FORECASTING POTENTIAL OUTPUT FOR GREECE

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ABSTRACT

This paper presents a description of the current version of the production function methodology used at the Bank of Greece for assessing and forecasting potential output and the output gap. Medium-term projections are also presented: potential output growth is expected to be 1.9%, supported by Total Factor Productivity (TFP) and capital, while the negative demographics are soon to weigh on the productive capacity of the economy. At the end of the projection horizon, most of the potential output growth accrues from TFP, suggesting the need to continue implementing structural reforms. The paper concludes with a brief discussion regarding the complexities of estimating TFP.

Keywords: economic growth; potential output; output gap; NAWRU; total factor productivity

JEL classification: E23; E27; E52; J11; O40

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ΠΡΟΒΛΕΨΕΙΣ ΔΥΝΗΤΙΚΟΥ ΠΡΟΪΟΝΤΟΣ ΓΙΑ ΤΗΝ ΕΛΛΑΔΑ

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ΠΕΡΙΛΗΨΗ

Το παρόν άρθρο περιγράφει την τρέχουσα μεθοδολογία της συνάρτησης παραγωγής που χρησιμοποιείται στην Τράπεζα της Ελλάδος για την εκτίμηση και την πρόβλεψη του δυνητικού προϊόντος και του παραγωγικού κενού. Παρουσιάζονται επίσης μεσοπρόθεσμες προβλέψεις: η αύξηση του δυνητικού προϊόντος αναμένεται να διαμορφωθεί σε 1,9%, υποστηριζόμενη από τη συνολική παραγωγικότητα των συντελεστών παραγωγής και το κεφάλαιο, ενώ τα αρνητικά δημογραφικά στοιχεία θα επιβαρύνουν σύντομα την παραγωγική ικανότητα της οικονομίας. Στο τέλος του ορίζοντα πρόβλεψης το μεγαλύτερο μέρος της αύξησης του δυνητικού προϊόντος προέρχεται από τη συνολική παραγωγικότητα των συντελεστών παραγωγής, γεγονός που δείχνει την ανάγκη να συνεχιστεί η εφαρμογή διαρθρωτικών μεταρρυθμίσεων. Τέλος, παρουσιάζεται εν συντομία η πολυπλοκότητα της εκτίμησης της συνολικής παραγωγικότητας των συντελεστών παραγωγής.

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I INTRODUCTION

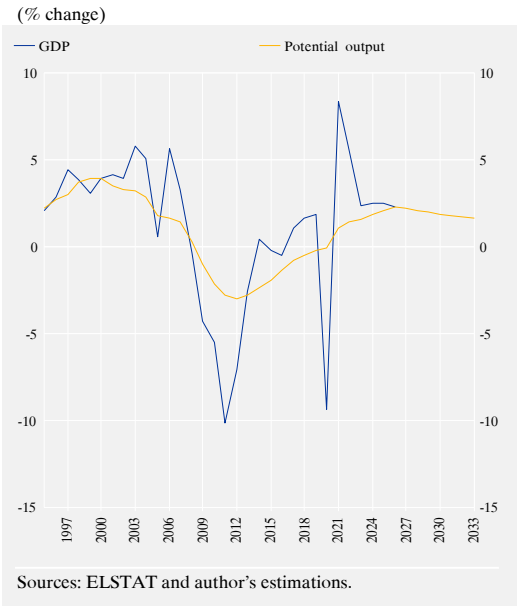
Potential output shows the production capacity of an economy, i.e. the maximum level of output that can be achieved given the factors of production, the state of technology and the structure of the economy, without creating pressure on the rate of inflation. It depends on the supply side of an economy and indicates an economy's prospects for long-term sustainable non-inflationary economic growth. It differs from GDP, which shows the actual output produced by an economy at a certain point in time. Potential output is by default a much smoother time series compared to GDP (see Chart 1). During booms, economic activity will rise above potential output and the increased demand will put pressure on prices, while, during recessions, GDP will drop below potential output and inflation will de-escalate; but, on average, GDP will gravitate towards potential output and inflation will tend to stabilise. Over the longer term, actual output is moving alongside potential output and, as a result, potential output is an indicator of the future prospects of an economy.

A concept relevant to potential output is that of the output gap, which is defined as follows:

Output gap *= 100*(GDP – potential output)/ potential output*

The output gap is a measure of overheating or slack in the economy and, together with potential output, it is a useful indicator for assessing the cyclical position of an economy. Thus, these two indicators are highly relevant to policy making and important for the future stance of monetary and fiscal policies. When the production level is higher than potential output, i.e. when the output gap is positive, the rising level of factor utilisation puts upward pressure on factor costs. The economy overheats, inflation increases and monetary policy needs to be tightened. This will reduce activity and restore price stability. Similarly, potential output is important for conducting fiscal policy, as budget items on both the revenue and the expenditure side depend on activity trends, as well as for assessing the fiscal stance and carrying out debt sustainability analysis. Acknowledging the important information embodied in potential output and output gap estimates, the European Union has formally embraced their use in the fiscal surveillance framework in the context of the Stability and Growth Pact.

Chart 1 GDP and potential output for Greece



Sources: ELSTAT and author's estimations.

Potential output is not directly observable, neither can it be determined with certainty, even with the benefit of hindsight. Thus, estimating potential output and, therefore, the output gap, is surrounded by great uncertainty. There

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are several sources of uncertainty. First, the input data are themselves estimates and are subject to revisions when statistical authorities have new or better information. Second, the estimates are affected by model uncertainty or end-point uncertainty. Third, particularly in real time, it is difficult to understand to what extent developments in an economy are driven by cyclical or structural factors. Currently, it is particularly complex to distinguish between the two, given that the global economy has experienced multiple shocks, i.e. the pandemic, the war in Ukraine and the energy crisis, which resulted in large swings in both aggregate supply and demand. In addition, there are ongoing structural developments, such as population ageing, artificial intelligence developments and trade fragmentation that have both long-term consequences for the productive capacity of an economy and potential medium-term effects.

Potential output can be derived using statistical or econometric techniques.[1] In both cases, several assumptions and choices need to be made regarding the level of parameters, specifications, estimation techniques, etc. Moreover, although potential output is by default a smooth series, different types of potential output measures can vary by the degree of sensitivity to short-run fluctuations of activity. The Eurosystem, and thus the Bank of Greece too, use a smooth approach.

2 A PRODUCTION FUNCTION APPROACH

One of the most widely used methodologies for estimating potential output is the production function method. It is an approach used by most of the Eurosystem's National Central Banks (NCBs), but also by international agencies, e.g. the European Commission (D' Auria et al. 2010) and the OECD (Chalaux and Guillemette 2019).

Economy-wide output is assumed to be given by a two-factor **Cobb-Douglas production function** in capital and labour of the form:

$$Y_t = L_t^{\alpha} K_t^{1-\alpha} TFP_t \quad (1)$$

where Y_t is real GDP, L_t is total employment, K_t is the capital stock and TFP_t is total factor productivity. Total factor productivity is a measure of how efficiently labour and capital are used. It is calculated as the share of production growth that cannot be explained by increases in the two inputs. Specifically, it is derived as the Solow residual from equation (1). The coefficient α, which is assumed to have a value between 0 and 1, is the output elasticity of labour, while $(1\text{-}\alpha)$ is the output elasticity of capital. The estimation of α is discussed below.

Important properties of the Cobb-Douglas production function are constant returns to scale and diminishing marginal products of the inputs.

In order to estimate **potential output**, the long-term trend of the two production factors as well as of productivity must be extracted. In other words, one needs to estimate the quantities which accrue after removing the cyclical component from the three variables. Potential output $\bar{Y}$ is:

$$log(\bar{Y}_t)=\alpha\, log(\bar{L}_t)+(1-\alpha)log(K_t) + log(\overline{TFP}_t) \quad (2)$$

where the bar suggests trend variables. Thus, potential output depends on three components:

- **Trend employment** $(\bar{L}_t)$ is defined as:

$$\bar{L}_t = \text{Working age population} * \overline{\text{Participation rate}} * (1-\overline{\text{NAWRU}}), \quad (3)$$

  i.e. the product of working age population, trend participation rate and trend of the non-accelerating wage rate of unemployment (NAWRU). NAWRU is the unemployment rate consistent with stable inflation and is a proxy of the long-run equilib-

1 For an overview of methods to estimate potential output, see Murray (2014).

rium unemployment. Any excess demand would push the unemployment rate below its equilibrium level, leading workers to demand higher wages, thus putting upward pressure on inflation.

- **Trend total factor productivity** ($\overline{TFP}_t$), which is derived by smoothing out the TFP series.

- **Capital** is the potential use of capital which is equal to the actual capital. So, there is no need to smooth out the series, since the maximum potential output contribution of capital is given by the full utilisation of the existing capital stock.

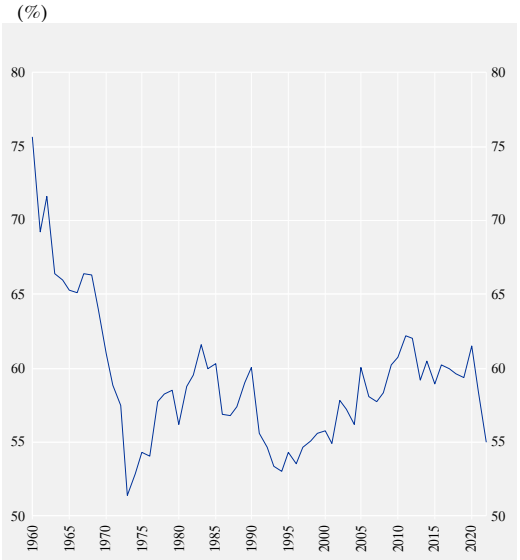
3 CALIBRATION OF THE PRODUCTION FUNCTION FOR GREECE

The model described in Section 2 is calibrated for the Greek economy. Recalibration takes place at irregular frequency to reflect mainly structural changes taking place in the economy.

Labour input is measured in terms of headcount. Labour (and capital) are assumed to be rewarded an amount equal to their marginal revenue products. Thus, the production elasticity of labour, α, is calibrated as the share of labour income. It is estimated as the share of compensation of employees over the sum of compensation of employees and the gross operating surplus/gross mixed income (the latter represents the remuneration of the production factor capital). This share is adjusted to account for the imputed labour income of the self-employed, assuming that the self-employed have the same average wage as employees. This adjustment is important, as the self-employed form a significant part (about 30%) of total employment in Greece. The average labour income share for Greece during the period 1960-2021 is 60% (see Chart 2).

The equilibrium unemployment rate is unobserved and therefore needs to be estimated. The **NAWRU** estimates are based on Phillips curve considerations combined with time series

Chart 2 Labour income share for Greece



Sources: ELSTAT and author's estimations.
Note: The labour income share is defined as the share of compensation of employees over the sum of compensation of employees and the gross operating surplus/gross mixed income.

techniques. Elmeskov (1993) defines NAWRU as the unemployment rate above which wage inflation accelerates:

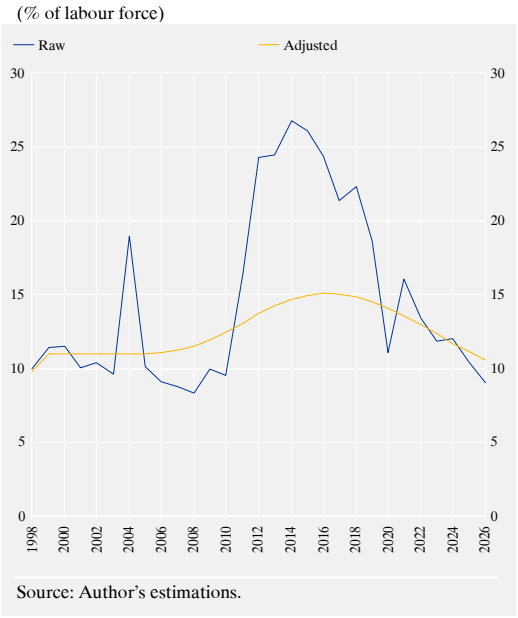
$$d^2lnw = -\lambda*(u-NAWRU), \qquad \lambda>0 \qquad (4)$$

where w is the nominal wage level, u is the actual unemployment rate and d, d^2 and d^3 are the first, second and third difference operators. It follows that a NAWRU can be estimated in terms of wages and unemployment:

$$NAWRU = u-(du/d^3lnw)*d^2lnw \qquad (5)$$

This definition fit well with the Greek economy until the crisis. However, this relationship suggests that during the crisis the NAWRU had reached unreasonably high levels (see the yellow line in Chart 3). The values remain non-intuitive, even after using a Hodrick-Prescott filter to smooth the time series. Unemployment rates as high as 20% or 25% cannot be perceived as equilibrium values; people will get discouraged and, eventually, will exit the labour force. However, from 2022 onwards, i.e. after the end of the crisis and the pandemic,

Chart 3 Non-accelerating wage rate of unemployment (NAWRU)



Source: Author's estimations.

this relationship seems to have been restored in the economy. Note that the estimates of NAWRU for 2024-2026 are based on the June 2024 Bank of Greece projections of the underlying data. Therefore, to reach more intuitive estimates, judgement is used for the crisis period, when the Phillips curve relationship seems to have broken down. Judgement is informed by satellite models available at the Bank of Greece. The series is then filtered to get a smooth NAWRU time series (see the blue line in Chart 3).

For the **capital input**, data is not available by the Hellenic Statistical Authority and a time series needs to be constructed. The capital stock corresponds to the economy-wide capital stock. It is constructed using the perpetual inventory method, together with an assumption on the initial capital stock. More specifically, the level of capital at the beginning of the estimation period (1960) is assumed to be three times the level of GDP. This is a convention used in empirical studies.[2] Then, the law of motion of the capital stock is:

$$K_t = (1-\delta_t)*K_{t-1}+I_t \qquad (6)$$

where I_t is investment and δ_t is the depreciation rate. For the period 1960-1994, the depreciation rate is assumed to be 4%. For the period 1995-2021, the depreciation rate is estimated using the share of consumption of fixed capital to GDP from the national accounts. For the forecasting period, the depreciation rate is kept fixed at the level of the last year of actual data (2021).

Finally, the participation rate, the labour force, the NAWRU and the TFP are smoothed with a Hodrick-Prescott filter, in order to eliminate some irregularities of the data.

4 MEDIUM-TERM FORECASTS

Following the calibration, the model is estimated for the Greek economy for the period 1960-2023 and it is used to produce projections for the next ten years.

4.1 END-PERIOD ASSUMPTIONS

In order to forecast potential output for the Greek economy, assumptions about future values and convergence paths need to be made for several variables. It is noted that the convergence paths from the latest data point to the anchor values, i.e. the values towards which a variable will converge at the end of the forecasting horizon are typically smooth.

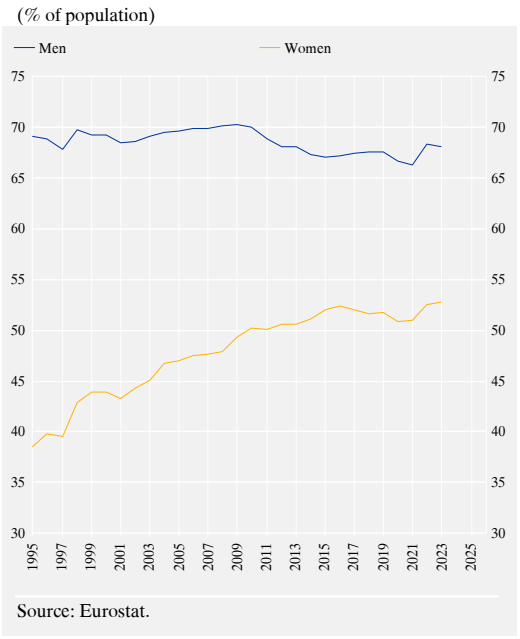
Projecting the labour component necessitates assumptions/projections to be made for the three relevant variables, namely the evolution of the working age population, the labour force participation rates and the NAWRU. For the working age population (15-74), Eurostat's projections are used.

2 Derbyshire et al. (2011) calculated at three the average capital-output ratio for EU Member States in 1995. Alternatively, when calculating capital as the ratio of investment over the sum of the GDP growth rate and the depreciation rate ($K_{t-1} = I_t /(g_{GDP}-\delta_t)$, where g_{GDP} is the growth rate of GDP) the average capital-output ratio for Greece for the period 1960-1990 is estimated at three. For an overview of the most important approaches employed in the literature regarding the methods for estimating the initial capital stock, see Berlemann and Wesselhöft (2014).

The participation rate continues to be quite different between men and women (see Chart 4). For men, it has been very close to 70%, i.e. it is similar to the euro area (EA) average. For women, the participation rate has been on an upward path over the past twenty years, while significant increases have also occurred in more recent years. In particular, female participation in Greece has been moving closely together with the EA average, although consistently lagging behind by about 10 percentage points. Further increases of participation rates are expected, as policy initiatives have been introduced targeting higher participation especially of women, including child and elderly care reforms to reduce the care burden of women. It is expected that labour force participation rates in Greece at the end of the projection horizon will close the gap to the EA average for men, but only partially for women. So, the relevant anchor is currently a participation rate of 63% (70% for men and 56% for women).

To estimate the NAWRU anchor for t+10, i.e. the value towards which the NAWRU will converge 10 years into the future, a linear regression model is utilised. Specifically, the NAWRU is regressed on labour market structural indicators and non-structural indicators to control for persistent macroeconomic shocks.[3] However, the results are not always robust. So, a compromise is reached as described hereafter. For the years 2024-2026, the NAWRU is estimated by equation (5) (using values of unemployment and wages as projected by the Bank of Greece).[4] For the period outside the Broad Macroeconomic Projection Exercise (BMPE) horizon (2027-2033), the NAWRU is assumed to remain constant. Such an assumption is a compromise consistent with the common perception of the NAWRU as a stable long-run level of the unemployment rate.[5] The NAWRU is projected to stand at 10.6% in 2026, which is higher than the estimates of the European Commission, according to which the NAWRU anchor for Greece in 2027 will be 9.1% (Spring 2024 Forecast).[6]

Chart 4 Participation rate in the labour force



Source: Eurostat.

Next, we move on from the labour component to the other components needed in order to estimate potential output, namely capital and TFP. Medium-term forecasts of capital growth are built on the assumption of Greece's convergence to the EA average regarding the path of the investment-to-GDP ratio. In particular, a gradual convergence towards the EA average is expected. This implies that the share of investment to GDP will be increasing over the coming years. In practice, this means for Greece that the total investment-to-GDP ratio is projected to converge to 17% by the end of the forecasting period (t+10). This ratio is below the historical average for Greece (19% for 1980-2008), as the post-crisis recovery of residential investment is expected to be partial. It is also below the historical average for the EA (21% for 1995-2022) due to the production structure of the Greek economy, which is relatively more labour intensive compared to the EA.

3 Such approaches are described in, among others, Gianella et al. (2008), Orlandi (2012) and Heimberger et al. (2017).
4 June 2024 Broad Macroeconomic Projection Exercise (BMPE).
5 It is noted that the smoothed line yields a (marginally) decreasing projection for the whole ten-year period horizon.
6 The European Commission's material related to the estimation of output gaps, including data and projections, is available at the online depository CIRCABC (https://circabc.europa.eu).

Finally, regarding the **TFP anchor**, i.e. the value of TFP 10 years into the future, it is expected to be around 1%. This level is marginally higher than the historical average estimated by the Bank of Greece (0.9% for the period 1980-2008). It reflects the positive impact of the following factors. First, past structural reforms and planned reforms in the context of the NGEU are expected to have a positive impact on TFP. Second, new investments embody new technologies with higher productivity. The value of the anchor is close to that estimated by the European Commission.[7]

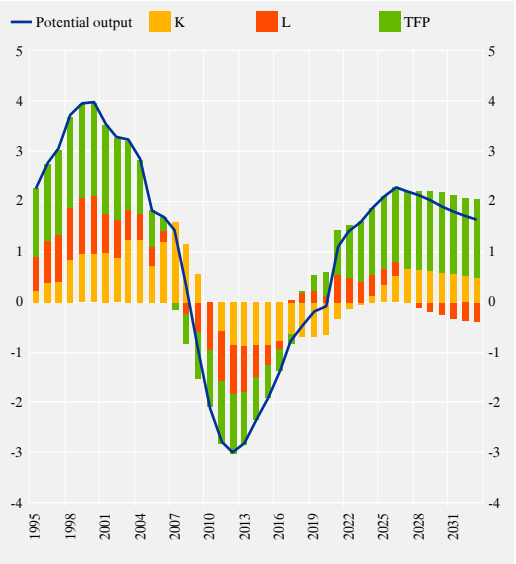
4.2 PROJECTIONS

The results presented here focus on the period 1995-2033. As can be seen in Chart 5, potential output estimates vary between the different phases of the economy throughout the years. In the run-up to the introduction of the euro, the potential output of Greece was increasing at high rates. All factors were contributing, with TFP explaining slightly more of the potential output's growth compared to capital and labour. This booming era was followed by a sharp deterioration during the sovereign debt crisis, when the Greek economy lost cumulatively about 25 percentage points (pps) of its GDP and 20 pps of its potential output. TFP contribution suffered the largest drop, followed by the labour component, while the contribution of capital showed the smallest decline, as capital is by default less responsive to an economy's short-run fluctuations. In recent years, potential output has been recovering – with the only exception being a short-lived interruption during the pandemic.

Looking ahead, potential growth is primarily driven by TFP. This reflects the impact of past reforms, as well as the partial and conservatively estimated impact of selected structural reforms to be implemented in the context of the Recovery and Resilience Facility (RRF). The capital stock makes positive contributions only after 2022 and is gradually gaining pace thereafter, as the impact of the financial crisis and the COVID-19 pandemic fades out, and

Chart 5 Decomposition of potential output

(potential output: %; K, L, TFP: percentage point contributions)



Source: Author's calculations.
Note: K = capital, L = labour, TFP = total factor productivity.

on the back of NGEU support. Trend labour is contributing positively in the short run due to the increasing participation rate and the decreasing NAWRU, which outweigh the negative impact from the shrinking working age population. Its contribution turns negative in 2027, as the impact of negative demographic developments becomes stronger over time. It is noted that the decline in the NAWRU over the extended projection horizon and the increase in the labour force participation rate are supported by past labour market reforms, but also by interventions under the Recovery and Resilience Plan that aim to support reforms of active labour market policies, as well as the upskilling and reskilling of the labour force.

The current estimate of the medium-term growth rate is 1.9%. At the end of the horizon, most of the 1.7% of potential output growth accrues from TFP (1.6 pps), while the contribution of capital is 0.5 pps and the contribution

7 According to the 2024 Ageing Report, TFP in Greece is expected to be 0.8% in 2030 and 1.4% in 2040.

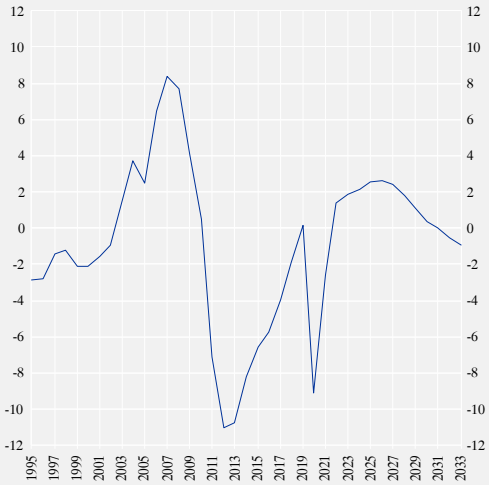
of labour is -0.4 pps. Thus, in the outer years, deteriorating demographics almost cancel out the positive impact of capital accumulation. Regarding TFP, earlier studies on the Greek potential output suggested that its contribution in terms of percentage points was of similar magnitude, although the share was smaller due to better demographics of that time resulting in higher overall potential output (see Albani et al. 2010). While it is a common feature for the TFP contribution to be larger than the contributions of capital and labour, Greece stands at the upper side.[8] More specifically, according to the European Commission's 2024 Ageing Report, TFP in Greece explains about 85% of potential output growth in ten years from now, while the euro area average share is 66%. This result implies that a lot of emphasis needs to be put on efforts to enhance TFP, since in the medium term productivity developments are of vital importance for growth.

Regarding the output gap, during the first years after the euro accession the Greek economy was growing at high rates and the output gap was both positive and large (see Chart 6). This trend was abruptly interrupted by the debt crisis. The output gap remained negative for a decade, reaching its lowest level in 2013. The subsequent swift recovery of the Greek economy and the rebound of potential growth since 2021 led to the closure of the output gap in 2021 for the first time in a decade. The output gap of the Greek economy is projected to be positive and large throughout the projection horizon, reflecting the recovery of the Greek economy from the decade-long crisis. It follows that the Greek economy is expected to have a negative unemployment gap, i.e. unemployment will be lower than the NAWRU for the coming years and, therefore, there will be upward pressure on wages and prices.

The potential output estimates of the Bank of Greece are close to the ones obtained from the Unobserved Components Model (UCM), developed by the ECB and calibrated by the Bank of Greece for the Greek economy (see Tóth 2021), and the ones from the OECD, but higher than the estimates of the EC and the IMF (see Chart 7). Thus, the model of the Bank of Greece implies an output gap similar

Chart 6 Output gap

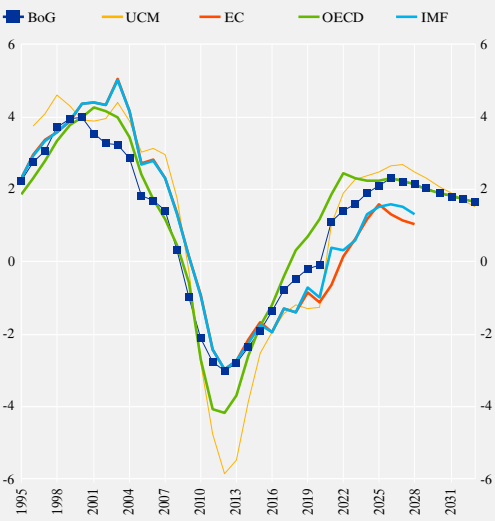
(% of potential output)



Source: Author's estimations.

Chart 7 Potential output

(percentage change)

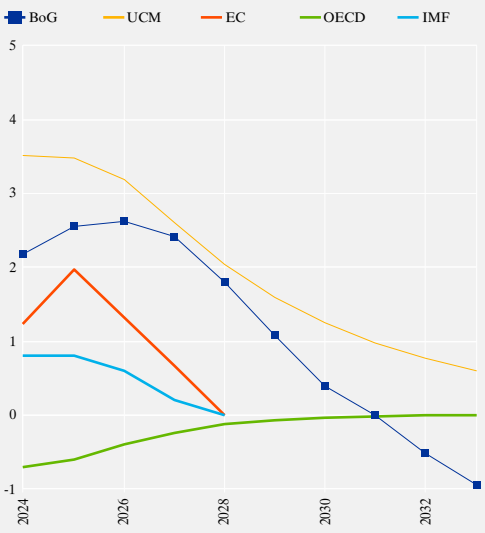


Sources: CIRCABC (Spring 2024 Forecast), IMF (World Economic Outlook, 2023), OECD (Economic Outlook No. 114) and author's estimations.
Note: BoG = Bank of Greece; UCM = Unobserved components model of Tóth, 2021; EC = European Commission's estimations available at CIRCABC.

8 See the Spring 2024 Economic Forecast of the European Commission at https://circabc.europa.eu.

Chart 8 Output gap

(% of potential output)



Source: CIRCABC (Spring 2024 Forecast), IMF (World Economic Outlook, 2023), OECD (Economic Outlook No. 114) and author's estimations.
Note: BoG = Bank of Greece; UCM = Unobserved components model of Tóth, 2021; EC = European Commission's estimations available at CIRCABC.

to that estimated by the UCM, but considerably higher compared to the estimates of other institutions (see Chart 8).

5 IN FOCUS: TOTAL FACTOR PRODUCTIVITY AND SOURCES OF BIAS

As already shown, TFP is the main driver of potential output growth in the medium term for Greece but also for the euro area. Hence, it is a very important factor for future growth. For this reason, the present paper includes a special section discussing more thoroughly some specificities surrounding the definition and estimation of TFP.

TFP is strongly correlated with incomes. Indeed, sustainable growth of output per capita can only occur via TFP growth, as shown as early as 1957 by Robert Solow, given that investments in capital and labour have diminishing returns. Currently, the sustainability of growth is further challenged by environmental concerns and ageing societies.

TFP represents the productivity of the whole economy. It is a measure of an economy's ability to generate income from inputs (here, labour and capital) and it is generally thought to reflect the extent to which technology and knowledge are utilised domestically in the production process. If more output can be produced for any given amount of inputs, then the economy is said to have higher TFP. However, TFP in the Cobb-Douglas framework is defined as a residual and, therefore, captures the impact of several other factors. For this reason, TFP has the famous epithet "measure of our ignorance", while Solow (1987) questioned the measurement of productivity with his famous quip "You can see the computer age everywhere but in the productivity statistics".[9]

A first source of the TFP bias is the **mismeasurement of capital and labour**. One aspect that standard measures of capital and labour do not capture is the **quality** of these inputs. Workers will produce more economic value added, if they have more years of schooling, better education and training or is healthier. So, enhanced labour skills produce more output. But if labour input is measured by headcount or hours worked, then this increased output will be wrongly attributed to higher TFP. Similarly, investing in capital upgrades the quality of capital stock, thus resulting in higher output for the same amount of inputs. This change will be wrongly attributed to higher TFP.

Moreover, TFP could also be reflecting the impact of **different types of capital**. In the case of a shift between types of capital with different productivity, e.g. between residential and non-residential, then the average productivity of the total stock of capital will be different. Failing to acknowledge this shift will result in a bias of the TFP estimate. This last case is very relevant for Greece, as housing investment collapsed during the crisis; today, it stands at about one quarter of its pre-crisis value. Thus, new total capital added to the economy, consisting mostly of productive capital, will result

9 For a witty discussion about the TFP measurement issues see Hulten (2000).

in relatively higher output, and thus higher TFP, compared to the past.

TFP numbers could also be plagued due to intangible assets. Investments in intangibles are often poorly measured in national accounts. This will likely become more important over time with the increasing adoption of artificial intelligence (AI), which requires significant complementary investment in intangible assets. Productivity growth may be underestimated in the early years, when firms and organisations invest in (unmeasured) intangible capital and, later, when the benefits of intangible investments are harvested and (measured) output increases, productivity growth is overestimated. Brynjolfsson et al. (2021) show that adjusting US data for IT-related capital yields a TFP level that is 15.9% higher than official measures by the end of 2017.

Next is the resource allocation within the economy. Firms in an economy differ as to their degree of productivity. If the most productive firms can attract a big share of labour and capital, i.e. if the economy is "allocatively efficient", then an economy's average productivity will be higher. If, instead, a lot of labour and capital is tied up in relatively unproductive firms, the economy is "allocatively inefficient" and TFP will be low. The efficient allocation of capital and labour across firms can be undermined by several factors, from institutional and financial barriers to poorly-designed industrial policies.[10]

TFP is also impacted by international trade. Trade can increase the market share of an economy. This can potentially result in specialisation according to comparative advantages for an economy, offering firms the opportunity to exploit economies of scale. Moreover, in the face of international competition, the relatively more productive firms do better than their unproductive counterparts. A smaller survival rate of less productive firms will raise the productivity level of the whole economy.

Concluding, it is clear that TFP should be interpreted as the joint effect of technical innovation, varying quality of inputs used in production, efficiency gains, economies of scale, and changes in the organisation of production or the wider regulatory environment, shifts in societal attitudes, omitted variables and measurement errors.

6 CONCLUSIONS

This paper provides a description of the current version of the production function methodology used in the Bank of Greece for assessing potential output and output gaps, i.e. the productive capacity and the cyclical position of the Greek economy. Current projections for the next decade are also presented. The paper concludes with a brief discussion regarding the complexities of estimating TFP.

There are many sources of uncertainty involved in the estimation of potential output, including data revisions, methodological choices, forecast assumptions and the difficulty to assess whether developments are due to cyclical or structural factors. Moreover, forecasts inevitably involve expert judgement. Therefore, new data sources, new information about the economy or policy changes, together with developments in the literature, imply that the forecasting methodology needs to be periodically fine-tuned.

Next milestones in the improvement of the forecasting methodology of the Bank of Greece are the use of structural information in the estimation of anchor values for NAWRU and TFP and the use of information about the financial cycle to produce "finance-neutral" output gaps.[11] Structural changes with longer-term implications, such as artificial intelligence, geopolitical changes or climate change, will also need to be included, as their effects will become more relevant over time.

10 See the IMF's April 2024 Fiscal Monitor on industry policy for innovation. For a discussion of the structural sources of frictions resulting to lower allocative efficiency, see Box 3.1. in World Economic Outlook, April 2024.

11 For a methodology of how to embed information about the financial cycle in potential output estimation, see Borio et al. (2013).

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