recommended treating the results with a grain of salt. In that edition Czech Republic was flagged and has remained flagged as counterintuitive until now (AF2024). Hungary, Poland, Estonia and Cyprus were flagged at least once since 2022 (respectively 4, 3, 2 and 1 time). In AF2022, when adaptions to methodology related to the influx of refugees from Ukraine where introduced (in many countries on top of the COVID-19 adaptations), and in SF2023 overall 11 countries were flagged as "borderline cases" (output gap out of the RMSE68 bound), 6 countries in AF2023 and SF2024, and 4 countries in AF2024. This indicates that EUCAM results have become more unstable in 2022, and for many countries the results were inconsistent with the structural econometric model.

While the production function approach has become gold standard for potential output estimation, it is not free of limitations. (Chen & Gornicka, 2020) list the main drawbacks of the approach. First, it relies on assumptions of perfect competition and constant returns to scale through the Cobb-Douglas function, which poorly reflect modern economies characterized by monopolistic competition and varying returns across sectors. Second, the approach of single-sector aggregation (in the of EUCAM) ignores substantial heterogeneity within economies, potentially missing important structural dynamics. Choosing the appropriate detrending method for each component of the production function is also not straightforward.

2. Projection revisions since AF2019

We start with a comparison of pre- and post-pandemic projections of potential GDP. Table 1 shows the scale of revisions based on AF2021 and AF2019 EC economic forecast vintages in percent deviations from the AF2019 projections. While AF2019 is the last forecast vintage before the outbreak of the COVID-19 pandemic in the first quarter of 2020, AF2021 is the last forecast vintage before the outbreak of war in Ukraine and the subsequent energy, inflation and migration crises. At the same time, choosing AF2021 as the post-pandemic reference can be also justified by the fact that the EUCAM estimates were undergoing several adjustments in 2020 and 2021. In the autumn 2021 there was the biggest chance that these adjustments were appropriate and that the possibly permanent impact of temporary shocks was mitigated.

As can be seen in Table 1, the revisions of potential output estimates for 2020 are actually not large (with the exception of a few countries: Ireland, Luxembourg, Bulgaria, Cyprus and Greece). A simple average revision for the EU27 countries is around 0%, with a standard deviation of 2.5. However, revisions accumulate over time – the average revision for the year 2023 is slightly below 1% and twice as much for 2028. This means that the pandemic did have a permanent effect on potential GDP.

Table 1 Potential GDP revisions during the COVID-19 pandemic

YEAR	AUT	BEL	BGR	HRV	CYP	CZE	DNK	EST	FIN	FRA	DEU	GRC	HUN	IRL	ITA	LVA	LTU	LUX	MLT	NLD	POL	PRT	ROM	SVK	SVN	ESP	SWE	avg.	std.dev.
2019	-1.5	-0.3	-3.1	1.0	3.7	0.5	2.2	1.3	-0.2	-0.3	-0.7	-2.9	0.9	4.7	-0.4	0.0	1.8	5.4	1.8	-0.4	0.1	-1.0	-0.8	-0.8	0.5	-0.6	0.5	0.4	1.9
2020	-2.2	-0.6	-4.1	-0.1	4.0	-0.8	2.5	1.8	-0.3	-0.7	-1.1	-4.0	0.6	7.9	-0.5	-0.8	2.1	5.2	-0.6	-0.7	-0.6	-1.6	-1.2	-1.9	-0.3	-1.7	0.5	0.0	2.5
2021	-2.6	-0.6	-4.7	0.1	4.3	-1.6	3.0	2.6	-0.1	-0.8	-1.4	-3.9	0.6	9.7	-0.6	-0.9	2.2	5.3	-2.3	-0.7	-0.9	-1.9	-0.9	-2.7	-0.8	-2.2	0.4	-0.1	3.0
2022	-2.7	-0.2	-4.8	1.2	4.9	-1.6	3.8	3.1	0.6	-0.3	-1.3	-3.3	0.8	11.4	0.1	-0.5	3.6	5.4	-3.4	-0.4	-0.7	-1.5	-0.5	-2.2	-1.1	-1.9	0.6	0.3	3.3
2023	-2.6	0.5	-4.6	2.9	5.7	-1.5	4.6	3.4	1.3	0.3	-1.1	-2.6	0.9	13.4	0.9	0.2	5.0	5.6	-3.9	0.1	-0.4	-0.9	0.3	-1.1	-1.1	-1.2	0.7	0.9	3.6
2024	-2.7	0.9	-4.6	4.5	6.2	-1.7	5.0	3.7	1.6	0.6	-0.9	-1.9	1.1	15.6	1.8	0.5	5.4	5.3	-5.5	0.3	-0.2	-0.7	0.6	-0.4	-1.2	-0.8	0.9	1.2	4.0
2025	-2.9	1.3	-4.6	5.7	6.5	-1.8	5.2	3.8	1.9	0.7	-0.7	-1.2	1.2	18.0	2.7	0.5	5.7	5.2	-7.3	0.5	-0.3	-0.6	0.6	0.1	-1.1	-0.6	0.9	1.5	4.5
2026	-3.0	1.6	-4.5	6.8	6.6	-1.9	5.1	4.0	2.0	0.6	-0.4	-0.6	1.4	20.5	3.7	0.4	6.2	5.3	-9.1	0.6	-0.4	-0.5	0.3	0.3	-0.8	-0.5	0.6	1.6	5.0
2027	-3.1	1.9	-4.5	7.4	6.6	-2.1	5.0	4.0	2.0	0.4	-0.1	0.1	1.4	22.9	4.6	0.1	6.6	5.2	-10.7	0.7	-0.8	-0.5	-0.1	0.5	-0.4	-0.5	0.3	1.7	5.6
2028	-3.2	2.1	-4.6	7.7	6.6	-2.3	4.9	4.2	1.9	0.2	0.2	0.6	1.5	25.0	5.4	-0.3	7.2	5.1	-12.1	0.6	-1.1	-0.6	-0.5	0.6	0.0	-0.6	-0.2	1.8	6.0
2029	-3.3	2.2	-4.9	7.7	6.6	-2.5	4.8	4.4	1.7	-0.1	0.3	1.1	1.5	27.0	6.2	-0.7	7.6	4.9	-13.4	0.5	-1.5	-0.8	-0.9	0.6	0.3	-0.8	-0.7	1.8	6.5
avg.	-2.7	0.8	-4.4	4.1	5.6	-1.6	4.2	3.3	1.1	0.1	-0.7	-1.7	1.1	16.0	2.2	-0.1	4.9	5.3	-6.0	0.1	-0.6	-1.0	-0.3	-0.6	-0.5	-1.0	0.4	1.0	4.2

Note: This table shows the percentage changes in potential output estimates for each country in each year: $(YPOT_{t,AF2021} - YPOT_{t,AF2019})/YPOT_{t,AF2019} * 100\%$. Potential GDP is measured in national currencies in constant prices (2015=100), similarly to real GDP.

The direction of revisions is not consistent across Member States. While downward revisions can be explained by the protracted effects of the COVID-19 shock, upward revisions are more difficult to justify, given that EUCAM estimates were designed to mitigate temporary shock effects. It should be noted that, even though the forecast vintages are based on different population projections of EUROSTAT, none of them accounts for the impact of the pandemic on life expectancy. Revisions can be partly caused by changes in demographic projections, but only from T+2 onwards, when population projections are based on growth rates from EUROPOP.

It should be noted that in many MS there were substantial revisions of the 2019 potential output value and that in some cases these revisions proliferated over time (see, for example, Austria, Bulgaria, Estonia, Lithuania). This can be due to revisions of outturn data for 2019 (in AF2019 it was still a forecast), however revisions of the magnitude of 3% are rather difficult to justify by revisions of historical data. The revisions of 2019 potential GDP can also be linked to the impact of COVID-19, which really alters not only future potential output estimates but also values from the near past.[13] All of the above point to the instability of the estimates in the presence of large shocks.

Extending the analysis beyond the pandemic period to capture the additional impact of Russia's invasion of Ukraine and subsequent energy and migration crises reveals even larger and more varied revisions across MS. Table 2 shows the scale of revisions based on SF2024 and AF2021 EC economic forecast vintages in percent deviations from the AF2021 projections. While the average revision is rather small (-0.7%), there is an increasing variation in magnitude over time. In other words, the further in the future is the projection year, the more variation there is in the size of revisions across MS. For some MS the T+10 potential GDP projections have been revised upwards or downwards by 10, 20 or even 30%. Overall, potential output estimates have been lowered for eighteen MS and increased for eight MS. While some degree of downward revision can be justified by deteriorating global macroeconomic conditions since 2019, potential GDP losses of 5 to 10% projected for many Central and Eastern European MS[14] appear difficult to justify, given that these are catch-up economies. Together with upward revisions in "old" MS (or

[13] In EUCAM trends of potential GDP components are extracted from the entire time series of underlying data. For example, the NAWRU rate in the T+2 horizon is the result of the Kalman filter applied on the entire path of observed unemployment rates in a given country, considering also the EC forecasts for T+1 and T+2. This means that a revision of one data point will lead to a re-estimation of the entire path of the NAWRU rate. As it is a trend it should not be affected substantially, but large punctual revisions of historical data/T+2 data can lead to non-negligible trend revisions in periods surrounding the revised data point.

[14] Countries who joined the EU since 2004.

more modest downward revisions) this implies that less developed countries are actually expected to converge at a slower rate (or even diverge).

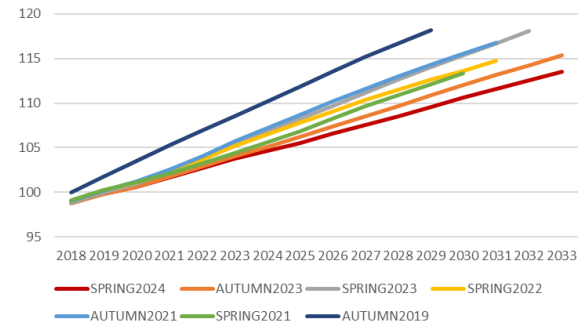
Table 2 Potential GDP revisions between autumn 2021 and spring 2024

YEAR	AUT	BEL	BGR	HRV	CYP	CZE	DNK	EST	FIN	FRA	DEU	GRC	HUN	IRL	ITA	LVA	LTU	LUX	MLT	NLD	POL	PRT	ROM	SVK	SVN	ESP	SWE	avg.	std.dev.
2019	-0.3	0.5	1.3		2.3	-0.6	0.1	-0.5	-0.6	-0.7	-0.2	3.3	-0.5	1.9	0.5	-1.0	-0.6	-0.7	4.1	0.3	0.8	0.8	0.6	0.6	0.1	-0.1	0.1	0.4	1.3
2020	-0.5	0.7	1.9		3.3	-0.3	0.0	-1.2	-0.9	-0.7	-0.4	3.5	-1.0	1.3	0.4	-1.8	-0.9	-1.0	6.1	0.6	1.1	0.9	0.5	0.4	0.3	-0.2	0.4	0.5	1.7
2021	-0.9	0.8	2.3		3.9	-1.4	0.0	-2.7	-1.7	-0.9	-1.0	2.6	-1.4	-0.2	0.1	-2.2	-0.8	-1.5	6.8	1.0	0.7	1.4	-0.8	-0.1	0.1	-0.6	0.9	0.2	2.0
2022	-1.3	1.0	2.6		4.3	-2.5	0.2	-4.7	-2.0	-1.3	-1.6	1.8	-2.2	-0.6	0.1	-3.7	-1.5	-2.3	10.2	1.6	1.3	1.4	-2.0	-1.4	-0.6	-0.6	0.8	-0.1	2.9
2023	-1.8	1.2	2.7		5.3	-2.8	0.2	-6.6	-2.4	-1.7	-2.3	1.1	-3.6	-1.3	0.0	-4.6	-2.4	-3.3	11.6	2.4	0.8	1.8	-3.2	-2.0	-0.9	-0.5	0.6	-0.5	3.5
2024	-2.4	1.3	3.2		6.7	-3.4	0.3	-8.9	-3.0	-1.9	-3.0	0.9	-4.9	-2.5	-0.4	-4.9	-2.6	-3.9	14.1	3.1	0.2	2.7	-3.8	-2.7	-1.2	0.0	0.0	-0.6	4.4
2025	-2.9	1.5	3.4		8.0	-3.8	0.3	-10.7	-3.5	-1.9	-3.7	1.1	-5.8	-3.9	-0.7	-4.6	-2.7	-4.6	16.9	3.8	-0.1	3.8	-4.1	-3.1	-1.5	0.7	-0.3	-0.7	5.2
2026	-3.3	1.7	3.7		8.6	-4.3	0.1	-12.5	-3.8	-2.2	-4.4	1.2	-6.8	-4.9	-1.1	-5.1	-2.9	-5.1	19.5	4.3	-0.8	4.4	-4.4	-3.9	-2.1	1.1	-0.4	-0.9	6.0
2027	-3.7	1.9	4.0		8.8	-4.8	-0.5	-14.5	-4.3	-2.7	-4.9	1.0	-7.7	-5.6	-1.5	-5.9	-3.6	-5.4	22.1	4.7	-1.6	5.0	-4.9	-4.9	-2.8	1.5	-0.5	-1.2	6.7
2028	-4.0	2.1	4.5		8.8	-5.3	-1.3	-16.5	-4.7	-3.2	-5.2	0.8	-8.6	-6.0	-1.8	-6.7	-4.4	-5.4	24.4	5.1	-2.6	5.6	-5.6	-6.0	-3.3	2.0	-0.6	-1.5	7.4
2029	-4.1	2.3	4.9		8.6	-5.7	-1.9	-18.4	-5.2	-3.7	-5.5	0.6	-9.2	-6.1	-2.1	-7.4	-5.2	-5.4	26.8	5.7	-3.7	6.0	-6.2	-7.0	-3.6	2.5	-0.6	-1.7	8.1
2030	-4.2	2.6	5.4		8.4	-6.1	-2.4	-20.2	-6.0	-4.2	-5.7	0.3	-9.6	-6.0	-2.3	-7.9	-6.1	-5.3	29.1	6.4	-4.7	6.4	-6.8	-8.0	-3.8	3.1	-0.7	-1.9	8.7
2031	-4.4	3.0	5.9		8.1	-6.4	-2.7	-21.8	-6.7	-4.7	-5.9	0.1	-10.0	-5.7	-2.6	-8.4	-7.0	-5.3	31.2	7.0	-5.5	6.7	-7.4	-8.9	-4.0	3.8	-0.8	-2.0	9.4
avg.	-0.5	1.6	3.5		6.5	-3.6	-0.6	-10.7	-3.4	-2.3	-3.4	1.4	-5.5	-3.1	-0.9	-4.9	-3.1	-3.8	17.1	3.5	-1.1	3.6	-3.7	-3.6	-1.8	1.0	-0.4	-0.7	5.1

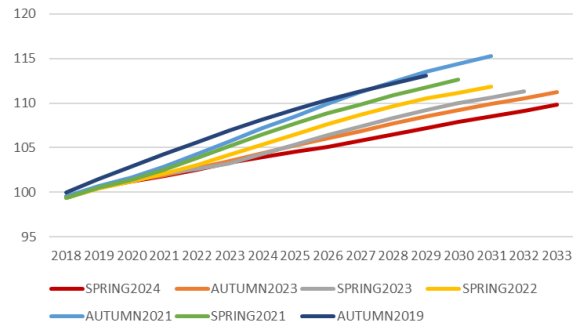
Note: Same methodology and interpretation as in Table 1. Missing values for HR due to the adoption of the euro in 2023 and the change in measurement units of potential GDP.

The magnitude of revisions across subsequent EC forecast vintages are further presented in Figure 1 and Figure 2. In a few countries AF2021 and AF2019 estimates overlap to a large extent (FR, PL, ET, NL), suggesting that the COVID-19 pandemic was a temporary shock and these economies will eventually go back to pre-2020 growth paths. The second pattern is represented by the consistency in "historical" potential output estimates – those obtained by filtering macroeconomic data in the T+2 horizon. In some countries, such as Poland, the estimates are stable until 2025 – meaning that the T+5/T+10 predictions based on trend extrapolations were in line with more recent estimates obtained from filtering outturn data. Additionally, the further we look into the future, the more tilted downwards the latest estimates are (or tilted upwards in Figure 2).

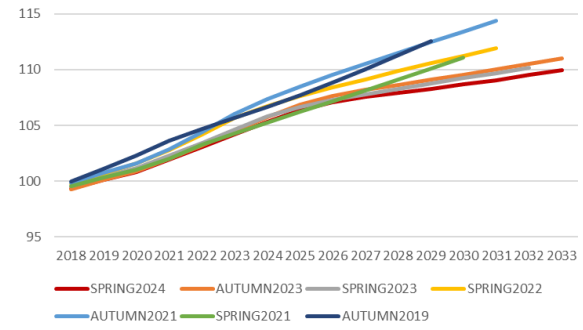
Figure 1 Potential output revisions since AF2019 in selected MS – downward revisions



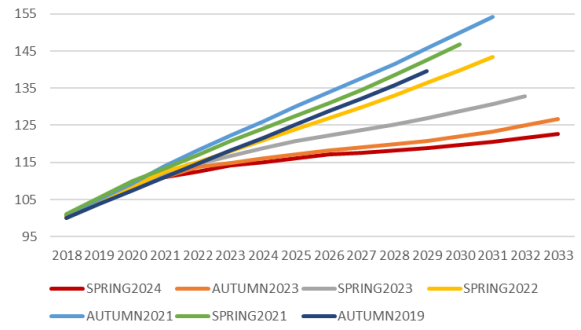
Austria



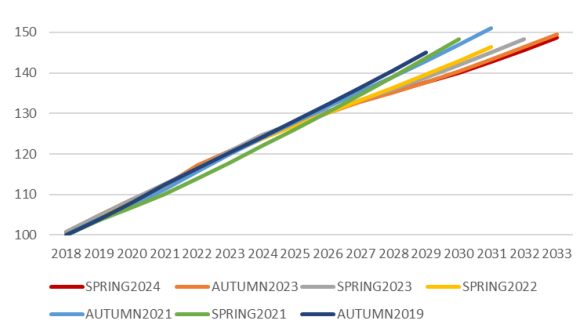
Germany



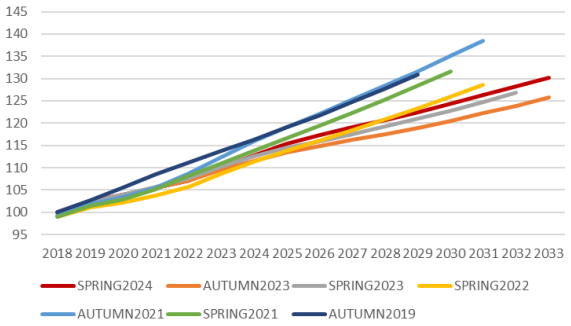
France



Estonia



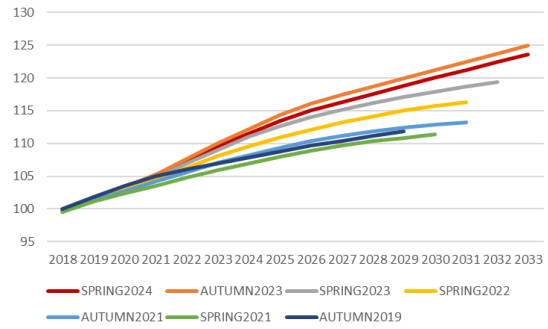
Poland



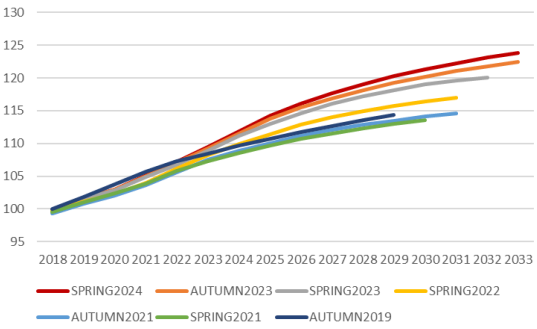
Slovakia

Note: Projections from each AMECO vintage were normalized such that AF2019 estimated value for potential GDP in 2018 is equal to 100. If, for example, the SF2024 value in year 2030 is equal to 140, it means that according to the spring forecast 2024 potential GDP in 2030 in this country will be 40% higher than the estimate for the year 2018 from autumn forecast 2019.

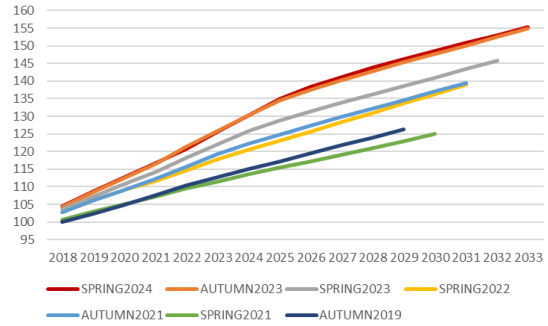
Figure 2 Potential output revisions since AF2019 in selected MS - upward revisions



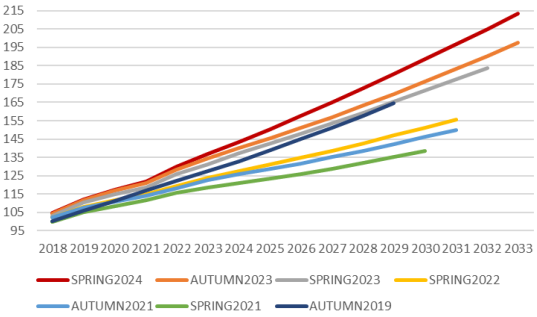
Netherlands



Portugal



Cyprus



Malta

Note: Same methodology and interpretation as in Figure 1.

3. Revision example – a closer look at the case of Poland

Before going into the detailed analysis, a brief look at potential growth decomposition might be helpful to learn about the main drivers of long-run growth in Poland. Table 3 presents a comparison between the decomposition of cumulated projected potential growth over the time horizon 2025-2031 – SF2024 vs. AF2021. While there is a 6.9 p.p. gap in cumulated potential growth, the decomposition looks similar in both cases in terms of proportions. The most relevant factor is potential Total Factor Productivity. This is a significant drawback of the

methodology – attributing a large fraction of economic growth to the "measure of our ignorance" hindering growth stimulating policy recommendations[15].

SF2024 is projecting an even stronger negative contribution of labor (persons), as well as a change from a positive to negative contribution of average hours worked per worker. These changes in contributions are related to data revisions mentioned in b) and will be further analyzed in the following sections.

It should be noted that such an analysis of changes in factor contributions to growth is not sufficient to evaluate which factors caused the largest revisions and in which directions. Each change in input data automatically leads to revisions of the TFP series and its trend. The analysis of average hours worked presented below shows that the impact of TFP growth projections can be stronger than the revision of the contribution of a given factor.

Table 3 Factor contributions to potential growth - SF2024 vs. AF2021

Cumulated 2025-2031 contribution	AF2021	SF2024	difference
Potential growth	21.83	14.96	-6.86
Sum of factor contributions:[16]	21.33	14.91	-6.42
TFP	15.78	11.24	-4.54
Labor (persons)	-3.13	-3.89	-0.76
Capital	8.37	7.82	-0.55
Hours worked	0.32	-0.25	-0.56

In order to evaluate the impact of each input on potential growth revisions, we have replaced EUCAM SF2024 input data with their AF2021 equivalents one after the other. This means that we do not consider each factor in isolation – our aim was to reproduce AF2021 projections, starting from SF2024 input and changing it step by step. It should be noted at this point that a full replication is not possible – in AF2021 the values in the years 2024-2025 were beyond the T+2 short-term COM forecast horizon, therefore they were projected using the EUCAM T+3 to T+5 methodology. In SF2024 these values are treated as given (COM country-desk short-term forecasts) and T+3 to T+5 methodology is applied to following years (for which in AF2021 the T+10 projection approach applied).

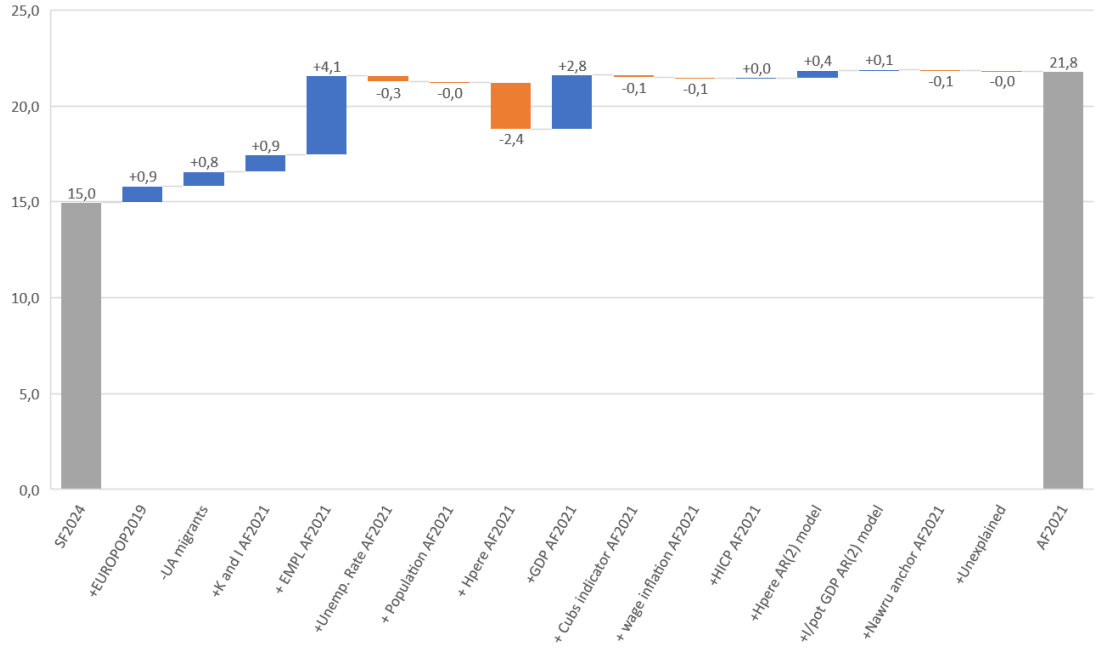
The results of this decomposition are shown in a summarized manner in Figure 3. Each bar of the graph shows changes in cumulated potential growth predictions obtained by changing the factor from the horizontal axis legend in the SF2024 input data, on top of previously made changes. This means that starting from the SF2024 predictions we first replace the source data for population growth rates to EUROPOP2019 (which is the one that was used in AF2021) and we obtain an increase in cumulated potential growth predictions by 0.9 p.p. Removing the assumptions of refugees in the labor market in each MS (introduced in AF2022) adds another 0.8 p.p. We continue replacing input data and other differences in assumptions until we obtain a result reasonably close to the original AF2021 predictions.

[15] For a genesis of this name see e.g. (Hulten, 2001)

[16] The sum of cumulated contributions of all factors of production is not exactly equal to the overall cumulated growth due to nonlinearities in the calculation of cumulated growth: $1 + g_Y^{cum} = \prod_{t=2025}^{2031}(1 + g_{Y,t}) \neq \sum_j \prod_{t=2025}^{2031}(1 + contribution_{j,t})$, where $j \in \{Labor, Hours, Capital, TFP\}$.

Our analysis shows that the downwards revision of the growth projections was mainly caused by revisions in employment, GDP, capital and investment data and T+2 forecasts. Around 30% of that was compensated for by changes in the average annual hours worked projections (second most important factor, with the opposite impact). The third important set of revisions includes the update of the population projections and consideration of increased migration flows from Ukraine since 2022[17].

Figure 3 Decomposition of cumulated potential growth revisions



The main reason for data revisions is the unpredictable shock caused by the Russian invasion on Ukraine in February 2022. However, in the case of employment data, there is also the 2021 National Population and Housing Census (2021 NPHC) that has been considered since 2022 (break in the series, jump by ca. 500 thousand as compared to the 2022 pre-census value). The upward revision of capital and investment data can be attributed, at least partially, to the inclusion of RRF financed projects.

In spring 2022 there was also a revision of historical LFS data, affecting the whole series of the unemployment rate. While this variable is used for the NAWRU rate extraction, the revision did not affect substantially the results in the projection period considered.

The estimate of hours worked per worker has been revised considerably. While in AF2021 it was assumed that an upward trend would continue until 2023 – data for 2022 and 2023 showed its reversal. This means that the contribution of trend *Hpere* to potential growth is not projected to be positive any more in SF2024. Yet, focusing only on the contribution to growth as shown in Table 3 is misleading, because it does not take into account the impact of changing the values of a known factor on TFP estimates. Lowering the values of a factor (which is what happened with *Hpere* in SF2024) translates into a larger unexplained part of GDP – and higher TFP value translates into higher TFP growth. This effect seems to more than compensate for the drop in hours worked leading to an overall opposite effect on growth. In other words, average hours

[17] We also analyzed the impact of the revision of population data but this change has only a negligible effect on potential growth projections.

worked per worker are lower in SF2024 than in AF2021, but they lead to higher potential growth through higher TFP growth.

Some minor changes in specifications were also applied, for example increasing the number of lags from 2 to 4 in the autoregressive processes which provide the 3-year extensions of hours worked and investment to potential GDP ratio. In case of the first series, a constant term was added. Moreover, the NAWRU anchor has been lowered and anticipated by 3 years (see Table 4). As the higher NAWRU anchor from AF2021 is also further away in the future, this change does not affect the projected NAWRU rate substantially (increase by around 0.1 p.p.).

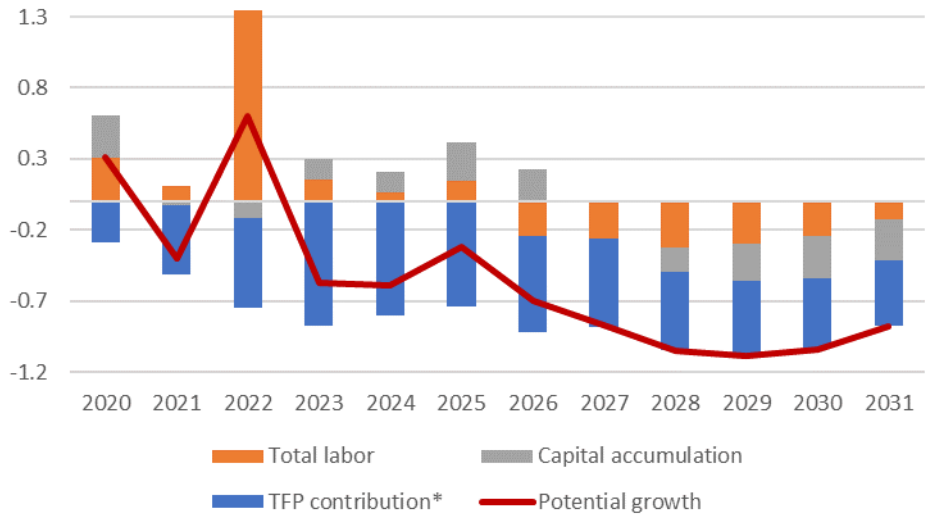
Table 4 Nawru anchor assumptions – SF2024 vs. AF2021

	AF2021	SF2024
NAWRU anchor	6.69	4.29
Year achieved	2041	2038

Revisions of historical data are inevitable and will affect any projection methodology. As indicated in Table 3, potential GDP growth revisions are mostly due to drops in projections of trend TFP growth and changes in trend TFP projections result from revisions of observed variables. This is additionally shown in Figure 4, where revisions of Polish potential GDP growth projected in SF2024 and AF2021 are decomposed by factor of production. There is a large spike of contribution of potential total labor hours in 2022 due to the arrival of persons from Ukraine, which was impossible to anticipate in the AF2021 vintage. The contribution of potential labor in this year increased from 0.6 to 2.0 p.p. The revisions in the following years are much smaller (between -0.3 and 0.2 pp). As population data are not filtered in the EUCAM, such one-time spikes and jumps in potential output/growth are possible. As this spike happens towards the end of the horizon of historical data, it translates into a lower value of TFP at the end of the sample (additionally strengthened by the low TFP value in 2023 due to very low observed growth of only 0.2% p.a.). Yet, lower TFP growth at the end of the sample translates into lower projected trend TFP growth in the following years (downward contribution by 0.6 p.p. in 2022, 0.9 p.p. in 2023, slowly decreasing to 0.5 p.p. in 2031 due to the mean-reverting property of the trend TFP filtering methodology). This suggests that within the current EUCAM framework, increased immigration that expands the labor force mechanically results in lower estimated TFP growth in the medium term. The research based on the experience of Canada discussed below suggests that such an artificially imposed downward trend in productivity should be corrected, as with time immigrants will find jobs that match better with their skills and companies will invest in equipment to improve their capital to labor ratio. The current assumption in EUCAM is opposite – as of T+3 potential labor depends on Eurostat population projections, which in the case of Poland assume net emigration in the following years. This assumption is at odds with data showing positive net migration flows to Poland since 2018 (considering all age groups of migrants)[18].

[18] The latest Eurostat Short-term population projections (2024-2050) actually assume small but positive net migration for Poland during the discussed horizon (apart from the year 2028 for which the baseline net migration estimate is -1437 persons). Due to different timings of the forecasts, these projections were not yet implemented in EUCAM potential output calculations.

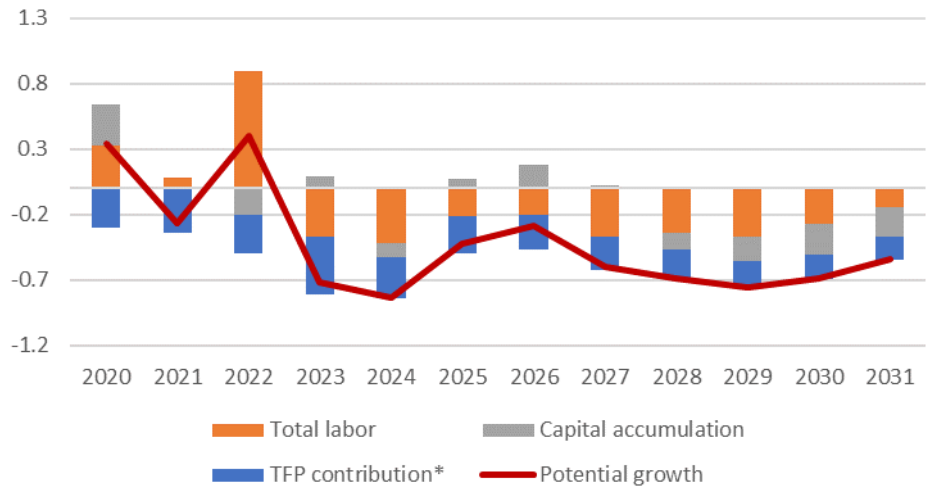
Figure 4 Contribution to potential growth revision - SF2024-AF2021



Note: TFP contribution is calculated as the residual after accounting for the contributions of labor and capital to potential growth.

Figure 5 shows that already in the SF2025 forecast vintage potential GDP estimates for Poland were substantially revised upwards (resulting in a smaller difference compared with AF2021 projections). The average revision of the trend TFP contribution between 2022 and 2031 goes down by half, from -0.6 to -0.3 p.p. The projected trend TFP contribution in 2031 increases to 2.0 p.p. in SF2025, compared to 1.7 p.p. a year earlier and 2.2 p.p. in AF2021.

Figure 5 Contribution to potential growth revision - SF2025-AF2021



Note: TFP contribution is calculated as the residual after accounting for the contributions of labor and capital to potential growth.

The upward revision of trend TFP projections for Poland indicates that the problem identified with the example of the SF2024 vintage (also present in other vintages after AF2021) cannot be explained by the secular downward trend of TFP growth described for example in (International Monetary Fund, 2024). It is more likely related to the abovementioned issues with estimating TFP trend. Changes to the last values of the Solow residual due to observed data revisions can

have protracted procyclical effects on potential TFP and potential growth. Lower TFP values at the end of the sample lead to lower projected trend TFP (and vice versa).

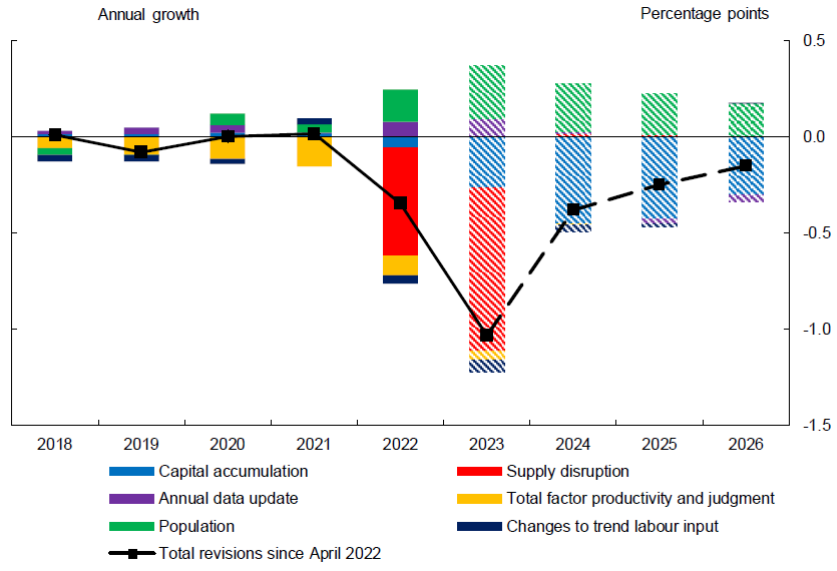
Immigration and potential output in Canada

Canada has population similar to that of Poland (around 40 million), but since 2022, it has experienced a significant surge in migration inflows (approximately 1.1–1.2 million annually in 2023 and 2024). This suggests Canada is facing an even more pronounced migration shock than Poland.

For years, Canada has actively encouraged economic immigration, targeting highly skilled workers (among others). Its 2023–2025 immigration plan aims to admit between 465,000 new permanent residents in 2023 and 500,000 by 2025, with roughly two-thirds allocated to economic migrants and only about 75,000 spots for refugees and protected persons.[19] Data for 2023 show permanent resident numbers aligned with these targets. Additionally, Canada unexpectedly welcomed around 700,000 temporary migrants (likely including Ukrainian refugees, not necessarily highly skilled). By the end of 2023, Canada's population was 2.3% higher than what was projected at the beginning of the year.

The Bank of Canada cites population growth from increased immigration as a driver of potential GDP growth, both currently and in the coming years, by boosting labor force projections (Champagne, Ens, et al., 2023). However, while the expanding population (with an employment rate above the national average) supports growth, it has been partially offset by a decline in labor productivity trends due to a sharp drop in capital per worker. Firms should therefore become more motivated to invest in machinery and equipment in the coming years to efficiently utilize the larger workforce and meet rising demand (fueled by more consumers).

Figure 6 Potential output growth revision in Canada 2023 vs. 2022 assessment



Note: Reprinted from (Champagne, Hajzler, et al., 2023)

Immigration is also expected to improve total factor productivity (TFP) trends in the medium term, as newcomers are typically younger than Canada's existing population. Temporary migrants currently earn lower average wages than other residents, signaling either lower

[19] 2023-2025 Immigration Levels Plan

productivity or skills mismatches. This could negatively affect TFP growth in the short term, pending labor market integration and better job matching. The Bank treats this as a risk factor but excludes it from baseline potential GDP estimates—unlike EUCAM's revisions for Poland, where downward TFP trend adjustments outweigh labor factor gains.

In 2023, Canada significantly revised historical potential GDP levels and the 2023–2025 forecasts, primarily to better account for disruptions to global supply chains during the COVID-19 pandemic and methodological changes (e.g., expanded toolkit of mechanical filters and adjustments to labor trend calculations, unrelated to immigration) (Champagne, Hajzler, et al., 2023). In the April 2024 estimates, the Bank of Canada viewed elevated immigration as a positive contributor for potential growth (Devakos et al., 2024). In April 2025 the impact of population change was revised downwards because of weaker anticipated population growth (but not to a weaker impact of immigration on potential GDP growth). This revision reflects the federal government's 2024 announcement of reduced targets for immigration and restrictions for temporary residents (Abraham et al., 2025).[20] At the same time the latest note evaluates that slower population growth than expected would lower potential output growth by 0.2-0.3 p.p. over the years 2025–27, while faster population growth could have the same impact in the opposite direction.

In summary, the Canadian experience and forecasts show that immigration should not be treated as a burden on economic growth.

4. Discussion

Our analysis examines the scale of revisions of potential growth estimates in the MS and the most important factors behind the drop in the T+10 potential growth projections for Poland in the last 3 years as a detailed example.

Pre- and post-pandemic potential GDP projections (AF2019 vs. AF2021) show minimal revisions for 2020 potential GDP for most EU27 countries, with an average revision of 0%. However, revisions grow for subsequent years, indicating a permanent effect of the pandemic. While EUCAM estimates sought to mitigate shocks, revisions are present and directions varied. Significant revisions to 2019 potential GDP, possibly linked to COVID-19's impact on estimates, underscore estimation instability.

The comparison of SF2024 and AF2021 EC economic forecasts additionally shows that despite a minor average revision (-0.7%), projection revision magnitudes increase over time and vary across Member States, with some T+10 potential GDP projections seeing 10-30% changes. While data revisions are inevitable and unavoidable, the example of Poland shows that they have counterintuitive effects on potential growth – larger employment and capital lead to lower projected potential output. On the other hand, lower hours worked lead to its increase. This shows that potential GDP projections rely extensively on trend TFP projections – a decline in a known factor implies a more-than-proportional increase in the projected TFP growth rate. While COM's note on the EUCAM T+10 projections[21] touches upon the problem of end-point bias (or procyclicality) of potential TFP projections, the magnitude of this problem is not fully analyzed therein[22].

[20] 2024–2026 Immigration Levels Plan and 2025–2027 Immigration Levels Plan.
[21] Note to the OGWG from February 16th 2024
[22] Annex 1 to COM's Note to the OGWG from February 16th 2024 says the following: "The dependence on the last observation is a source of instability across vintages."

These results relate to a body of literature that grew particularly after the financial crisis of 2008. For example, (Fatás & Summers, 2018) show that both US and EA real and potential output estimates and projections have undergone substantial downward revisions. As potential GDP estimates were lowered jointly with real GDP, it gave the policy makers a wrong impression that the output gaps are small and can be even positive, as was the case in Italy in 2019, when the country experienced an unemployment rate around 10% (Efstathiou, 2019, Tooze, 2019). The AF2018 output gap estimate for Italy was 0.3% and it was revised into the negative territory in AF2024 (-0.5%). With positive output gaps there is no room for fiscal stimuli, fiscal consolidation is usually advised. (Fatás & Summers, 2018) show that fiscal consolidations can lead to strong downwards revisions of both real and potential GDP, further worsening the fiscal position. Moreover, potential GDP is not only affected in the short run, but it can be reduced permanently. The reasons for downward revisions of potential output may not be related to structural changes (e.g. the secular decline in productivity), but they can also result from counter-cyclical fiscal policies justified by miscalculated output gap estimates. Researchers should aim at improving potential output estimation methodologies, so that the hysteresis effect from relying excessively on recent outturn data is eliminated.

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